Faculty of Humanities

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# An Evaluation of ICT Integration in Science Learning in Primary Schools in Saudi Arabia

Alaa Abdulaziz S Alharthi

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**DECLARATION**

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number Approval Number #RDSE-56-15

Signature: Alaa Alharthi

Date: 26 Oct. 18

**ABSTRACT**

Technology plays an important role in the development of education worldwide. To that end, Saudi Arabia has dedicated huge budgetary amounts to support the development of technology use in education. Most current studies conducted in Saudi Arabia have focused on teachers' perceptions of ICT integration in secondary school. The aim of this study is to evaluate the experience of integrating ICT into science learning at the upper primary level in Saudi Arabian schools by investigating both students' and teachers' perceptions of ICT use. In this study instruments were administered to 1,401 students (679 from grade 5 and 722 from grade 6) and 32 in-service science teachers. In addition, 54 students and 21 science teachers were interviewed. Using a mixed-methods triangulation design, the researcher collected and analysed quantitative data by comparing means, t-tests and response percentages. Qualitative data were analysed using thematic coding. Overall, students and teachers perceived the integration of ICT into science education positively. Triangulating the study's results showed the following: ICT integration could enhance learning outcomes; the most used tools in upper primary schools were projectors, computers, and interactive whiteboards; and the most used applications were PowerPoint and Word. In addition, both teachers and students perceived the benefits of using ICT, which included facilitation of deep understanding, increased enjoyment and motivation and more support for productive learning. However, students and teachers faced several challenges to ICT integration, including time and technical issues. Many participants suggested that devices be provided to improve science education at the upper primary level.

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## ABBREVIATIONS LIST

| | |
|---|---|
| **ICT** | Information Communication and Technology |
| **BECTA** | British Educational Communications and Technology Agency |
| **SATK** | Students' Attitudes Towards and Knowledge of Technology Questionnaire |
| **TATK** | Teachers' Attitudes Towards and Knowledge of Technology Questionnaire |
| **STEBI** | Science Teaching Efficacy Beliefs Instrument |
| **SPSS** | Statistical Package for Social Sciences |
| **NVivo** | A qualitative data analysis computer software package produced by QSR International |
| **Classera** | E-learning system |
| **MoE** | Saudi Ministry of Education |
| **Tatweer** | King Abdullah Public Education Development Project |
| **iEN** | National Education Portal -Saudi |
| **Obeikan education**<br>**"Obeikan"** | Specialize in the development of curriculum content, continuing professional development, as well as e-learning and educational technology, and involvement in the largest Science and Mathematics Development Project in the Arab World (Science and Mathematics gate). |
| **Al Manahij** | An application for Electronic Books K-12 |

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

> Education in Saudi Arabia is the necessary base which will help realize the aspirations of our people towards progress and advancement in science and knowledge.
>
> – King Sulman bin Abdulaziz Al-Saud, King of Saudi Arabia, 2018

This chapter is the introduction chapter of the research, dividing into eleven sections. After the introduction section 1.1, the researcher explained the brief background to the research in section 1.2. The focus of the research presented in section 1.3. The current study conducted in Saudi Arabia. Thus, there was a vital section described background to the integration of ICT in science education in Saudi Arabia in section 1.4. Rational of the study stated in section 1.5, followed by section 1.6 presented the aim of the study include the five Research Questions. Section 1.7 highlighted the significant of the study. The methodology of the study and data collection and analysis explained in section 1.8 and section 1.9. There were several limitations of this study presented in Section 1.10. The Final section 1.11 was designed to organization of the thesis.

### 1.2 Background to the Research

Many countries in the world, whether developed or developing, are aware of the importance of building up their education sectors generally, and through ICT integration specifically, because the success of any country is linked to the education level of its nation (Jamalahdin, Hashemi, Sosahabi, & Berahman, 2017). In the digital generation, most people around the world use information and communication technology (ICT) in different ways to make their lives more convenient. As Whitby (2013, p. 65) argues, “for today’s young people technology is more than simply something you use for fun or novelty, it is an integral and natural part of life”. ICT integration in education plays a key role for the preparation of the future generation for life, providing students with the necessary skills to improve learning outcomes (Abdullahi, 2014; Lawrence and Tar 2018; Nwoke, Udeji,

Alabekee, & Chikwendu, 2017; UNESCO 2012). Integration of ICT has become an effective choice for learning for all, especially for digital age students who have grown up with this technology (UNESCO, 2012; Tatweer, 2014). ICT tools that could be effective in classrooms include computers, projectors, and interactive smartboards and touch devices.

The government of the Kingdom of Saudi Arabia has a strong belief in the nation, and has put an initiative in place to implement ICT in schools in order to improve the overall education system in the country. Substantially, the Tatweer Project is a multi-billion Saudi royal initiative inaugurated by King Abdullah Bin Abdulaziz to reform education. The project aims to introduce digital content, develop workshops for teachers to use ICT effectively, and also enhance cultural education values. This giant project reflects the Saudi government's interest in developing the use of ICT in education.

Based on the reviewed literature, science in schools is a difficult and complex subject and, based on many studies in western nations, there is a decline of student interest in the learning outcomes of science (Marginson, Tytler, Freeman, & Roberts, 2013; Ruthven, 2011; Selwyn & Cooper, 2015). Therefore, ICT integration could support the teaching of science by using a learner-centered approach that can motivate students and enhance learning outcomes. Furthermore, ICT integration offers varied chances for students to engage in science classrooms and supports a learner-centered approach (Selwyn & Cooper, 2015). Gupta and Fisher (2012, p. 196) contend that

> "…not only has the use of technology increased to make the process of [science] teaching and learning in the classroom more effective, learner-centered and outcome-focused, but it has also given an impetus to teachers to use it as a tool to bridge the gap between traditional learning and modern educational requirements for the overall development of the learner."

However, enhanced teaching and learning of science by integrating ICT is not guaranteed for all students. There are factors that affect students' and teachers' use of ICT, a number of where act as barriers to effective ICT integration. Some studies categorise barriers as external and internal factors (Alahmari & Kyei-Blankson,

2016; Alghamdi & Higgins, 2015). External factors include availability of ICT resources while internal factors include teachers' and students' perceptions of ICT. Also, students and teachers' attitude towards and knowledge of ICT; teachers self-efficacy regarding ICT integration.

### 1.3 Focus of the Research

The study described in this thesis investigated the perceived impact of ICT integration in science in upper primary level schools and examined those factors that affected the effectiveness of this integration. The researcher examined internal factors, namely, participants' attitudes towards ICT integration, their perceptions of the benefits and concerns of ICT integration in science, and teachers' self-efficacy. External factors integration were the availability of ICT tools, development of ICT skills, and technical support. This study aimed to examine the current state of students' and teachers' perceptions of ICT integration in science teaching and learning in a sample of schools in Saudi Arabia.

### 1.4 Background to integration of ICT in science education in Saudi Arabia

The current Tatweer science education project is based on the constructivist theory of learning, aiming to enhance problem-solving and critical thinking skills, and prompting teachers and students using ICT to reach their goals in various ways. Furthermore, the Tatweer Project aims to develop self-learning and cooperative learning skills and expand teachers' and students' sources of knowledge. The new science education project endeavours to relate students' daily lives and experiences in meaningful ways (Saudi Ministry of Education, 2015).

Several researchers in Saudi Arabia have shown mixed results for ICT integration in education. For example, Alkahtani (2017) reported that the main challenges to the integration of ICT in teaching in Saudi secondary schools are lack of training of the teachers and lack of electronic tools and their maintenance. The sample for this study was from 50 secondary schools coming from 13 regions and 25 cities in Saudi Arabia. Albugami (2016) concluded that successful implementation of ICT in secondary schools indicated that ICT was an important tool in improving students' learning experience, cooperation, performance, and learning outcomes. Al Sulaimani (2010), however, found that there was little opportunity for ICT integration in the

science curriculum in intermediate schools. Oyaid (2009) conducted a similar study to investigate secondary school teachers' perspectives on using ICT and its relation to educational policy. Oyaid concluded that ICT is still not easy to implement effectively in secondary schools because teachers are more influenced by school policy than by the Ministry of Education policy.

Nevertheless, interpretive research by Almaghlouth (2008) on secondary science teachers' perceptions and their use of ICT tools revealed that teachers reported using ICT was beneficial in managing lesson preparations. Almaghlouth also found that teachers' difficulties with ICT integration were closely related to their training and technical skills. The literature on ICT integration in Saudi Arabia shows that there is considerably more research at the secondary school level rather than at the primary school level. Consequently, more effort needs to be invested into researching the impact of ICT on the primary level during future research.

In conclusion, ICT plays an essential role in developing a variety of systems in developing countries. Education is one of the vital systems that use ICT in an endeavor to improve the teaching and learning processes in institutions. Effective integration of ICT in learning and teaching is a complex process. Determining the factors that present barriers to effective ICT integration is vital for this study, which aims to evaluate the current factors that impact upon ICT integration in upper primary level schools in Saudi Arabia, including attitude towards ICT, perceived advantages and disadvantages, and self-efficacy, which are internal barriers, while ICT tools and training courses are external barriers. Clearly, the government of Saudi Arabia has invested a great deal of time and money into improving their education system through the Tatweer Project initiative, which has introduced new ICT tools into education. This study examines the extent of teachers' and students' use of ICT in science at the upper primary level in response to Saudi Arabia's renewed focus on ICT to improve science education.

### 1.5 Rationale

Although research related to Information and Communications Technology (ICT) in education has been conducted in Saudi Arabia, most studies have focused on the teachers' perspectives and the obstacles they encounter when attempting to integrate

ICT in Saudi schools. Few studies have focused on the students' perceptions of using ICT in learning.

Although a few studies have investigated the use of new technologies in primary schools, the researcher has not found research that examines teachers' and students' perceptions of the effectiveness of ICT integration for teaching and learning science in primary schools. Some Saudi studies (Al-Alwani & Soomro, 2010; Oyaid, 2009) have identified the following reasons for the relative ineffectiveness of ICT integration from the teachers' point of view: 1) rather than integrating new technology, the teachers use a 'delivery' teaching style; 2) professional development in the use of ICT is weak; 3) teachers misunderstand the students' needs in primary school; and 4) there is a lack of practical activities. There is a demonstrable need to integrate ICT in schools, especially in the primary mathematics and science classrooms. Oyaid (2009) has suggested that new research should focus on how teachers can effectively integrate ICT into teaching science. Based on the tenets of the Project of Science and Mathematics in Saudi Arabia, one aspect of the project will involve using ICT in teaching and learning science to achieve more positive outcomes.

In order to address these issues, the study needed a particular research design (triangulated mixed methods) which investigated the ICT issues that students are dealing with, collected students' responses and teachers' responses to questionnaires, and compared the analysed collected quantitative and qualitative data.

### 1.6 Aims of the study

This study was an evaluation of the effectiveness of ICT integration in teaching and learning science by examining teachers' and students' perceptions. Both internal and external factors may influence their perceptions. The researcher also examined any comparison between teachers' and students' perceptions of the effectiveness of ICT in teaching and learning science in primary schools in Riyadh.

Research Questions

*Research Question 1:* How do students perceive the extent of ICT integration in their science learning?

*Research Question 2:* Based on the results of Students' Attitudes Towards and Knowledge of Technology Questionnaire (SATK), are there any differences based on grade level or school type?

*Research Question 3:* How do teachers perceive the extent of ICT integration in their science teaching?

*Research Question 4:* What are the levels of interest, attitude, and knowledge of science teachers about integrating ICT in teaching?

*Research Question 5:* How do science teachers perceive the effects of ICT integration on students' learning outcomes?

### 1.7 Significance of the study

The importance of this research lies in the need to examine the significance of effective integration of ICT in teaching and learning science by evaluating students' and teachers' perceptions of the effectiveness of ICT integration, and teachers' self-efficacy in using ICT for improving students' outcomes in science education. The study evaluated the extent of the promotion of positive attitudes and perceptions among teachers and students regarding ICT implementation in schools, since enhancement of students' perceptions of using ICT in science could contribute to improving their engagement with science.

The results of this study can be used as a starting point for future professional development programs to enhance upper primary teachers' and students' attitudes, knowledge, and self-efficacy regarding ICT integration in science. A comparison of science teachers' and students' perceptions concerning the use of ICT to enhance science education in upper primary schools may contribute to the effective integration of ICT in science education, and provide the MoE in Saudi Arabia with new information. This study may open the way for additional research on the future of ICT use in Saudi Arabian science education.

### 1.8 Methodology

The current study used mixed methods, both quantitative and qualitative collection of data and analysis, to understand the identified research problem (Creswell, 2012). The data collection instruments were questionnaires and qualitative semi-structured

interviews. There were two types of questionnaires: a student questionnaire and a teacher questionnaire. A subsample of students and teachers were interviewed to gain a deep understanding of participants' perceptions of the use of ICT in science learning.

The study was conducted in Riyadh, the capital city of Saudi Arabia, because most educational development programs are being implemented in this city to determine if they are relevant to students throughout the country. The student sample size in the study was from 14 primary schools, (9 government and 5 private). All schools were already integrating ICT in their lessons at the time of the study. Participants were 1,401 fifth and sixth grade students, and 32 in-service science teachers, who completed the instruments. In addition, 54 students and 21 science teachers participated in interviews. For religious and cultural reasons, all participants in the study were female. All interviews took place at the schools.

The student questionnaire comprised five scales containing 39 items, using a 5-point Likert scale,adopted from the Students' Attitudes Toward and Knowledge of Technology Questionnaire (SATK) (see Appendix C), developed by Incantalupo, Treagust, and Koul (2014).

The teacher questionnaire included six scales with 65 items. The first five scales contain 41 items modified from the SATK, to measure teachers' attitudes, knowledge, and current use of ICT in teaching science. The sixth scale contained 24 items adopted from the Science Teaching Efficacy Beliefs Instrument (STEBI) to measure the extent of science teachers' perceived self-efficacy and outcome expectancy concerning ICT integration in their current teaching practices (Riggs & Enochs, 1990). Further details are provided in Chapter 3 (see Section 3.4.3).

### 1.9 Data collection and analysis

The quantitative data from the questionnaires was inferentially analysed using the Statistical Package for Social Sciences (SPSS) to assess students' and science teachers' perceptions concerning the effectiveness of learning and teaching with ICT. The qualitative data aimed to compare and provide more details and a deeper understanding of the quantitative data. The researcher used semi-structured interviews that contained primarily open-ended questions because these gave the participants a chance to expand their understanding and their point of view

(Creswell, 2012). The semi-structured interviews were analysed manually and by using NVivo software, a qualitative data analysis computer software package produced by QSR International, (Leech & Onwuegbuzie, 2011). The transcripts were used to translate Arabic responses to English, then, using thematic coding, similar responses were classified into themes and sub-themes to find the threads of participants' perceptions of ICT integration in science education in primary schools in Saudi Arabia. Further details are provided in Chapter 3.

### 1.10 Limitations

There were several limitations to this study in the process of collecting data from students and teachers. All schools that participated in this study were in the northern sector in Riyadh and participants were selected from science teachers and students at upper-primary schools in that sector. The students' sample was from two grade levels (fifth and sixth) due to limited access provided by the schools. The time of administering the survey for this research was in early 2016. Only female students and teachers were surveyed because of the segregated educational system in Saudi Arabia. Limited time was offered for conducting the interviews, varying from one school to another, and most participant responses were short and direct. The teachers' responses were analysed as one group because most schools that participated in the current study had one or two science teachers who taught both grades. Further, students' interviews were analysed as one group due to the analysis which showed similar perceptions of ICT integration from both grades; the quantitative data showed only a small significant difference in the effect size between fifth and sixth graders.

### 1.11 Organisation of the thesis

The chapters in the thesis are structured as follows:

***Chapter*** 2 presents a review of research into the impact of integrating ICT in primary science teaching and learning and the investigation of students' and science teachers' perceptions of this approach to science education and factors that affect the successful use of ICT. The education system and ICT implementation in Saudi Arabia, the Saudi Arabian vision 2030 for education, and several Saudi projects for ICT integration, are described. Some important definitions related to the study are given: Information and Communication Technology (ICT) integration in education,

and the perceptions of the benefits and challenges of ICT integration. Students' and science teachers' attitudes towards ICT are reviewed.

***Chapter 3*** illustrates the mixed method used to evaluate the state of current ICT integration in upper primary level in Riyadh through describing the quantitative and qualitative phases of the research, including data collection and data analysis. The chapter concludes with a discussion of how ethical issues were addressed.

***Chapter 4*** presents the quantitative results and analysis for student participants. Demographics and the reliability of instruments are described, and the first and second research questions are addressed through analysis of the data.

***Chapter 5*** presents the quantitative results and analysis for teacher participants. Demographics and the reliability of instruments are described, and the third, fourth, and fifth research questions addressed through analysis of the data.

***Chapter 6*** presents the qualitative results and analysis for student participants. Students' perceptions of ICT integration in science learning are investigated through the identified themes: ICT integration, perceptions of the benefits and concerns of ICT integration, and suggestions.

***Chapter 7*** explains the qualitative results and analysis of the data for student participants. The teachers' responses are divided into the same themes as students.

***Chapter 8*** presents the comparison between participants' perceptions of ICT integration in science. Examines the quantitative surveys and qualitative interviews, then triangulated findings from students' and teachers' responses to compare their perceptions of ICT integration in science.

***Chapter 9*** discusses the quantitative and qualitative phases and briefly presents the main findings from the research questions. The last part of the chapter presents the conclusion, limitations, implications, and recommendations.

# CHAPTER 2

## LITERATURE REVIEW

### 2.1 Introduction

This chapter is divided into two main parts; firstly, a detailed context of the Saudi Arabian education system to provide the context for the research, and secondly a review of the literature on the impact of integrating ICT in primary science teaching. Consequently, this chapter is divided into eight sections .The study context includes the education system and ICT implementation, the Saudi Arabian vision 2030 for education, several Saudi projects for ICT integration, and a brief description of the science curriculum in Section 2.2. ICT integration in education discussed in Section 2.3 The chapter explains the theoretical framework that is related to the current study in Section 2.4, and the internal factors that could impact ICT integration in schools that include students' and teachers' perceptions of the "benefits and concerns" of ICT integration in science; students' and teachers attitudes towards and knowledge of ICT; teachers' self-efficacy. Describes the external factors which contain the availability of ICT tools; teachers' professional development in Section 2.6. Reviewed the constructivist theory as learning theory for this study illustrates in Section 2.7.The chapter concludes with a summary in Section 2.8.

### 2.2 Education system in Saudi Arabia

When the Ministry of Education was established in 1953, the education levels for males were primary, intermediate, secondary and employment education; there was no official education for females. In 1960, female students were officially enrolled in schools. In Saudi Arabia, males and females are segregated in separate schools at all levels, including higher education, The segregation of the students could be attributed to the Saudi views of Islam where single-sex education is related to social traditional values and culture (Wiseman & Anderson, 2012). Nevertheless, both sexes receive the same quality and educational facilities and school levels are the same in both male and female schools (Al Johani, 2011).

The Saudi general education system includes four levels: First, pre-primary-school: students at five years old enrol to study one year in pre-primary; Second, primary

school students start study in primary school when they are six years old; they start in first grade and finish in sixth grade when they are 12 years old; Third, intermediate school students start at 12 years old in (seventh grade) and end in ninth grade when they are 15 years old; Fourth, secondary school students start tenth grade when they are 15 years old and graduate from secondary school at the end of grade 12 when they are 18 years old. The completion of at least primary and intermediate stages is compulsory education for all children in Saudi Arabia (Saudi Ministry of Education, 2016).

The Saudi Arabian school week is five days, Sunday to Thursday; the weekend is Friday and Saturday. The academic year is divided into two semesters; each semester has 18 weeks for all school levels. Primary school students have six classes a day; each class runs for 45 minutes. Students at all school levels receive the textbooks for free (Alrashidi & Phan, 2015). Primary schools are divided into two levels. The early level includes first grades to third grade; they study numerous subjects such as the Arabic language, Islamic studies, mathematics, science, and art education; the upper level includes fourth to sixth grade students who study new subjects such as computers, English, and social studies. Early primary teachers teach all subjects, while at the upper level, each subject has a teacher, who teaches up to 24 lessons per week. Thus, science teachers teach only science subjects; this is the main difference between the two levels. This study focused on the upper level, fifth and sixth grades, in primary girls' schools in Riyadh.

Government (public) schools are supervised by the Ministry of Education and provide free education to their students. Private schools are established by the private sector and are also supervised by the Ministry of Education; they provide education to their students whose parents pay fees. Ali, Ghani and Ali (2010) defined the private school as "a school under financial and managerial control of a private or charitable trust accepting mostly fee paying students" (p.163).

Government and private schools are led by principals who are overseen by the Ministry of Education, and in both school types teachers are required to implement the government-directed curriculum (Deraney & Abdelsalam, 2012). As ICT integration grows around the world, the Ministry of Education in Saudi Arabia aims to enhance the integration of ICT tools in the traditional curriculum in both

government and private schools, in order to improve the teaching and learning process. According to Al-Asmari and Khan (2014), several government and private schools in Saudi Arabia are integrating ICT to develop the quality of learning outcomes and improve the relations between students, teachers, and parents.

### *2.2.1 ICT implementation in Saudi Arabia*

The Kingdom of Saudi Arabia has allocated substantial resources for developing the overall educational system, with funds specifically earmarked for implementing ICT within the system. The government desires to adjust to the new age of technology, and to achieve outcomes of a high standard for school leavers in terms of obtaining employment or moving to tertiary education; this is reflected in their far-reaching efforts to reform education (Saudi Ministry of Education, 2016). The Ministry of Education (MoE) has envisioned and planned distinctive aspects of the education system to support development projects in the kingdom during the next five years (Tatweer, 2014a). King Abdullah, in 2014, announced funds to develop a budget for education development in Saudi schools, costing an estimated SAR 80 billion (approximately AUD 20 billion) — this is the Project for Public Education Development (Tatweer, 2014b). This development is to be across three main areas — curriculum, school construction and teacher support — which are at the core of the educational process. Tatweer is the sector aiming to develop education in Saudi Arabia through several projects. One of these projects is the Project of Science and Mathematics, which aims to train science and mathematics teachers to enhance educational outcomes in these two fields, and raise the quality of learning levels by providing teachers with up-to-date knowledge and enhancing their skills.

The philosophy of the project is to "focus on school development, and this was because of the importance of school as a unit of the educational system, where efforts of reform and improvement of the education system can be made" (Alyami, 2014, p. 1515). Its objectives are: to identify gaps and areas of weakness among the administrators and teachers in the new curriculum for science and mathematics training; to enhance the capacity of education departments and supervisors based on the training of teachers in the curriculum: to support teachers with tools and materials to facilitate effective teaching of the curriculum; to provide tools to help parents support children's learning of maths and science; and to ensure the support

and commitment of the developer to education administrators, teachers, parents and management (Tatweer, 2014b). The overall vision of the project: is the development of capabilities and the creation of publicly educated students in the Kingdom of Saudi Arabia according to international standards; to reach a deep understanding of scientific material; the construction of new concepts, problem solving, innovation and product development through communication and the use of technology; and to meet the evolving needs of society and the labour market in the race for global competitiveness (AlShaya & Abdulhameed , 2011).

The philosophy of the Project of Science and Mathematics is designed to: 1) enhance a learner-centred approach and support active learning based on exploration and investigation; 2) integrate ICT resources to increase the quality of teaching and learning process; 3) develop thinking skills, especially higher-order thinking skills, and develop decision-making skills; 4) develop learner capabilities to benefit from delivery of the planned initiatives.; 5) enhance multiple approaches to the exchange of knowledge, communication, and representation of such cooperative learning; 6) link learning with daily life (Tatweer, 2014b).

### *2.2.2 Saudi Arabia's Vision 2030 in Education*

In April 2016, Deputy Crown Prince Mohammed bin Salman introduced a new transformation phase after the announcement of Saudi Arabia Vision 2030. Prince Mohammed declared that the vision's goal is to achieve "a strong, thriving, and stable Saudi Arabia that provides opportunity for all. Our vision is a tolerant country with Islam as its constitution and moderation as its method" (Vision 2030, 2016, p. 6). The Saudi Arabian vision 2030 in Education aims: to build an educated generation capable of taking responsibility and making decisions in the future; to provide education opportunities for all, and in an appropriate educational environment encourage creativity and innovation; and to raise the skills and abilities of education stakeholders. A new goal by 2030 is to close the gap between higher education output and labour market requirements (Saudi Vision 2030, 2016).

### *2.2.3 Projects in Saudi Arabia concerning ICT integration in education*

Saudi Arabia's integration of ICT with education is planned to cover several stages, starting from students' enrolment in schools and ending with obtaining a certificate and grade. Since 2011, the majority of communications between the Ministry of

Education (MoE), schools, and parents, have occurred through the Noor project (Saudi Ministry of Education, 2010). This project aims to establish comprehensive educational processes, relying on the latest technology in the field of electronic educational administration; it covers all schools supervised by the Ministry. The system will provide many electronic student services. Teachers, parents, the directors of the schools, and decision makers will also contribute to the system by preparing the necessary reports and providing basic information about the educational process when needed, and in the manner desired. Indeed, one of the Noor system's benefits is the ability to link the student technology gradually, as a prelude to making it a major technological tool in the educational process (Noor, 2010).

Another aspect of ICT integration in Saudi Arabia involves cooperation with Obeikan Education "Obeikan", which is a major organisation in the Middle East specialising in printing, packaging and education. Obeikan Education focuses on the development of curriculum content, teaching and learning solutions, and continuing professional development, as well as e-learning and educational technology. Obeikan Education is proud of the involvement in the largest Science and Mathematics Curriculum Development Project in the Arab World (Saudi Arabia, Bahrain and Qatar) (Saudi Ministry of Education, 2015). Obeikan education uses local and international expertise to suit the cultural and religious contexts of Arab and Islamic communities (Obeikan Education, 2014).

Like other countries around the world, Saudi Arabia has a relatively limited experience with ICT use in education and ICT integration is a developing field. Therefore, it was only 12 years ago that ICT was officially implemented throughout primary schools. ICT was introduced into education after numerous calls for its development and reform. Therefore, the present study aims to fill the gap in the literature from the region, looking at how effective the integration of ICT has been in teaching and learning science in upper primary schools. Recently, the MoE has offered new technologies, and it needs to be determined whether schools and teacher are using them effectively. Examples of ICT supplies include educational software programs, electronic whiteboards, and access to the Internet, digital cameras, and video and computer laboratories in schools.

There is no doubt that for current generations to keep up with the tremendous technological progress everywhere in the world, a suitable atmosphere for learning and aids to creativity needs to be established in all aspects of the educational process. Saudi schools need to prepare children to keep up with technological advances and to provide the latest scientific laboratories. Students should be provided with the types of information that will excite their minds and foster their potential for creativity, innovation, invention, and discovery. Accordingly, the Saudi Computer-Based Labs project been established to provide schools with new labs, including advanced technological devices, microscopes, and other ICT tools, to give students the opportunity to observe, examine, and investigate phenomena. These technical aids are intended to enhance the importance of the scientific experiments carried out by students (Tatweer, 2014b).

Integration of ICT as an e-learning system has several benefits, such as enriching knowledge, and improving thinking skills via activities to support the learning process. The development of a National Education Portal (iEN, 2018) is a measure designed to achieve one of the most important foundations of the national development strategies in Saudi Arabia. Tatweer has therefore sought to develop iEN, which contributes to the provision of e-learning services and solutions, and targets all students of the Kingdom, along with their teachers and parents. Moreover, some services in a broad range of planned services have been launched at this stage, and new ones will be launched gradually according to the educational plan. iEN has covered over 12,000 titles and more than 720 books (all in Arabic) and it continues to increase and improve them. The Agency for Curriculum and Educational Programs has also contributed to the provision of coursework and some digital illustrations (iEN, 2018).

### *2.2.4 Science curriculum*

The current science curriculum in Saudi Arabia is based on the constructivist theory of learning, and is geared towards enhancing problem-solving and critical thinking skills; it prompts teachers and students using ICT to reach their goals in various ways (Albadi, Harkins, & O'Toole, 2018). In addition, the science curriculum aims to develop self-learning skills, cooperative learning, and good communication of sources of knowledge. Further, the curriculum attempts to relate students' learning to their daily lives and experiences in meaningful ways.

As the literature review shows, ICT can enhance the teaching and learning process and open up new opportunities for both science teachers and students to improve their ability to investigate, develop their knowledge, experience, explore, observe and implement experiments in an effective way. The Saudi government's goal, therefore, is to blend ICT with education (Ministry of Education, 2014). In 2010, a new Saudi science curriculum was implemented in grades K-12; this was partly based on a translation of science textbooks by McGraw-Hill (an American publishing company). This curriculum K-12 incorporates current teaching and learning trends, and promises to adopt a student-centred approach with inquiry-based instruction (Albadi et al., 2018; Obeikan Education, 2014).

The science curriculum for fifth and sixth grades in primary schools represents one product of the Mathematics and Science Curriculum Development Project. It aims to achieve qualitative development in mathematics and science teaching and learning, and emphasises the use of a student-centred approach through the learning process. The science book's contents are presented in an interesting and exciting way and are claimed to be effective in engaging students in learning science through an active learning cycle using the scientific method (Obeikan Education, 2014). The book includes a variety of activity levels, taking into account the individual differences amongst students, and the activities that can be implemented. Pictures illustrate the contents of the unit, and the content of the science book enhances formative assessment in units and various chapters and lessons.

The philosophy of the science book promotes high-level scientific thinking, and aims to improve critical thinking and problem solving to enhance students' skills and mental processes. Knowledge is linked with students' daily life, and with literacy, health, the arts, society and mathematics. In this way, the science curriculum permits students to engage with science material directly rather than just memorising superficially, by applying student-cantered learning approach. The new science pedagogy reflected in the textbook is an application of the constructivist theory of knowledge and focused on problem solving and critical thinking (Alghamdi & Alsalouli, 2013; Al-Kahtani, 2017). This textbook and the accompanying booklet of activities are intended to contribute to a deeper implementation of the students' scientific knowledge, to improve their manual skills in the field of science and

technology, to elicit positive attitudes, and to facilitate the development of science and scientists.

For the science book in the fifth- and sixth-grade, students are encouraged to use the learning cycle as a scientific method. In the learning cycle approach, the role of the teacher is that of facilitator, students are like scientists, and teachers integrate ICT as a tool in the exploration phase (Witfelt, 2000). The 5E Learning Cycle (Bybee, 2014), is as follows: *Engaging* students by mentioning questions, events or objects to link students' prior knowledge and what they know and can do; *Exploring* phenomena or objects through activities such as hands-on activities; *Explain*ing concepts and processes based on students' understanding to introduce new concepts and skills; *Elabo*rating by using activities to promote students' application of concepts in context, and to build on or extend understanding and skill; and *Evaluating* students' knowledge, abilities and skills. Activities allow evaluation of student improvement and lessons' effectiveness.

### 2.3 ICT integration in education

The essential aim of ICT integration is to enhance teaching and learning processes generally, and improve learning outcomes specifically. Consequently, many countries have invested funds for huge projects to develop ICT in the education sector. However, a large number of ICT tools in the classroom does not guarantee that students will achieve a high educational level. Therefore, governments are searching for effective ways of using ICT tools to enhance the teaching and learning process, for instance, a large project costing £55 billion was published by the United Kingdom government entitled 'Building Schools for the Future' (BBC, 2011). The goals of this project were to provide schools with wi-fi-accessible learning hubs and personal laptops. A study revealed that in primary and secondary schools in the UK, around 70 % of the students used touch screen computers at the time of the study (Tech Knowledge, 2013). Similarly, in the United States, $6 billion has been spent on K-12 schools (Nut, 2010) to make ICT available and effective for learning achievement by encouraging teachers and students to enhance ICT integration (Patrick, 2008). However, despite large financial investments in ICT integration in education, results conducted in Cyprus, Ghana, and Cameroon have revealed that the

intended learning outcomes are not being achieved (Eteokleous, 2008; Natia and Al-hassan, 2015; Ngoungouo, 2017).

Nevertheless, several studies have measured the impact of ICT integration on learning and teaching, highlighting some results of the effective use of ICT in the education sector to enhance the teaching and learning process (Lawrence & Tar, 2018; UNESCO, 2012). These results include: the development and enrichment of teaching and learning quality; support for learner-centred and independent learning; increase in students' motivation (Kubiatko & Haláková, 2009; Uluyol & Şahin, 2016); development of critical high-order thinking skills and promotion of problem solving (Ross,Morrison, & Lowther, 2010); support for teachers by simplifying access to subject content (Alahmari & Kyei-Blankson, 2018; Ibieta, Hinostroza, Labbé, & Claro, 2017); provision of chances for learners to develop understanding and cultural sensitivity through collaborating and cooperating with students from other countries; provision of a creative learning environment (Alghamdi & Higgins, 2015; Balta & Duran, 2015; Minshew & Anderson, 2015); development of communication skills (Arukaroon & Krairit, 2017); and enhancement of cooperative learning (Aydin, Gürol, & Vanderlinde, 2016; Balta & Duran, 2015).

### 2.4 Theoretical Framework

Although ICT integration can have positive effects on learning and teaching, the literature illustrates that a number of factors have an impact on this approach. Several researchers mention these factors as barriers which can be any situation that challenges the achievement of or progress in an objective (Schoepp, 2005). There are a variety of factors categorised as factors for effective ICT integration; two categories are internal and external factors. Internal factors relate to individual concerns such as teachers' and students' perceptions, self-efficacy, and attitudes towards ICT (Alkahtani, 2016; BECTA, 2004; Ertmer, Ottenbreit-Leftwich & York, 2007; Bolandifar, Nooreen, babashamsi, & Shakib, 2013; Tiemo 2012). External factors relate to school policy and planning access to equipment and organisational support; they may also be factors outside of the schools, for example, offering ICT tools and continuing professional development (Alahmari & Kyei-Blankson, 2016; Alghamdi & Higgins, 2015).

Another way of categorising factors impacting on effective ICT integration is in relation to individual factors (concerning teachers and students), or organisational factors (concerning schools). The individual factors are a low level of self-efficacy, negative attitudes, and lack of time. Organisational factors are lack of effective training, and lack of availability of ICT tools and of technical support (Albugami, 2016; Alwani & Soomro, 2010; BECTA, 2004). Another way of classifying the factors impacting ICT integration is by an individual's attitudes and perceptions, knowledge, resources, institution, subject culture, and assessments (Hew & Brush, 2007).

## 2.5 The Internal Factors

The internal factors were divided into three main sections firstly, students' and teachers' perceptions of the "benefits and concerns" of ICT integration in science (Section 2.5.1). The term perception of ICT usage refers to the extent to which technology teachers and students perceived that ICT integration benefits them (Arukaroon & Krairit, 2017; Eickelmann & Vennemann, 2017; Sipilä, 2011). Secondly, students' and teachers attitudes towards and knowledge of ICT (Section 2.5.2). , and thirdly, teachers' self-efficacy (Section 2.5.3).

### *2.5.1 Benefits and concerns of ICT integration in teaching and learning*

ICT integration in learning and teaching has benefits and concerns; Several researchers explain the benefits that come from successful ICT integration and the factors that hinder ICT integration effectively (Al-Harbi, 2014; Alahmari & Kyei-Blankson, 2018; Albugami, 2016). The benefits and concerns of ICT grouped into five subsections: a) Improvement of understanding science; b) Enhancement of enjoyment; c) Ease of use flexibility; d) Communication and collaboration skills; e) Concerns regarding ICT integration in teaching and learning.

*a) Improvement of understanding science*

Using ICT could support students being more active in the learning process through interactivity, viewing simulations, and enhanced visualisation, to build their conceptual understanding (Mann, 2014). Indeed, ICT integration can act as a teaching assistant for the students. The aim of learning science is to develop learner understanding by building and connecting ideas. In other words, when learning new

concepts, ICT can help students build on their previous knowledge and understanding with new knowledge through critical thinking, problem solving, and discussion of experiments (Krajcik & Mun, 2014; Oyaid, 2009). The positive impact of using ICT in the teaching and learning process is valuable even though teachers may need to spend a long time preparing the lessons. For example, a European report regarding the impact of ICT in schools revealed that teachers motivate students and enrich their lessons by using interactive whiteboards. Because the board is large and the content is presented clearly, teachers believe that students are more motivated (Balanskat, Blamire, & Kefala, 2006). Integration of ICT in the classroom through interactive whiteboards enhances students' motivation and focus through a variety of learning approaches such as presenting pictures or videos (Essig, 2011).

Osborne and Hennessy (2006) reported that when students are motivated to search for science information by using online resources to solve problems, they are more engaged in the learning process and there is an increase in self-confidence and improve their understanding in a certain topic. Similarly, Watts and Lloyd (2004) and Kashkoul and Ba-Isa (2002) argued that using ICT may enhance students' engagement in learning because students are motivated to play an active role rather than be a listener. Akpan (2001) showed that the most effective way of using ICT to improve science achievements is to engage students in active learning, such as through simulations. Moreover, students can improve their education level by using ICT because they are likely to have better understanding and motivation and enjoying learning, which can lead to improved learning outcomes.

ICT could support students' deep understanding of subjects, as teams of students engage in solving complex, real-world problems, thereby enhancing higher-order thinking and student self-efficacy (Robertson & Al-Zahrani, 2012*)*. Integrating ICT in teaching and learning science contributes to the development of pedagogy, moving away from a focus on recalling factual material (which is now readily available), to a new focus on learning or knowledge creation through a social process (Choi & Hanafin, 1995; Elliott, 2007). Clearly, using ICT in learning could helping them to search and understand rather than memorising, and promoting collaborative rather than competitive learning.

*b) Enhancement of enjoyment*

The literature confirms that both teachers and students find the learning and teaching process more enjoyable and more interesting when ICT is integrated into the lessons. When students and teachers engage with their lessons, there is likely to be productive, diverse and motivated learning. Thus, the importance of increasing the perceived benefits of ICT integration may encourage teachers to use ICT in the teaching process and thereby improve and enhance learning outcomes (Cox, Cox, & Preston, 2000). Current studies argue that ICT integration can support an increased quality of the learning and teaching process (Lawrence & Tar, 2018; Selwyn & Cooper, 2015; UNESCO, 2012). Students enjoy using ICT while learning, and can increase their thinking skills, their creativity and achievement. Moreover, teachers can use ICT to prepare and design the lessons in an interesting, creative, and effective way.

Thus, students are likely to engage and be motivated in learning and become active learners. Some recent studies have shown that students' abilities in active learning improve the learning process through the effective integration of ICT in teaching by Finger and Trinidad (2002); Jorge, Jorge, Gutiérrez, García & Díaz, (2003); Young (2003); and Jamieson-Procter, Albion, Finger, Cavanagh, Fitzgerald, Bond, & Grimbeek, (2013). Students are usually motivated and enthused when ICT tools are integrated, especially when they can use ICT tools by themselves to solve problems.

ICT is useful because provides games or other fun ways to help students to enjoy while learning (Li, 2007). Using ICT in the teaching and learning system supports education in an enjoyable way. For instance, teachers can present interesting and enjoyable real-world examples with stimulating visual and audio material from a variety of resources (Alkahtani, 2016). An important component of classroom teaching is enjoyment for both teachers and students; the present study focuses on this aspect and examines whether or not participants in the current study enjoy learning while using ICT.

*c) Ease of use flexibility*

Ease of use and flexibility is another benefit to be gained from using ICT in science education. The growth of using ICT tools has opened up a vast arena of opportunities

for the improvement of education because ICT tends to be integrated in all aspects of society. A natural outcome is that teaching and learning can take place anytime and anywhere through the use of ICT (Cradler & Bridgforth, 2002). Integrating ICT in the teaching and learning process plays a vital role in improving learning outcomes through flexible learning experiences, anywhere and anytime, to suit the needs of individuals (Lawrence & Tar, 2018; UNESCO, 2012). In other words, students can learn and enrich their knowledge by choosing where and when to study, thus becoming independent learners. Jacobsen and Kremer (2000) also found that primary science teachers and students can benefit from flexible access to educational resources, using ICT at any time and place and not just in school hours. They can complete their work at home, in a café, or in a community centre. Tools that allow such flexibility for teachers and students are E-library, educational databases, or blackboards that are interactive between a teacher and her students, or between students (Sivakumar, 2014).

*d) Communication and collaboration skills*

Student communication and collaboration skills may improve when ICT is used in primary education, enabling students to express their ideas with teachers, experts, colleagues via email, social networks, and e-discussion. Gillespie (2014) asserted that using ICT in science education develops students' communication and collaboration skills; for example, students can search for science information and cooperate by sharing different resources such as videos and pictures. Bransford (2000) emphasised that students can achieve great outcomes in learning science by working with peers and communicating with them by using ICT. In a study of how ICT tools can be used in the primary classroom, Lim and Tay (2003) noted an improvement in communication between teachers and students and among students working together (Hertlein & Ancheta, 2014). ICT provides a communication channel not only for learning purposes but also by giving students' parents a chance to collaborate with the school by using ICT as a bridge for communicating and sharing their opinions, and for following students' attendance and behaviour in school (Albugami, 2016; Jewitt, Hadjithoma-Garstka, Clark, Banaji, & Selwyn, 2010). Thus, using ICT in primary schools could enhance communication skills of teachers, students, and parents.

*e) Concerns regarding ICT integration in teaching and learning*

Some studies, however, have found that the use of ICT has no effect or even a negative effect on students' outcomes (Bitter & Legacy, 2008). UNESCO (2012) reported some concerns to regard integrate ICT effectively in the classrooms and hinder teachers to effective integrate such as technical issues, time consuming, lack of professional development workshops, and lack of providing ICT tools.

Another issue with ICT integration is that this increases the school budget, because many ICT tools are expensive, and not all schools can afford them; this can give rise to a digital divide between well-resourced and poorly-resourced schools (Hanley, 2014). In addition, Al-Alwani and Soomro (2010) mention that ICT integration may raise ethical issues because students might come across unsuitable text or pictures while searching for information.

Overall, even though using ICT could improve primary science education, its success is dependent on the ways in which teachers are supported to use it (Noss & Hoyles, 1996). Considering the variability of teachers' experience and skills, and the benefits and potential risks of ICT integration in school science education, it is important to investigate how Saudi teachers and students are practising and perceiving ICT integration as required by the new curriculum.

### *2.5.2 Students' and teachers attitudes towards and knowledge of ICT*

Attitude is defined as a positive or negative point of view that is learned and organised through experience, and that exercises a discrete influence on the affective and cognitive responses of an individual toward some other individual, object or event (Ajzen & Fishbein, 2005). Specifically, attitude towards ICT has been defined as an individual's general feeling of favourableness towards ICT activities (Kubiatko & Haláková, 2009; Yapici & Hevedanli, 2012). Jonassen (1995) argued that with new technologies, teachers are playing new roles and have different attitudes than they did traditionally. Teachers' attitudes when evaluating ICT integration are usually expressed through statements which examine users' interactions with ICT tools such as computer hardware, computer software, other persons relating to computers, and activities that involve computer use (Palaigeorgiou, Siozos, Konstantakis, & Tsoukalas, 2005). The Students' and teachers attitudes towards and knowledge of ICT grouped into four subsections: a) Students' attitudes towards ICT;

b) Students' Knowledge and thinking skills; c) Teachers' attitudes towards ICT; d) Teachers' Knowledge.

*a) Students' attitudes towards ICT*

Since the early 1980s, considering students' positive attitudes towards technology, researchers have agreed that the integration of technology in learning is effective (Lawton & Gerschner, 1982). Over the past quarter of a century, most studies in this field have looked at attitudinal and motivational/personality factors concerning ICT in the teaching and learning process. Many of these studies used attitude surveys consisting of questions about anxiety related to computer use, attitudes towards using technology in school, and the extent to which users like technology. These studies showed strong links between students' and teachers' attitudes and the effect of ICT integration in the teaching and learning process (Marshall & Cox, 2008). Integrating ICT into the curriculum was found to positively enhance the attitudes of students toward ICT (Neo, 2003). A study conducted in Turkey to measure students' attitudes toward a tablet or personal computer (PC) use showed that students have a positive attitude toward tablet PCs (Dündar & Akçayır, 2014).

Several studies have measured the attitudes of teachers and students towards ICT integration in teaching and learning science, finding that outcomes were either positive or negative. For instance, Hall and Higgins (2005) argued that students using ICT had more positive attitudes towards learning science than students who were educated through traditional styles of teaching. Moreover, integrating ICT as a learning tool, and developing problem solving, writing, and higher thinking skills, led to the promotion of positive attitudes towards learning science amongst students (Ross, Morrison, & Lowther, 2010).

Earle (2002) found that using ICT in different activities which simulated the 'real world' gave students the chance to improve their attitudes toward the subject and enhance their enjoyment and motivation in learning. Overall, Earle (2002) found that ICT integration had a positive impact on teaching and learning and was encouraging for both teachers and students. For example, Earle found that the use of a digital microscope to conduct experiments in science, as well as using PowerPoint, Webpages, Flash animations, or digital video productions to develop science lessons, can increase ICT integration and promote teaching and learning science in primary

schools. Songer, Lee, & Kam (2002) state that when ICT is integrated effectively in teaching and learning science, it has the potential to create a variety of positive outcomes: improving student learning; creating new teaching styles; generating more effective teaching; enhancing student achievement, and improving social interaction.

BECTA (2004) showed that a negative attitude was an obstacle to ICT integration in teaching and learning. On the other hand, Kubiatko and Hălăkovă (2009) determined that students' attitudes towards the use of ICT in teaching and learning were generated through its impact. Similarly, Knezek and Christensen (2000) argued that positive attitudes towards ICT use are widely recognised as a necessary condition for effective ICT integration in teaching and learning. Further, the integration of ICT in teaching and learning science was found to depend on teachers' and students' attitude towards its use (Selwyn, 1999). One study found that ICT provided variety during the teaching and learning of science, and at the same time sustained teachers' own interest in teaching, thereby motivating students to learn (Slaouti & Barton, 2007). According to Myers and Halpin (2002), the attitudes of both students and teachers towards ICT integration were a major predictor of future classroom use. Another study, conducted in Turkey (Balta & Duran, 2015), indicates that the country is attempting to integrate ICT at all school levels. A quantitative study was conducted to examine the attitudes of students and teachers towards interactive whiteboards during the learning process. The participants in the research were sixth through twelfth graders and teachers from different areas. The findings of the survey revealed that both students and teachers gave the interactive whiteboard a very high rating, with mathematics receiving the highest score. Students' attitudes varied according to school level and gender. The positive attitudes towards interactive whiteboard technology decreased when students become older. The researchers stated that there was no difference between the students' and the teachers' attitudes. Clearly, teachers' and students' attitudes may influence their perceptions of the integration of ICT in teaching and learning science.

Integrating ICT in science learning is common practice in most primary schools in Quebec elementary and secondary schools. According to the research studies reviewed, students in different grade levels engage with ICT differently. Students' engagement with ICT while learning science can be observed through their level of interest and attitudes. Hasni and Potvin (2015) conducted a study of 1882 students

from grades 5 through 11 (seven grade levels) to investigate students' interest in science and technology; they revealed that the most noticeable differences were among elementary students (more of whom expressed high interest) and secondary students (fewer of whom expressed high interest). For most of the items, positive responses decreased as the grade level increased.

Moreover, studies by Ardies, De Maeyer, Gijbels, & van Keulen (2015) using the Pupil's Attitude toward Technology (PATT) instrument with a large number of students (N=2973) aged 12–14 (Grades 1 and 2 of secondary school in Flanders) showed that students in first grade had a significantly higher interest in technology than students in second grade. Overall, second graders were less positive and less interested in technology than first graders. A Turkish study of students' and teachers' attitudes towards the use of an interactive whiteboard in elementary and secondary schools was based on grade level and gender. The results show that students' positive attitudes toward technology decreased as they get older (Balta & Duran, 2015).

Students' attitudes towards integrating ICT in science learning is found to be likely to decline from the younger grade levels to older grades (grade 1 to grade 6) (Knezek, Christensen, Tyler-Wood, & Periathiruvadi, 2013). Barmby, Kind, and Jones (2008) reviewed the correlation between age and attitudes towards science and technology. They concluded that there was a consensus regarding the steady decline in students' attitudes towards science over time, particularly in secondary education. Past studies illustrate similar results (Knezek, Miyashita, & Sakamoto, 1995; Christensen, 2002).

*Therefore, this study seeks to assess whether grade level influences any major differences in student attitudes towards ICT and whether attitudes improve with the integration of ICT in science.*

*b) Students' Knowledge and thinking skills*

Students' knowledge and skills in using ICT are important factors in the effective integration of ICT in the learning process. Therefore, cognitive and technical skills in the use of ICT are needed to improve learning outcomes and enrich knowledge; for instance, searching for databases, E-learning systems, writing up research and

preparing presentations. A successful student-centred approach requires students' awareness of how to use ICT to assist in their learning process (An & Reigeluth, 2011). Students' understanding of how to use ICT tools in learning enables them to present their opinions and ideas critically, solve problems, and search and share information. According to Flavell (2006), when students use technologies to seek information, they become reflective and critical about their sources, as well as finding answers to self-directed enquiries. For effective ICT integration in primary school, it is vital to educate primary schools students how to develop their knowledge and skills in the use of ICT. Young students who are open to new ideas show creativity, develop critical thinking, and are ready to absorb new information. Thus, it is important to introduce the available educational ICT tools and show students how they will benefit by using these tools and will improve their learning outcomes by enhancing their ICT knowledge and skills (Pierce & Andersson, 2016).

ICT-integrated science learning will provide students with new knowledge. In primary science education, students' knowledge can develop via the integration of new technologies (Grabe & Grabe, 2007). Technological tools can be used to enable students to collect science information and interact with resources such as images and videos (Gillespie, 2014). ICT can also help students develop their data interpretation skills and can make information more meaningful and clear (Newhouse, 2002; Newton & Rogers, 2003). In the literature, several studies reveal that ICT has great potential to promote the growth of students' knowledge (Bransford, 2000). Students will be supported in the development of new knowledge by use of ICT while learning (Bransford, 2000; Murphy, 2006; Newton & Rogers, 2003; Selwyn & Cooper, 2015). Several researchers have found that the use of ICT can help students to practice basic skills; for instance, the use of ICT in education helps students with decision-making, being constructive, critical thinking skills, self-directed learning, and communication processes. Other skills which may be promoted include exploration, presenting information, applying ideas, and evaluation (Albugami, 2016; Romeo, Lloyd, & Downes, 2012). According to Honey, Culp, and Carrigg (2000) and Hennessy, Ruthven, and Brindley (2005), the use of the majority of new technologies while learning science can promote several kinds of student skills, such as communication skills and understanding concepts. Further, using ICT

in learning science encourages students to be independent and effective decision makers (Lawrence & Tar, 2018).

Several studies have demonstrated that when teachers use ICT in science classrooms, students' roles in the learning process shift from passive to active (Balanskat, 2009; Gao & Hargis, 2010; Rogers & Twidle, 2013). Integrating ICT tools in classrooms can also improve the relationship between students and teachers, and enhance a student-centred approach (Selwyn & Cooper, 2015). In such approaches, students are encouraged to use critical thinking skills and work cooperatively to solve problems (Jaber & Moore, 1999). Based on the previous literature, attitudes to ICT and ICT knowledge have the potential to affect teachers' and students' perceptions about the integration of ICT in teaching and learning science in primary schools. Many studies have found that the successful integration of ICT depends on interlinking variables, such as teachers' knowledge and attitudes, adequacy of ICT infrastructure, the curriculum strategy, and the school management's attitude. This list of variables shows that ICT integration into a curriculum is complex (Akbaba-Altun, 2006; Hennessy, Ruthven, & Brindley, 2005; Webb, 2005). Students' knowledge and skills in using ICT tools can be determined by looking for the ability of students in primary schools to use ICT. Another benefit of ICT use is that the students can enjoy and engage with the learning process while doing the tasks (Diesburg, Feldhaus, Oswald, Boudreau, & Brown, 2018).

*Thus, this study aims to evaluate the impact of ICT integration on students' knowledge and thinking skills.*

*c) Teachers' attitudes towards ICT*

Just as students' attitudes affect ICT integration in the learning process, teachers' attitudes toward technology are an important factor in the successful implementation of ICT. Many studies confirm that effective integration of ICT is related to positive attitudes towards using ICT in classrooms (Lim & Khine , 2006; Imtiaz & Maarop, 2014; Bolandifar, Noordin, babashamsi, & Shakib, 2013; Teo, 2015). Teachers who have positive attitudes towards ICT can achieve more in the teaching and learning process (Simonson & Maushak, 1996). Effective integration of ICT in teaching and learning science makes students the focus of the educational process, using a student-centred approach rather than a teacher-centred one. Since 1989, researches in

the literature have mentioned the importance of measuring teachers' attitudes towards computers (Alahmari & Kyei-Blankson, 2016; Balta & Duran, 2015; BECTA, 2004; Davis, 1989); teachers' attitudes will affect the teaching and learning process either positively or negatively. A negative or neutral attitude hinders the effective use of ICT in the teaching and learning process (Alahmari & Kyei-Blankson, 2016; Albirini, 2006; BECTA, 2004; Buabeng-Andoh, 2012).

According to the British Educational Communications and Technology Agency BECTA (2004), the main factor affecting teachers' attitudes concerning ICT integration is their understanding of how ICT may improve the teaching and learning process. Similarly, Yurdakul and Coklar (2014) found that in integrating ICT into educational settings, teachers' beliefs influenced what they did in the classrooms; therefore, it is important to examine various teachers' attitudes towards successful integration of electronic tools.

Several studies have shown that teachers have positive attitudes towards integrating ICT in teaching and learning science but are hindered by other factors. A qualitative study was conducted in Malaysia to explore the attitudes of Malaysian teachers toward integrating internet technology; the study showed that Malaysian teachers had positive attitudes toward ICT usage generally, but that there were some barriers that meant they used ICT infrequently in their teaching. The common barriers hindering ICT integration were computer facilities, insufficient computer skills, lack of internet access, and lack of time in the classrooms (Bolandifar et al., 2013).

*This study aims to measure the attitudes of teachers towards ICT using a mixed method of quantitative and qualitative assessment. The significance of teachers' and students' attitudes to integrating ICT in science merits such an investigation.*

*d) Teachers' Knowledge*

Integration of ICT into pedagogic methods could help teachers to develop effective teaching and learning strategies in specific content subjects (Koehler & Mishra, 2009; Milman, 2011). Teachers' knowledge of how to use ICT can impact their effective use of ICT tools in their teaching. Knowledge competence is considered an essential factor for effective ICT integration by science teachers (Al-Harbi, 2014; Albirini, 2006). Several studies have revealed that the main negative influence on the

effective integration of ICT in teaching and learning is teachers' lack of knowledge relating to ICT (Balanskat, 2009; BECTA, 2004; Hew & Brush, 2007; Newhouse, 2010). There is a correlation between teachers' lack of knowledge of how to use ICT and the low use of ICT across the curriculum (Newhouse, 2010). Many teachers are unenthusiastic about the changes associated with bringing ICT into their classroom practices because they lack ICT knowledge. When they lack technical skills, teachers are likely to be anxious 'about possible technical problems, as they would have less of an understanding of how to avoid or solve such problems independently' (BECTA, 2004, p. 21).

In their study of teaching objectives, Gibbs and Krause (2006) argue that ICT integration will contribute to the teaching and learning of science. However, the integration of ICT into teaching and learning science may be less effective if it does not match the objectives of the curriculum. Before ICT activities are chosen, therefore, the aims, objectives and activities of science learning and teaching should be identified clearly in order to avoid ineffective integration. BECTA (2004) showed that even providing teachers with technological knowledge does not ensure that they will effectively integrate ICT into teaching and learning. In fact, teachers' knowledge of ICT is an essential factor in the integration of ICT into teaching and learning science. Therefore, it is vital for the education system to encourage teachers to regard ICT as an interesting and enjoyable tool that saves time and effort, by providing ICT tools, and offering training workshops to improve their knowledge and skills.

Pelgrum (2001) conducted a worldwide survey of nationally representative samples of schools from 26 countries to investigate indicators of ICT infrastructure in primary and lower secondary education, and found that lack of computers and lack of teachers' knowledge was a serious obstacle to the integration ICT in primary and secondary schools. Research in developing countries has illustrated that teachers' lack of technological knowledge is a major factor affecting their perceived and actual integration of ICT (Al-Oteawi, 2002). A study conducted in Ghana found that due to lack of access to the internet, to computers, and to technical support, teachers' knowledge and skills in using computers in the teaching process was weak (Natia & Al-hassan, 2015). Thus, lack of ICT knowledge and skills has been an important barrier to the integration of ICT into teaching and learning science (Al-Alwani &

Soomro, 2010; Almohaissin, 1993; Al Sulaimani, 2012). Similarly, in Syria, teachers' lack of ICT knowledge has been cited as the main barrier to ICT integration (Albirini, 2006).

### *2.5.3 Teachers' self-efficacy regarding ICT integration*

By integrating ICT into their teaching strategies, teachers can promote student-cantered approaches, enrich problem solving skills, and promote higher order thinking skills. Several studies have confirmed that ICT integration is vital to achieving learning outcomes (Keengwe, Schnellert, & Mills, 2012; Minshew & Anderson, 2015). Nevertheless, the failure to provide appropriate ICT classroom tools and make stakeholders aware of effective ways of integrating ICT tools limits the outcomes of this integration (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2012). Some teachers who integrate ICT into the teaching process do not recognise how many functions they could use with devices such as interactive whiteboard, due to lack of time. A large number of teachers desire to use ICT tools during teaching, but some do not have enough self-efficacy to try out new technological tools. Thus, this study looks at the internal factors that hinder effective ICT integration — attitudes, self-efficacy, and perception of ICT integration (Kim, Kim, Lee, Spector, & DeMeester, 2013; Minshew & Anderson, 2015) (see Section 2.3).

Teachers' self-efficacy or sense of purpose and effectiveness is associated with completing the set tasks (Ferla, Valcke, & Cai, 2009; Robertson & Al-Zahrani, 2012). Self-efficacy refers to an individual's judgment of their ability to achieve certain outcomes. Bandura (1997) described self-efficacy as people's development of certain beliefs, related to their own capability to accomplish specific tasks. Teachers' self-efficacy can be affected by the mental effort they exert in developing their skills. ICT integration into the teaching of science motivates some teachers to achieve their best performance (Bransford, 2000; Grabe & Grabe, 2007; Murphy, 2006; Newton & Rogers, 2003; Robertson & Al-Zahrani, 2012). Moreover, positive self-efficacy in teachers leads to an improvement in their performance in teaching science, and to an improvement in students' learning outcomes. One of this study's aims is to investigate ICT integration into teaching science and its impact on teachers' self-efficacy, regarding enhancing teaching performance, and thus, students' learning outcomes (Jungert & Rosander, 2010; Robertson & Al-Zahrani, 2012).

A mixed method study conducted in Lebanon investigated the correlation between teachers' perceived self-efficacy with ICT usefulness, attitudes after training, and the student's science performance outcomes ( Kazan & ELDaou, 2016). Moreover, this study evaluated the impact of integrating ICT into the science learning process, the student's concentration, contributions, and the interaction between teacher and colleagues in the classroom. The results revealed that teacher's attitudes and self-efficacy in ICT use have important impacts on the students' marks and on communication with teachers and classmates. The results indicated that participants in one group of students who were trained were able to better define and apply technology in the science classroom. The findings of the study show that teachers determined to use ICT in the classroom can impact the outcomes with their knowledge and beliefs and that there is an important positive correlation between teacher's self-efficacy, knowledge, attitudes and students' science results ( Kazan & ELDaou, 2016)

Measuring the impact of ICT integration on improving learning outcomes is complex. Nevertheless, the investigation of effective ICT integration in the learning and teaching process needs to measure internal factors that improve or hinder this integration, such as individual perceptions of using ICT, attitudes towards ICT, and self-efficacy. Further, limited external factors that affect the teaching and learning process, such as the availability of ICT tools, technical support, and professional development (PD), will be reviewed in the following sections.

### 2.6 The External Factors

The external factors that could impact the productivity of ICT integration not only providing a classroom with ICT tools but also repair the damaged devices and offer continuous technical supports. Another related factor that helps to get the benefits out of those devices that get the knowledge how to use the prorate tools in the teaching process. Thus, there are two external factors in this study that could impact ICT integration in Saudi primary schools. Firstly: The availability of ICT tools and technical support (Section 2.6.1). Secondly: Professional development (PD) (Section 2.6.2).

### *2.6.1 The availability of ICT tools and technical support*

In order to succeed part of the aim in ICT integration process, one of the important factors is ICT tools (such as computer, smart whiteboard, projector, printer/scanner, and iPad), (Newhouse, 2010) argues that providing resources and ICT tools is the essential external factor in ICT integration in schools. Technical support is also a critical factor, regarding making help and support available when hardware and software problems occur within the system. Thus, teachers and students can be encouraged to use ICT if they have tools in the classroom that support teaching and learning. ICT integration will enable teachers and students to enjoy higher benefits (Pare & Raymond, 1991).

ICT tools improve student learning through the use of visual meaning-making in science; for instance, videos, pictures, animations, and digital microscopes are vehicles for illustration, thinking and argument skills. When teachers and students use and integrate ICT, these tools become effective in the teaching and learning process (Otrel-Cass, Cowie, & Khoo, 2011).

A case study from Nigeria aimed to determine the elements that can influence teachers' decisions to integrate ICT in the teaching and learning process (Lawrence & Tar, 2018). The researchers developed a model for the integration of ICT in teaching and learning by measuring the factors at play at the levels of teacher, technology, and institution. They found that a lack of ICT resources hinders teachers from integrating ICT in the teaching and learning process (Lawrence & Tar, 2018). A previous study showed that teachers' pedagogical use of ICT in teaching is determined by the availability of ICT resources in classrooms (Lawrence & Tar, 2018). This is supported by prior studies which found that the main hindrances to the effective ICT integration in schools is the availability of ICT tools (Pelgrum, 2001).

Several Saudi studies have shown that ICT is available in schools, and some researchers have focused on the technology used by primary, intermediate and secondary teachers. Most of these studies have revealed a low level of ICT usage and a lack of training in the field. For example, a previous Saudi study showed that Saudi Arabia was still in the early stages of integrating ICT into the classroom (Bingimlas, 2009). Almaghlouth (2008) found that the most common ICT tools available at secondary schools were digital projectors, TV monitors, overhead projectors,

printers, and DVD players. The purpose of using ICT in science classrooms may differ from teacher to teacher, but some tools have been found to be particularly popular. Oyaid (2009) found that ICT was often used to prepare lesson activities and provide information through multimedia — pictures, videos and sound. However, in intermediate schools, ICT was rarely used in science classrooms (Al Sulaimani, 2010). A study conducted in the city of Yanbu, Saudi Arabia showed that science teachers integrated ICT most frequently when planning lessons and creating instructional materials (Al-Alwani & Soomro, 2010).

Some studies have focused on the teachers' use of new technologies in intermediate or secondary science education (Al Sulaimani, 2010; Oyaid, 2009). Al-Showaye (2002) found that among Saudi teachers, integrating ICT is increasingly common in activities that take place in and out of the classroom, including lesson preparation. Conversely, Al Sulaimani (2010) found that there was little opportunity to integrate ICT into the science curriculum in intermediate schools. A similar study by Oyaid (2009) showed that that ICT was not easy to implement effectively in secondary schools.

Technical support is important for teachers who wish to integrate technology into their teaching process. Conversely, lack of technical support hinders teachers from integrating ICT in classrooms (Korte & Hüsing, 2006; Lawrence & Tar, 2018). ICT support in schools helps teachers to use the tools without wasting time trying to fixed technical issues (Alkahtani, 2017; Yilmaz, 2011).

### *2.6.2 Professional development (PD)*

An important factor in ensuring the production of active lessons is the professional development of teachers to increase their desire for teaching (Torff & Tirotta, 2010). Professional development can improve teachers' attitudes, skills, and enjoyment, thus raising the quality of teaching and learning (Merriam, Caffarella, & Baumgartner, 2012). In the twenty-first century, when new ICT tools are being introduced in classrooms, numerous workshops should be offered to teachers, to enrich their creativity and improve their teaching abilities (Alghamdi & Higgins, 2015). Indeed, training courses play a vital role in assisting teachers to be independent learners.

Provision of continuous workshops and training for teachers is one of the external

factors that play an important role in ICT integration in schools. In several studies with a similar context to this study, many teachers perceived the importance of training to help them learn new skills and get benefits form all the functions of the ICT tools available in the schools (Albugami, 2016; Alghamdi & Higgins, 2015; Oyaid, 2009). However, some teachers had difficulty with the training session times and locations. Another issue that negatively affects ICT integration in classrooms is that most teachers will not attend training outside of working hours in Saudi secondary schools (Albugami & Ahmed, 2015).

Throughout 2014, the Ministry of Education (MoE) in Saudi Arabia sought to identify the numbers of teachers and group them into their teaching subject areas, with a view to determining training needs and setting standards for quality control and performance in professional development (PD) programmes (Ministry of Education, 2014). However, almost all teachers had only participated in PD once during their service. Teachers need ongoing PD programs that are updated with new technology and new teaching and learning strategies to enable them to improve students' achievements.

A study conducted by AlShaya and Alhassan (2007) determined that Saudi science teachers need computer skills to integrate ICT into effective science learning and teaching. Moreover, Al Sulaimani (2010) argued that most of the training activities were provided after working hours, which may not suit female teachers. In a quantitative study to investigate how Saudi teachers in primary schools were trained to use Interactive White Board (IWB), (Alghamdi & Higgins, 2015) revealed that the lack of training for teachers caused them to depend on themselves or their colleagues to improve their capabilities and had a significant effect on their IWB skills. Thus, providing support from the school administration and providing teachers with training, both technical and pedagogical, is crucial for effective integration of IWBs in classrooms (Alghamdi & Higgins, 2015).

Implanting E-learning systems for teaching and learning in Saudi schools is ongoing. Several schools have piloted Classera, aiming to improve the teaching and learning process and assist the enrichment of knowledge and enhancement of communication between students, teachers, and parents. A recent study examines the advantages and disadvantages of the integration and use of Classera (Alahmari & Kyei-Blankson,

2016). This findings revealed that teachers achieve several advantages while using Classera: easing student learning, fast sharing of content, and encouraging colleague cooperation and teacher-parent communication. Nevertheless, several disadvantages hinder use of the system: lack of Internet access, lack of professional development for teachers, and lack of time for training (Alahmari & Kyei-Blankson, 2016). These issues need to be addressed to achieve the effective integration and implementation of Classera in all schools across Saudi Arabia.

### 2.7 Constructivism as a learning theory

Constructivism is one of the most important theories of modern learning and has its basis in the constructivist theories developed by several philosophers, including John Dewey, Jean Piaget, and Lev Vygotsky (Brandsford et al., 2000). Dewey first proposed the idea that teachers should work with students' current understanding, as well as the students' existing ideas and interests, and the notion of constructivism emerged from this suggested approach (Dewey, 1966). Jean Piaget developed a discovery-based constructivist theory, which asserted that educators should encourage students to be active learners, building knowledge that is meaningful to them, through discussion, interpretation, positing questions, constructing interpretive hypotheses, and scientific investigations, Students should adopt different perspectives rather than assuming passive roles (Piaget, 1977). The sociologist Lev Vygotsky added the social aspects of learning to constructivist learning theory, asserting that knowledge is constructed within the social environment (Vygotsky, 1978).

A constructivist perspective on learning emphasizes students' roles in constructing their own knowledge, applying their own previously acquired knowledge and prior experiences (Gunstone, 1995); that is, learners' experiences and social interactions play a key role in the learning process. Therefore, learning is an active, positive process, in which the learner learns new ideas based on previous knowledge and experience, by integrating new information into his or her existing knowledge, and modifying the new concepts and previous perspectives to comprehend the new experiences.

Several studies have asserted the importance of constructivist theory in science education and teaching process; for instance, Bransford et al., (2000) and Murphy

(2006) have emphasised the positive impact of constructivist theory on science education and information and communications technology (ICT) integration. Jonassen (1995) advocates that constructivist learning theory highlights the need for more student-centred learning activities. Teachers who are more likely to integrate ICT into their teaching prefer and do implement a student-centred learning approach (Wozney, Venkatesh, & Abrami, 2006).

ICT integration during the learning process could facilitate effective constructivism-informed primary science teaching by, for example, engaging students in effective critical thinking and communication skills using PowerPoint and interactive whiteboards (Murphy 2003). Therefore, the integration of ICT in the learning process through purposeful observation, interaction with presentations, images, texts, sounds, and videos could facilitate the effective construction of meaning on the part of the learner (Alabdulaziz & Higgins 2017). Hall and Higgins (2005) observed that ICT integration may also have a positive effect on student motivation: the powerful visuals and engaging conceptual presentation of the illustrated information may motivate students to interact with and respond to their teachers when they seek answers. Therefore, teachers should augment their teaching styles by integrating ICT tools and encouraging students to be autonomous learners: in this way, teachers should be motivators, facilitators, and constructors of knowledge. A study conducted by Yarden and Yarden (2011) summarised three approaches to constructivist teaching supported by ICT integration: first, the use of visualisation tools appeals to the cognitive basis of learning. Second, the promotion of meaningful learning within a multimedia environment relies on the role of the teacher and their use of animation in the classroom. Third, the development of animations for use in the classroom to promote effective implementation illustrates the importance of understanding the teacher's perspective.

A study conducted by Huang, Liaw, Henderson, Conrad, & McGreal (2018) concluded that two main factors - perceived interaction and perceived self-efficacy - affect the perceived ease of use, perceived usefulness, and learning motivation.. Furthermore, perceived usefulness may be affected by learning motivation. Therefore, there are three vital factors that affect students' intentions regarding the integration of ICT in the learning environment: perceived usefulness, learning motivation, and perceived ease of use.

Based on a constructivist theory that focuses on motivating learners with reference to real-life activities, Cheng and Tsai (2012) asserted that the efficacy of students' learning outcomes may be enhanced by students' application of their knowledge to activities performed in their daily lives and active interaction with the real world. According to Herrington & Oliver (2000) the integration of ICT in the classroom could offer an alternative to real-life learning environments. Therefore, constructivist learning environments may provide students with more effective learning experiences through the integration of ICT tools aimed at visualization, simulation, communication, and virtual reality (Lombardi, 2007; Huang, Liaw, Henderson, Conrad, & McGreal, 2018). A study conducted in Greece aimed to investigate integrated ICT tools (tablets) to teach students about the digestive, respiratory, and circulatory systems. The sample comprised 162 sixth--graders divided into three groups: the first group was taught using textbooks only. The second group applied a constructivist approach, to which the teachers contributed actively. The third group was taught using constructivist teaching methods and additionally integrated ICT tools (tablets) with applications that had augmented reality features. The findings indicated that the third group's performance surpassed those of the other two groups. Students' misconceptions differed significantly between the first and third groups only. Also, the results indicated that the participants' attitudes toward using technology were positive overall, were associated with enhanced motivation, and increased enjoyment, as well as improvements in the students' learning outcomes.

As discussed in the above paragraphs, there is considerable research that supports constructivist theory as an appropriate learning theory for this study. Science education in Saudi Arabia has recently been informed by constructivist theories, supported by the integration of ICT in the learning process (Albadi, Harkins, & O'Toole, 2018). The present study aims to investigate students' and teachers' perceptions of ICT use and evaluate their current experiences regarding the integration of ICT into science learning.

## 2.8 Summary of the Chapter

This chapter describes the current educational system in Saudi Arabia, and reviews the literature of some Saudi and international studies that focus on ICT integration in education. The education system in Saudi Arabia and ICT implementation in Saudi schools are explained to clarify the current level of ICT integration. The chapter then presents most extant studies investigate secondary or high school level. Therefore, this study aims to measure the impact of ICT integration in teaching and learning science in female primary schools. To determine whether ICT integration enhances the teaching and learning process, it is necessary to assess the factors that impact ICT integration. The present study focuses on several factors that can influence ICT integration. Internal factors reviewed are: benefits and concerns of ICT integration in teaching and learning; students' and teachers attitudes towards and knowledge of ICT; teachers' self-efficacy regarding ICT integration. External factors are: the availability of ICT tools; and professional development. In this chapter, the benefits of and concerns around ICT integration frame the debate on the impact of ICT integration in science. Several studies measure students' and teachers' attitudes toward ICT integration in science. Thus, some studies on the impact of attitude towards the effective use of ICT by students and teachers are reviewed. Studies that consider science teachers' self-efficacy and its impact on ICT integration and student learning outcomes are discussed.

Studies show that science is classified as a hard subject for most students, and students' engagement decreases as students become elder. Therefore, using constructivism as a learning theory in science teaching and learning can have a positive impact on students' learning outcomes. Constructivist theory play an essential role in learning science. Constructivist teachers encourage students to assess how the activity is helping them to understand. Students in the constructivist classroom ideally become expert learners. In a well-planned classroom that integrates ICT, students could motivate them to learn. Thus, encouraging constructivist teaching and learning classroom practices is one of the vital goals emphasised in improve science education in Saudi Arabia. Thus, the researcher discusses learning science through ICT, and the issues that impact on the extent and effectiveness of ICT integration in science.

# CHAPTER 3

## RESEARCH METHODOLOGY

### 3.1 Introduction

The aim of this study was to evaluate the perceived effectiveness of information and communication technology (ICT) integration in science classes in a sample of primary schools in Saudi Arabia. This research methodology chapter explains the mixed methods used to answer the research questions. The quantitative phase analysed responses to questionnaires, and the qualitative phase analysed the interviews. This chapter is divided into 11 sections to describe the methodology used in this study. Section 3.2 presents the research questions of the study. Section 3.3 explores the research paradigm chosen for the study. The procedure of the study is discussed in Section 3.4. Section 3.5 explains the quantitative data collection. Qualitative data collection is described in Section 3.6. Section 3.7 presents the results of the pilot study to measure the reliability and validity of the instruments of the study. Quantitative data and qualitative data are analysed in Section 3.8 and Section 3.9. Section 3.10 discusses the ethical considerations in this study. Section 3.11 summarises the chapter.

### 3.2 Research Questions

This study investigates students' and teachers' perceptions of the use of ICT in their science learning and teaching, in order to evaluate the impact of the ICT integration in science classes in primary school. The following research questions were explored:

*Research Question 1:* How do students perceive the extent of ICT integration in their science learning?

*Research Question 2:* Based on the results of Students' Attitudes Towards and Knowledge of Technology Questionnaire (SATK), are there any differences based on grade level or school type?

*Research Question 3:* How do teachers perceive the extent of ICT integration in their science teaching?

*Research Question 4:* What are the levels of interest, attitude, knowledge, and skills of science teachers in integrating ICT in teaching?

*Research Question 5:* How do science teachers perceive the effects of ICT integration on students' learning outcomes?

### 3.3 Research Design

This study used a mixed method research design. According to Creswell and Plano Clark (2008), mixed methods allow a researcher to collect, analyse and merge both quantitative and qualitative research methods to understand the identified research problem. An advantage of using a mixed methods approach to investigate the effect of integrated ICT in learning science in primary schools is that merging quantitative and qualitative research data enables a deeper understanding of the research questions . The greatest benefit of using a mixed methods design is that it can provide a deep understanding of practices, perspectives, and relations, and an accurate measurement of outcomes and attitudes (Lodico, Spaulding, & Voegtle, 2010, p. 282). Thus, through presenting statistical results, and describing interviews in depth, the researcher can consider the extent of effective integration of ICT in science education in Saudi primary schools.

The aim of triangulation in research design is to answer research questions by combining quantitative and qualitative data and integrating the interpretation. The researcher collects and analyses both sets of data separately in the same frame time. Then the results are compared for similarities or dissimilarities, and the triangulated data interpreted (Figure 3.1).

This triangulated mixed methods study aimed to evaluate the perceived effectiveness of integrating ICT in science teaching and learning in a sample of upper primary level schools in Saudi Arabia. Students' perceptions of using ICT in learning science was measured using the Students' Attitudes Towards and Knowledge of Technology Questionnaire (SATK) and the teachers' perceptions of using ICT was measured by using the Teachers' Attitudes Toward and Knowledge of Technology Questionnaire (TATK). In addition, teachers' self-efficacy were measured by using the Science Teaching Efficacy Beliefs Instrument (STEBI) instruments. The rationale for merging both quantitative and qualitative data were to investigate answers to the research questions through the triangulation of large statistical results and in-depth

individual perspectives. However, using a triangulated design had some limitations. Creswell (2008) points out that the researcher must learn both types of methods to use them in this design, and analyse each type of data in separate steps before integrating the results.

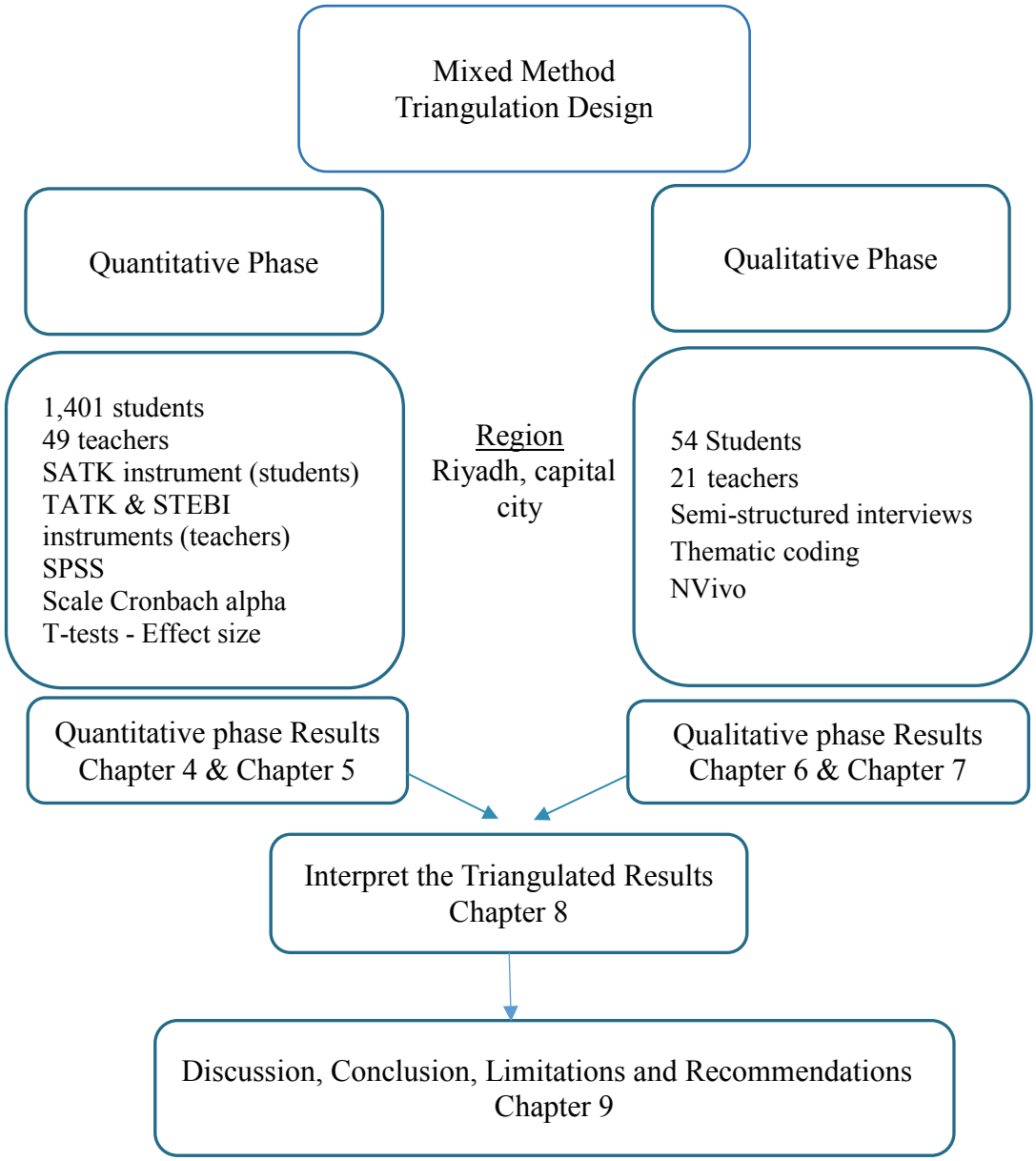


Figure 3.1 Triangulation design model

## 3.4 Research Procedure

### *3.4.1 Context*

Riyadh, the capital city of Saudi Arabia, is the region in which this study was conducted. The researcher chose Riyadh because most Saudi Arabian educational development programs are being implemented in this city to determine if they are relevant to students throughout the country.

This study was conducted in upper primary schools with a focus on fifth- and sixth-grade science students and their teachers from government and private schools in order to provide a diverse sample. The study was conducted in the city where the researcher had worked. While the sample was diverse, it was chosen with convenience not randomly. The researcher proposes that these are significant years for students because there are limited research projects published that have measured primary school students' attitude and knowledge towards ICT integration in science. The instruments used for this study are suitable for students from 11 years of age upwards. Furthermore, conducting research in primary schools in Saudi Arabia is more flexible in the upper primary levels. Moreover, the researcher was herself a sixth-grade teacher and is, therefore, familiar with the common characteristics of students and teachers at this grade level.

### *3.4.2 Participants*

The target population for this study included in-service female teachers and female students in primary schools in Riyadh, Saudi Arabia. The sample size in the study was 1,401 fifth- and sixth-grade students (fifth-grade = 679; sixth grade = 722) and 49 in-service science teachers from government and private schools (Government =9, Private =5) who completed the instruments. Fifty-four students (30 students from private school and 25 students from government schools; 31 from sixth-grade and 23 from fifth-grade) and 21 science teachers (12 teachers from private schools and 9 teachers from government schools) participated in interviews.

The major objective of the sampling was to achieve maximum responses concerning the targeted respondents' (science teachers and students) attitudes toward ICT in science teaching and learning, including their opinions on the effectiveness of integrating ICT in the learning and teaching of science subjects. For religious and

cultural reasons, all participants in the study were female. All interviews took place at the schools.

### *3.4.3 Instruments*

In this study, the data collection instruments consisted of questionnaires and qualitative, semi-structured interviews. There were two types of questionnaires: a student questionnaire and a teacher questionnaire. Further, the researcher interviewed some students and teachers to gain a deep understanding from participants' responses regarding their perceptions of using ICT effectively in science learning.

*a) Student Questionnaire - Students' Attitudes Toward and Knowledge of Technology Questionnaire*

This modified questionnaire elicited students' attitudes and knowledge concerning the effective integration of ICT when learning science in upper primary schools. Demographic variables were included in the questionnaire (type of school, ICT experience, and grade level) which contained 39 items and used a 5-point Likert scale. The items were modified them from the Students' Attitudes Toward and Knowledge of Technology Questionnaire (SATK) (see Appendix C) developed by Incantalupo, Treagust, and Koul (2014). Most of the scales in SATK were originally taken from the Pupil's Attitude toward Technology (PATT-USA) survey (Bame, Dugger, & de Vries 1993) and one was taken from the modified Technology-Rich Outcome-Focused Learning Environment Instrument (TROFELI) (Aldridge & Fraser, 2008). The questionnaire includes the following five scales: the student's interest in ICT, attitude towards ICT, knowledge related to ICT, learning with ICT, and ICT usage. Table 3.1 explain the instrument with five scales taken from SATK and TROFELI, items number and example for each scale.

Table 3.1 Description and Example of Items for Each Scale of the Students Questionnaire Modified Students' Attitudes Toward and Knowledge of Technology Questionnaire (SATK)

| Scale | No. of items | Description | Item examples |
|---|---|---|---|
| Interest in ICT | 8 | Extent to which students find ICT interesting. | -I would like to know more about ICT.<br>- I enjoy learning by using ICT. |
| Attitude towards ICT | 6 | Extent to which students find ICT relevant and useful | -You have to be smart to learn with ICT.<br>-Working with ICT would be boring. |
| Knowledge of ICT | 10 | Extent to which students have knowledge of ICT. | -I think science and technology are related.<br>- In everyday life, I have a lot to do with ICT. |
| Learning with ICT | 11 | Extent to which students are interested in, enjoy lessons with ICT. | -I am able to learn faster through the ICT classroom.<br>-I am motivated to learn by using ICT in science classroom. |
| ICT Usage (TROFLEI) | 7 | Extent to which students are using ICT in science learning. | -I use ICT to type my assignments.<br>-I use ICT to find out information about the course. |

*b) Teacher Questionnaires - Attitudes Toward and Knowledge of Technology Questionnaire and Science Teaching Efficacy Beliefs Instrument*

This questionnaire elicits science teachers' perceptions concerning the integration of ICT in teaching approaches. This is accomplished by measuring science teachers' attitudes towards effective ICT integration in teaching science at the upper primary school level, as well as by measuring the extent of science teachers' self-efficacy concerning ICT integration in their current teaching processes. Also, demographic variables are included in the questionnaire: type of school, age, years of teaching experience, and experience with ICT. The teacher questionnaire includes six scales and 65 items.

The first five scales were the teacher's Interest in ICT,Aattitude towards ICT, Knowledge related to ICT, Teaching with ICT, and ICT usage and comprised 41 items modified from SATK (see Appendix D). The goal was to measure teachers' attitudes, knowledge, and current use of ICT in teaching science. The sixth scale which contains 24 items adopted from the Science Teaching Efficacy Beliefs Instrument (STEBI) measures the extent of science teachers' perceived self-efficacy and outcome expectancy concerning ICT integration in their current teaching practices. The STEBI instument is divided into two scales with each scale having 12 items; the first sacle is Personal Science Teaching Efficacy Belief Scale (PSTE), the second scale is Science Teaching Outcome Expectancy Scale (STOE) (Riggs & Enochs, 1990).

Table 3.2 Description and Examples of Items for Each Scale of the Teacher Questionnaire Teachers' Attitudes toward and Knowledge of Technology Questionnaire (TATK) and Science Teaching Efficacy Beliefs Instrument (STEBI)

| Scale | No. of items | Description | Item examples |
|---|---|---|---|
| Interest in ICT | 8 | Extent to which science teachers find ICT interesting. | -I would like to know more about ICT.<br>- I enjoy teaching by using ICT. |
| Attitude towards ICT | 6 | Extent to which science teachers find ICT relevant and useful. | -You have to be smart to teach with ICT.<br>-Working with ICT would be boring. |
| Knowledge of ICT | 10 | Extent to which science teachers have knowledge of ICT. | -I think science and technology are related.<br>- In everyday life, I have a lot to do with ICT. |
| Teaching with ICT | 11 | Extent to which science teachers are interested in, enjoy teaching lessons with ICT. | -I am able to teach faster through the ICT classroom.<br>-I am motivated to teach by using ICT in science classroom. |
| ICT Usage (TROFLEI) | 7 | Extent to which science teachers are using ICT in science. | -I use ICT to prepare lesson note for students.<br>-I use ICT to find out information about the course. |
| Science Teaching Efficacy Beliefs Instrument (STEBI) | 24 | Extent to which science teachers' self-efficacy and outcome expectancy concerning using ICT. | -I am continually finding better ways to teach science with ICT integration. |

## 3.5 Quantitative Data Collection Procedures

In the current research study, as already discussed, the data were gathered through both quantitative and qualitative methods. Quantitative research requires collection of numerical data to describe a specific phenomenon, and is appropriate for certain types of questions, such as what, where, when, how often, and how long (Johnson, 2008). Quantitative research is suitable for measuring attitudes, comparing the performance of several groups, or using correlations to examine the relationships between variables (Creswell, 2008). One of the advantages of quantitative methods is that one can predict how people behave in the future by using statistics to extrapolate the data collected (Creswell, 2008). The quantitative method in the current study was used to measure students' and science teachers' attitudes concerning the effective integration of ICT in learning and teaching science subjects at upper primary school levels. In this study, all data were collected in the local language and Arabic script (See Section 3.8.2).

The questionnaires aimed to evaluate the attitude and knowledge of students and science teachers concerning the effective integration of ICT in their existing teaching and learning. Moreover, the data were used to measure science teachers' perceived self-efficacy concerning ICT integration in their current teaching processes. A further aim was to identify teachers' perceptions of the effects of ICT integration on student outcomes. Inferential analysis of the data from the questionnaires was used to relate students' and science teachers' perceptions concerning learning and teaching effectiveness with ICT.

### *3.5.1 Students' Questionnaire*

Students completed the questionnaire in their classrooms. This kind of method was new for the majority of students, because it was the first survey they had answered. Therefore, the researcher spent some time explaining the meaning of the survey and the goal of this study, and explained to the students that it was not an exam (because when they saw the papers, they thought it was an exam). The researcher explained that the survey "was all about your opinion, and even though it might differ from your friend's, there is no right or wrong." After that, it was briefly explained how they were to answer each question; for example, the first part was the general question, and the second was the Likert scale, and they had to choose one option.

After that, they started answering the survey; most classes spent 35 minutes to complete the questionnaire, depending on student numbers in each class, and whether there was an assistant teacher helping the researcher. Most of the students engaged well with the questionnaires, even though it was the first experience of a field survey for almost all of the students, and they were excited about the study and looking forward to more ICT integration in the future.

### *3.5.2 Teachers' Questionnaire*

Teachers completed the questionnaires in their free time and gave it to the researcher. Some teachers were interested in the study, wanting to improve the teaching process and students' achievements by using ICT in their practice. Other teachers said they that they had to use ICT, even though they were not interested in it, because it is one of their educational roles. Another group of teachers mentioned that they needed workshops and training on integrating ICT in science, such as how to use the interactive Smartboard, how to make their own website or blog, and that they needed guidance on new effective strategies for using ICT in science lessons.

## 3.6 Qualitative Data Collection Procedures

In this study, the qualitative research involved a small amount of data. The aim of using this approach was to provide and compare deeper information in order to obtain a clearer vision of the quantitative data. Qualitative research seeks the 'why' rather than the 'how' of a topic through the analysis of unstructured information in interview transcripts and recordings, and notes or various forms of feedback (Creswell, 2008). Qualitative analysis is a suitable method when flexibility is required for an in-depth study (Patton, 2002; Sarantakos, 2005).

The researcher used semi-structured interviews that contained primarily open-ended questions because these gave the participants a chance to expand their understanding and their point of view (Creswell, 2008). Furthermore, the interview content provided participants with the opportunity to respond and record their answers. Interviews were conducted in a face-to-face manner and recorded using a high-quality digital recorder with each of the participant's consent. Each interview was limited to a maximum of 30 minutes. From an ethical perspective, all targeted respondents were given a letter from the author elucidating the primary objectives of

the interviews and ensuring that their responses would be kept confidential by the researcher (see section 3.7).

Interviews were conducted after the participants had completed the questionnaires so that they had a clear idea about the study. There were two types of questions in the interview; the first type was similar to the questionnaires questions to make sure that they understood the meaning of the questions. The second type included questions asked to justify and explain their points of view and give suggestions and recommendations to improve ICT integration in science learning in their Saudi primary school. Interview time was up to 15 minutes for students and up to 30 minutes for teachers, depending on the participants' free time (see Table 3.3 students interview questions, Table 3.4 teachers interview questions, and Students' and Teachers' interview responses in Appendix M & N).

### *3.6.1 Students' interviews*

The researcher faced difficulties in conducting the interviews for several reasons. For instance, some schools' principals did not allow the researcher to take video recording with the students; they only allowed audio recording. Another challenge was to find time to interview some students. Some schools were very cooperative in allowing access to the students and provision of a quiet area for interviews. But some interviews had to be done in a noisy area and there was not much time to go over all the interview questions. In this situation, the researcher attempted to summarise the important questions to get as much information as possible about the participants' perceptions.

The majority of students were engaged and interested in integrating ICT in science, while some were aware of some concerns about using these technological devices frequently or for a long time. Few students were not interested in technology and felt it was boring. Some students liked using technology but their parents did not allow them to do so at home even though it was the part of the required school tasks.

Table 3.3 Students Interview Questions and brief Description for each Question

| | Students Interview Questions | Description |
|---|---|---|
| Q1 | Are you interested and enjoying integrating technology in learning? Why? | Understand general interest of ICT |
| Q2 | Do you use educational sites that explains Science lessons like Obeikan? | Determine ICT Usage |
| Q3 | How can make the integration of technology in Sciences interesting or enjoyable? | Explore perception of Interest of ICT |
| Q4 | What are the benefits of the integration of technology in learning sciences? Mention them. | Identify the benefits of ICT |
| Q5 | How can the integration of technology in sciences enhance your understanding of the subject? Give examples. | Understand influences of ICT in students understanding. |
| Q6 | Explain how do you use the technology to achieve tasks and homework? | Impacts of ICT |
| Q7 | What are the advantages and disadvantages of integrating ICT in learning science? | Identify the Impacts of ICT from positive and negative sides. |
| Q8 | How can you enhance your educational level through using technology in learning Science? | Understand influences of using ICT towards educational level. |
| Q9 | Does your teacher encourage you to use technology, how? | Determine teacher role of using ICT |
| Q10 | What is your suggestion on developing integrating technology in teaching Science? | Explore students' perceptions to improve ICT integration in primary schools. |

### *3.6.2 Student responses*

Fifty-four fifth and sixth grade students from government and private schools in Riyadh were involved in this study. The participating students were each asked ten interview questions. The original interview questions were in English, and translated into Arabic by the researcher. The participants responded in Arabic, and were back translated by the researcher to avoid ambiguity. The researcher then coded the interview answers and divided them into categories and sub-categories. Due to the small differences between students based on grade level and school type, the researcher prefer to analyse students' interviews as one group.

### *3.6.3 Teachers' interviews*

The teachers' interview was not an easy task in this project. First, it was difficult to find time to interview the teachers. Second, some of the teachers agreed and others did not agree with recording the interview; the latter answered the questions on paper. Third, it took time to find suitable times, and some teachers were only able to spare 10 minutes of the school's teaching time.

On the other hand, some of the teachers organised enough time to do the whole interview. Most teachers (19 out of 21) were interested in integrating ICT in science teaching, and they agreed that ICT had an effective role in improving students' learning outcomes. On the other hand, a few two teachers who did not agree that integrating ICT would help students to improve. Moreover, three teachers out of 21 teachers pointed out that some parents did not allow their children to use ICT while some families could not provide these technologies for their children.

Table 3.4 Teachers Interview Questions and brief Description for each Question

| | Teachers Interview Questions | Description |
|---|---|---|
| Q1 | Are you interested and enjoying integrating ICT into teaching? Why? | Understand general interest of ICT |
| Q2 | Do you use the online educational sites to explain science lessons easily? Give an example | Determine ICT Usage |
| Q3 | Explain the most effective devices in teaching Sciences for upper primary level students and give an example. | Determine ICT tools that used |
| Q4 | To which level using ICT in teaching Science improve the students to understand better? | Understand influences of ICT in students understanding. |
| Q5 | Explain how the use of ICT in teaching leads to improve students' learning outcomes. | Understand influences of using ICT towards students' learning outcomes. |
| Q6 | Do you use ICT with your student in the classroom or you use it only? | Determine ICT usage |
| Q7 | What are the devices you usually use in teaching Sciences for sixth or fifth grade? | Determine ICT tools that used |
| Q8 | How the school administration does encourage the teachers to integrate ICT with teaching? | Determine school administration role of ICT integration |
| Q9 | From your experience, what are the advantages and disadvantages of it? | Identify the impacts of ICT from positive and negative sides. |
| Q10 | How could using ICT in science classroom improve teacher's teaching, and teacher technical skills? | Determine the impact of ICT on teachers' skills. |
| Q11 | Is your students do their work by using ICT? How? | Explore ICT usage in the classroom. |
| Q12 | Is there a relation between the improvement of students' educational level and the teaching with ICT? | Understand influences of using ICT towards educational level. |
| Q13 | Is the integrating of the ICT in the teaching process has little influence on achievement of students with low motivation? | Determine the impact of ICT with students have low motivation. |
| Q14 | What's your suggestions to improve this process in Saudi Arabia? | Explore teachers' perceptions to improve ICT integration in primary schools. |

### *3.6.4 Teachers' responses*

In the current study, the 21 science teachers in government and private schools in the north sector of Riyadh who participated in this study had had differing periods of experience (three months to more than 30 years). They were each asked 14 interview questions. The English version of the interview questions was translated into Arabic by the researcher (see section 6.2)

## 3.7 Ethical Considerations

The researcher must observe certain ethical considerations to ensure that participants supply authentic responses in the study. Most people in Saudi Arabia are not familiar with social science research to the same degree as are inhabitants of Australia, European states, and the US. Therefore, before collecting the data, the researcher clearly informed the school principals about the goals and significance of the research. Each principal's permission was sought to gain access to the schools to collect data from students and teachers.

In this study, the participants were informed about the purposes of the research verbally and in writing. The written form appeared on a cover letter accompanying the questionnaire (see Appendices H, I, J, and K), and on the invitations requesting participation in the interviews. The letter, which was sent to the student participants and their parents, explained to the participants that their identity would be kept confidential and sought permission to record interviews. The letter also explained that participants were free to withdraw from the research at any time, and reminded individuals of the importance of answering questions honestly, in order to ensure the validity of the research findings. In this study, the researcher attempted to collect data electronically; otherwise the data were collected by using pen and paper questionnaires. However, only one school conducted the questionnaires online. The researcher shared the results with participants to engage them in the study and its outcomes. The researcher intends that the findings can play a significant role in improving ICT integration in learning and teaching science subjects at Saudi Arabian upper primary level schools.

## 3.8 Pilot Study

The main aim to conduct a pilot study for several reasons, firstly: achieved potential results with a small number of participants (Section-3.8.1). Secondly: validate the

questionnaires and ensure the Arabic version have the same original meanings (Section 3.8.2) and (Section 3.8.4). Thirdly: examine the reliabilities of all five scales that have reliable value (Section 3.8.3). The importance of conducting a pilot study for this project was ensuring that all respondents, especially primary school students and the majority of the percipients did not have experience with completing questionnaires, understood the questions in the questionnaire.

### *3.8.1 Sample size*

The sample size for the pilot study was 84 students from fifth and sixth grades. Also, the teachers' questionnaire was used with 19 science teachers in Riyadh. However, the sample size for the main study was much larger with 1,401 students from fifth and sixth grade and 54 science teachers in Riyadh the capital city of Saudi Arabia.

### *3.8.2 Instrument translation*

Questionnaires were translated from English to Arabic by the researcher, and two other Saudi experts, both science teachers, used the back-translation method in both languages. For further accuracy, the instruments were translated in a certified translation centre in Riyadh.

Questionnaires translation is an essential process in this study. The process began with the translation of the English statements into Arabic by the researcher. After this step, the researcher reviewed the Arabic version of the questionnaires several times to check the accuracy and avoid ambiguously.

"Back translation is a process aimed to assist the researcher to evaluate questionnaires accuracy of translation. The translated questionnaires, that is the Arabic- translated questionnaires, were then translated back into the language- English. The two versions of the questionnaires are then compared. Based on similarities and differences between the source version and the back translated version, the accuracy percentage about the quality of the translated version can be evaluated" (Harkness, Pennell, & Schoua-Glusberg, 2004 p. 468). According to Brislin (1970), the back translation procedure is highly recommended as it is a way to verify the translation of an instrument.

In this study, The Arabic translation then was sent to an English language teacher in Saudi Arabia, fluent in both languages, for back translation. Then, the researcher comparing two English version of the questionnaires to find out if there are

differences. As such, the back translation could confirm that the meaning of the Arabic language statements was equivalent to the English version. In fact, the researcher found several ambiguous and misunderstanding in the back translation version. In this stage, the questionnaires accuracy was 90%. Therefore, the researcher edited some questions to make sure they were as accurate as the source version questionnaire. For example, some words have different meanings in English such interesting and enjoyable, but in Arabic they have the same meaning. With changes, the questionnaires' accuracy improved to 98%. Clearly, translation and back translation is an essential process in this study to validate the questionnaires' accuracy.

### *3.8.3 Reliability of the Instruments*

Scale reliability refers to the consistency of measurement. While there are several ways to measure reliability, in this study, Cronbach's alpha coefficient was used to measure internal consistency. Cronbach's alpha uses correlations between every single item on the scale and every other item on the scale to generate an average (Santos, 1999). Using this method helps to determine how reliable any given item on the scale is compared to any other given item on the same scale. Furthermore, Bland and Altman (1997) recommends that the value of Cronbach's alpha must be 0.7 or more for each scale to be measured as reliable.

After analysing the data, mixed results were obtained for the instruments scale reliability; this could due to the small size of the sample or because of some translation issue. Thus, the pilot study step was essential in the current study, to verify the reliability of the instrument before conducting the whole sample of the study. The researcher checked instruments and revised scale reliabilities for both student and teacher samples. Three items had low reliabilities, two items after being translated were not given the same meaning as the original version, and one item had low reliabilities for both students and teachers. Therefore, the deletion of three items from 3 scales (item 2.3, item 3.2, and item 4.11) was deemed to improve consistency and scale reliabilities of the instruments (see Table 3.7 and Table 3.8). Table 3.5 describes the alpha reliability for the five scales of the SATK questionnaires for the pilot students' sample, and Table 3.6 describes the alpha reliability for five scales of the TATK questionnaires of the pilot teachers' sample.

The justification for the deletion of item 2.3 -You can teach with ICT only when you are good at both mathematics and science - was to improve the scale reliabilities for both student and teacher samples. Moreover, the reason for the deletion of item 3.2 - In ICT, you can think up new things -was because after being translated the statement was not given the same meaning as the original version. Also, the justification of deletion item 4.11 -Using ICT in science improve my performance – was because the statements for items 4.10 and 4.11 had very similar meaning in the translated version which could confuse the participants. See Appendix A for the first version of the student and teacher questionnaires.

Table 3.5 Descriptive Statistics and Internal Consistency (Cronbach's alpha Reliability) for Five Scales of the SATK Questionnaires for the Pilot Students' Sample

| Scale | No. of items | Mean | SD | Alpha reliability |
|---|---|---|---|---|
| Interest in ICT | 8 | 4.14 | 0.49 | 0.57 |
| Attitude toward ICT | 6 | 3.57 | 0.67 | 0.52 |
| Knowledge of ICT | 10 | 4.14 | 0.54 | 0.75 |
| Learning with ICT | 11 | 4.26 | 0.56 | 0.80 |
| ICT Usage | 7 | 3.73 | 0.79 | 0.74 |

Table 3.6 Descriptive Statistics and Internal Consistency (Cronbach's alpha Reliability) for Five Scales of the TATK Questionnaires of Pilot Teachers' Sample

| Scale | No. of items | Mean | SD | Alpha reliability |
|---|---|---|---|---|
| Interest in ICT | 8 | 4.29 | 0.45 | 0.66 |
| Attitude toward ICT | 6 | 3.47 | 0.53 | 0.16 |
| Knowledge of ICT | 10 | 4.27 | 0.31 | 0.23 |
| Teaching with ICT | 11 | 4.42 | 0.43 | 0.67 |
| ICT Usage | 7 | 4.09 | 0.61 | 0.72 |

As shown in Table 3.7 the alpha reliability for the five scales of the SATK questionnaires are for the edited version of pilot students' sample, and Table 3.8 describes the alpha reliability for five scales of the TATK questionnaires for the edited version of pilot teachers' sample. The researcher made the changes in both Arabic and English versions of the questionnaires for both students and teachers to be ready to the whole sample size (see Appendix B).

Table 3.7 Descriptive Statistics and Internal Consistency (Cronbach's alpha Reliability) for Five Scales of the SATK Questionnaires for the Edit version of Pilot Students' Sample

| Scale | No. of items | Mean | SD | Alpha reliability |
|---|---|---|---|---|
| Interest in ICT | 8 | 4.14 | 0.49 | 0.57 |
| Attitude toward ICT | 5(Q2.3 deleted) | 3.12 | 0.85 | 0.72 |
| Knowledge of ICT | 9(Q2.3 deleted) | 4.14 | 0.57 | 0.73 |
| Learning with ICT | 10(Q4.11 deleted) | 4.32 | 0.56 | 0.78 |
| ICT Usage | 7 | 3.73 | 0.79 | 0.74 |

Table 3.8 Descriptive Statistics and Internal Consistency (Cronbach's alpha Reliability) for Five Scales of the TATK Questionnaires for the Edit version of Pilot Teachers' Sample

| Scale | No. of items | Mean | SD | Alpha reliability |
|---|---|---|---|---|
| Interest in ICT | 8 | 4.29 | .45 | 0.66 |
| Attitude toward ICT | 5(Q2.3 deleted) | 3.58 | .68 | 0.60 |
| Knowledge of ICT | 9(Q2.3 deleted) | 4.07 | .31 | 0.48 |
| Teaching with ICT | 10(Q4.11 deleted) | 4.42 | .43 | 0.78 |
| ICT Usage | 7 | 4.09 | .61 | 0.72 |

### *3.8.4 Validity of the Instruments*

The degree to which a concept is accurately measured by the instruments is called validity (Heale & Twycross, 2015). There are several types of tests for validity: consequential validity, criterion-related validity, construct validity, and content validity. Content validity focuses on whether the instrument accurately measures all aspects that it should with respect to the variable (Ary, Jacobs, Irvine, & Walker, 2018; Heale & Twycross, 2015). In this study, the researcher tested content validity in the pilot study by sharing the instruments with four experts in Saudi to examine items for use in grades 5 and 6, and for use with science teachers. The experts were asked to edit the instruments and provide comments to the researcher regarding the content of the instruments. The experts' feedback was important to ensure that the instruments were clear and to avoid any repetition or ambiguity.

### 3.9 Quantitative Data Analysis

For the data analysis phase, a significant part of the study, all raw quantitative data were gathered and transformed into relevant information using processes and statistical techniques that are appropriate for identifying answers to the research questions.

In this research, all quantitative data were analysed using SPSS (Creswell, 2012). Both descriptive and inferential statistical results were achieved by calculating frequencies and percentages of closed-ended questions in the questionnaires. Descriptive statistics were computed the percentage to identify the background characteristics of the respondents for students' participants calculated the number and the percentage for the whole sample and based on grade level and school type is used. However, teachers' participants' descriptive statistics represent the number and the percentage of teachers based type of school, ICT skills level, where ICT is used, teaching experience, age, level of education. The inferential statistical results, based on the data analyses of the mean and standard deviations included t-tests and effect size analyses. Effect sizes are used to examine the practical differences for each scale in the questionnaire. According to Cohen, 1988, effect size value is small when d = 0.2, medium when d = 0.5, and large when d = 0.8. The analysis to examine the differences between students' perceptions of ICT integration was based on two variables - grade level, school type - while, measurement of teachers' perceptions of ICT integration in science teaching was based on one variable—school type. The researcher could not compare perceptions according to grade level between teachers and between teachers and students because most teachers who participated in the study taught both fifth and sixth grades. The researcher made a request for a teacher to calls several students without determine wither students excellent in science or not from fifth and sixth grades. The researcher decided that if there were small differences between results, the qualitative data would be analysed as one group.

### 3.10 Qualitative Data Analyses

In this study, the qualitative data from the semi-structured interviews were analysed using thematic coding, with pattern codes to identify the information from the participants' perceptions of ICT integration in their science education in primary schools in Saudi Arabia. All interviewing sessions and transcriptions produced by

the researcher enabled greater familiarity with the data. Thematic coding included selective parts of the text which have the same idea (Gibbs, 2007). In other words, it is a simple way to classify data from the research.

The researcher tried to build findings based on similar themes from the data. All the interview sessions and transcriptions produced by the researcher enabled greater familiarity with the data. The aim from the qualitative phase of the data analysis was to gain a better understanding of the participants' perspectives and points of views based on their experiences, which could help the researcher provide in-depth information that supported the study's findings (Creswell, 2008). Before analysing interviews responses, all interviews transcripts were in the Arabic language and the translation of the the responses to English was made by a certified translation center in Riyadh. The reseacher read the transcripts several times to determine the similarity and interesting points and identified the codes that created sub themes and the main themes. The trustworthiness of this type of analysis in terms of reliability and validity was checked by the researcher.

### *3.10.1 Data Coding*

In this study, the researcher started coding the participants' responses manually to identify the relationship among codes and the frequency of the codes, points grouping the codes. After that, sub-themes that emerged were identified, follows by the major themes. The researcher coloured the codes based on the similarity of the answers. However, due to the large number of the participants—75 (54 students and 21 teachers), the researcher decided to use NVivo software to organise the data (Houghton, Murphy, Meehan, Thomas, Brooker, and Casey, 2017). First, the data were imported to create two NVivo files; one file for students' and teachers' data. Second, the data were analysed by organising the codes according to nodes; Table 3.9 explains NVivo's organisation of codes, themes, and sub-themes while generating the data. In this stage, the researcher created the nodes, parent nodes and child nodes based on the manual method, and more nodes emerged while using NVivo (Hutchison, Johnston, & Breckon, 2010), because aid to validate and compare between participants electronically rather than by manual data analysis. Third, the findings were organised visually; the data were explored by creating a hierarchy chart that represented more coding for the largest area for that node.

Finally, the findings were exported from the software and reported, based on the hierarchy chart.

Table 3.9 Representation of codes, themes, and sub themes in NVivo

| Analysis of data with NVivo | |
|---|---|
| Codes | Nodes |
| Themes or categories | Parent nodes |
| Sub themes or sub-categories | Child nodes |

*Student sample coding*

In this study, to code each participant of the student sample and figure whether she from which she had an number of the whole sample; grade level (5 or 6), school type (government or private), school name, and the number of the participant in her school.

For example (Figure 3.2):

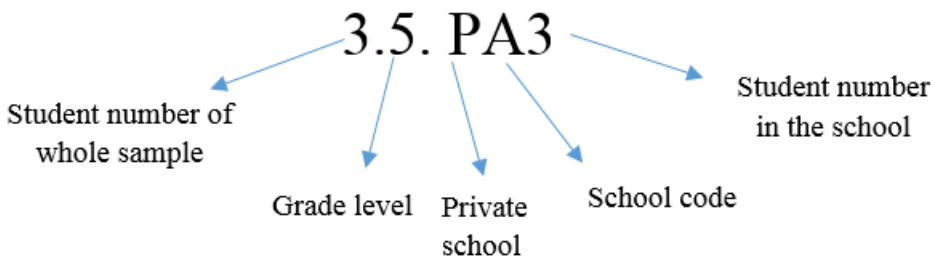


Figure 3.2 Example of sample student coding

*Teacher sample coding*

Similar method that used to code student sample, teacher sample coded by wrote the teacher number of whole sample, school type (government or private), school name, and the number of the teacher on her school (Figure 3.3).

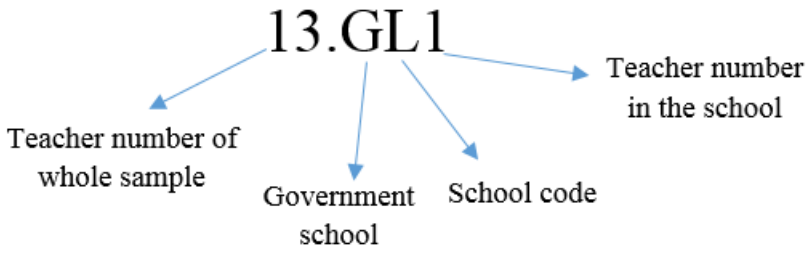


Figure 3.3 Example of sample teacher coding

### *3.10.2 Analysing Students' Interviews*

Students' interview responses were an important source for answering Research Questions 1 and 2. The aim of the students' interviews was to provide a deeper understanding of students' perceptions of integrating ICT in their science lessons. Researcher used NVivo to organised students responses and verify the manual analysis process. Thus, run queries by created word cloud and explore nodes by created hierarchy chart. As shown in Figure 3.4 shows the word cloud for the students' results, the largest font represent the most repeated words. However, as shown in Figure 3.5 hierarchy chart that illustrates the main themes, sub-themes, and codes, the bigger box means that more responses at this box (Figure 3.5). Thus, using NVivo to analyse the data could be a tool to validate the manual analysis.

The researcher divided students' responses into four major themes, and each theme had sub-themes. As shown in Table 3.10 presents the student's themes and sub-themes, starting with the most coded theme. The first theme, ICT Integration, had four sub-themes: *Teacher's role, Enhancing learning outcomes, Applications, Students' usage of ICT, and Availability of ICT.* Each of the sub-themes had secondary sub-themes emerging from similarly coded data. The second theme was Benefits of ICT Integration; this theme involved four secondary sub-themes: *Ease of use, Understanding, Interest level, and Knowledge.* Also, each sub-theme of the

benefit theme had several secondary sub-themes created from the students' responses. From the Disadvantages theme emerged four sub-themes: *Wasting time, Health issues, Lack of clarity, and Technical issues.* Students suggested improving ICT integration in the science learning process. Therefore the Suggestions theme had four sub-themes: *Devices, Educational activities, Time, and Co-teaching.*

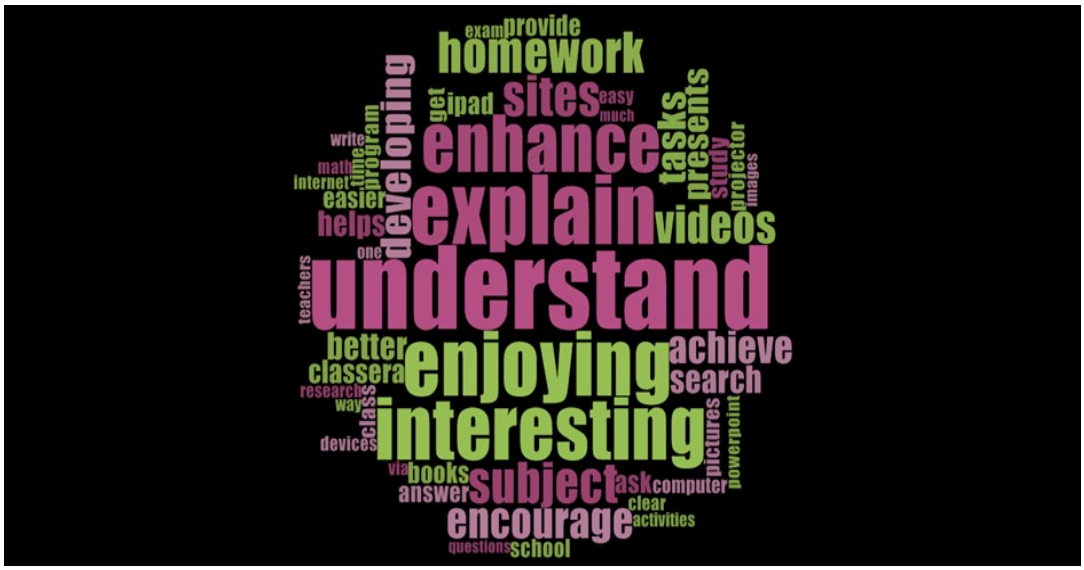


Figure 3.4 Word cloud represents the most common words based on students' interviews results

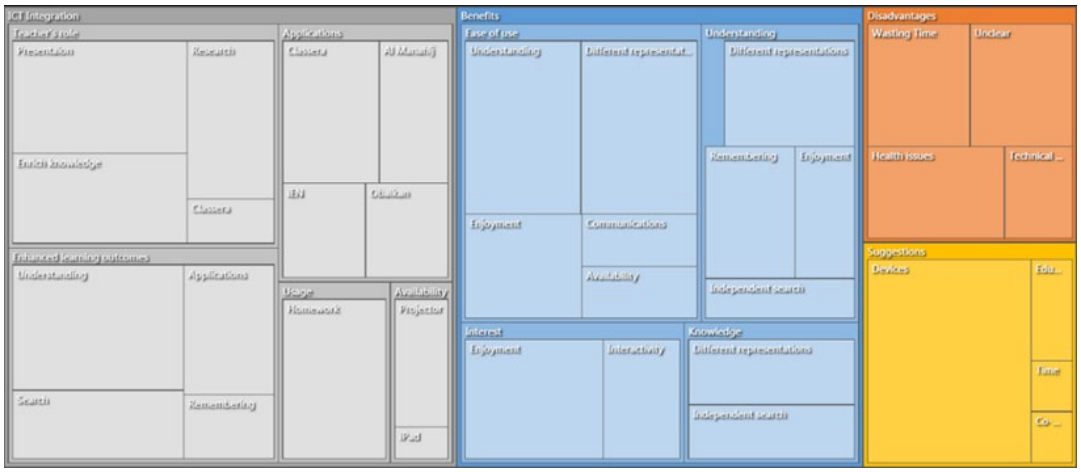


Figure 3.5 Hierarchy chart represents the main themes, subthemes, and nodes of students' responses on interviews based on NVivo software

Table 3.10 Themes based on analysing of students' interviews

| Themes or categories | Sub-themes or sub-categories |
|---|---|
| ICT Integration | *Teacher's role* |
| | *Enhance learning outcomes* |
| | *Applications* |
| | *Students' usage of ICT* |
| | *Availability in schools* |
| Benefits | *Ease of use* |
| | *Understanding* |
| | *Interest level* |
| | *Knowledge* |
| Disadvantages | *Wasting time* |
| | *Health issues* |
| | *Lack of clarity* |
| | *Technical issues* |
| Suggestions | *Devices* |
| | *Educational activities* |
| | *Time* |
| | *Co-teaching* |

### *3.10.3 Analysing of Teachers' Interviews*

In this study, teachers' interview responses had a vital role in answering Research Questions 3 and 5, and supporting Research Question 4 as well (see Sections 8.4, 8.5, and 8.6). The researcher aim conducted semi-structured interviews to gain more detailed information about the current experience of the impact of ICT integration in the science teaching process. The researcher analysed the interview responses by using the coding thematic method, which organised the responses into codes, then organised the codes into sub-themes and secondary sub-themes in some cases, and finally the major themes. The researcher used NVivo software to verify the theme organisation regarding the themes most responded to. Figure 3.6 shows the most common words based on the teachers' responses; Figure 3.7 illustrates the hierarchy chart for teachers' responses the larger spaces indicating the most responses. Thus, all themes illustrated in Table 3.11 are based on teachers' results.

The teacher interview responses were analysed into four major themes: ICT Integration, Benefits of ICT Integration, Disadvantages in using ICT, and Teachers' suggestions (see Sections 7.2.1, 7.2.2, 7.2.3, and 7.2.4). The first theme was ICT integration six sub-categories created under the ICT integration theme: *students' learning outcomes, improving the teaching process, schools' role, teachers' usage of ICT, students' usages of ICT, and applications* (see Section 7.2.1). The second theme was the Benefits of ICT Integration, including three sub-categories: *ease of use, enjoyment, and understanding* (see Section 7.2.2). The third theme was Disadvantages in using ICT; considering the issues that hinder the effective use of ICT is vital to improving ICT integration in the future (Figure 3.7). The final theme was Teachers' suggestions; the most common suggestions were providing more devices and continuous professional development workshops, plus offering a variety of different representations (see Section 7.2.4).

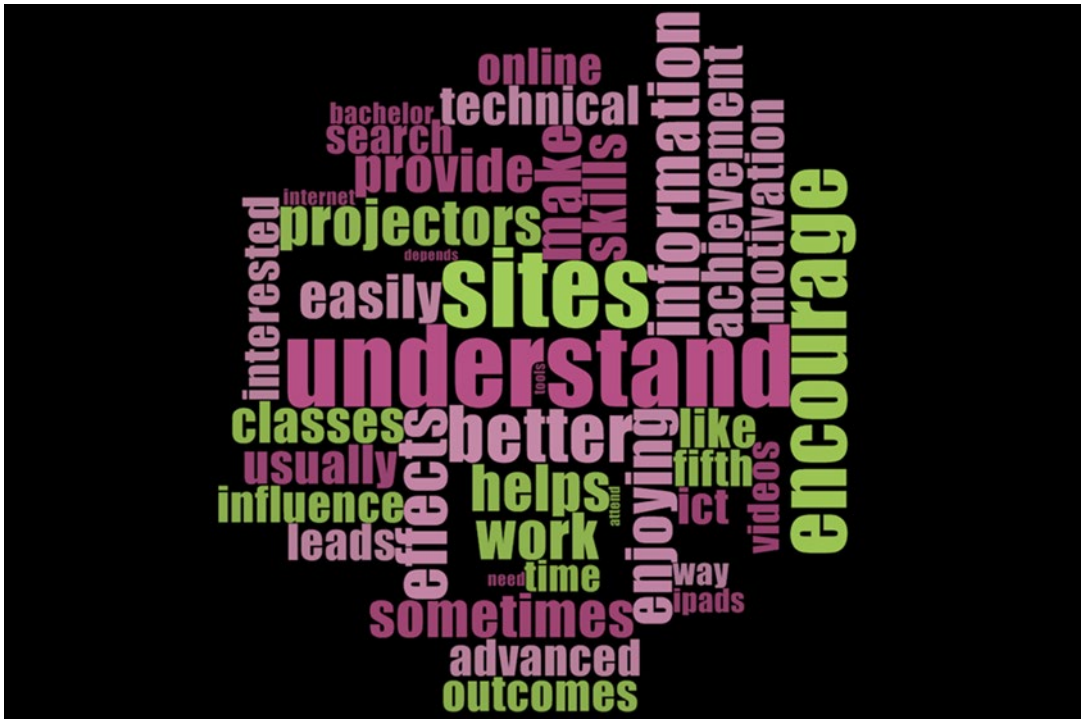


Figure 3.6 Word cloud represents the most common words based on teachers' interviews results


Figure 3.7 Hierarchy chart represent the main themes, sub-themes, and nodes of teachers' responses to interviews based on NVivo software

Table 3.11 Themes based on analysing teachers' interviews

| Themes or categories | Sub-themes or sub-categories |
|---|---|
| ICT Integration | *Students' learning outcomes* |
| | *Improved teaching skills* |
| | *School's role* |
| | *Teachers' usage of ICT* |
| | *Students' usage of ICT* |
| | *Applications* |
| Benefits | *Ease of use* |
| | *Enjoyment* |
| | *Understanding* |
| Disadvantages | *Time* |
| | *Lack of clarity* |
| | *Technical issues* |
| Suggestions | *Devices* |
| | *Continuous professional development* |
| | *Different representations* |

### 3.11 Summary of the Chapter

This chapter explained the methodology used in the research to evaluate the perceived effectiveness of ICT integration in science at upper primary level schools in Saudi Arabia. Participants' perceptions of using ICT in learning science were measured using SATK and TATK and teachers' self-efficacy. The rationale for merging both quantitative and qualitative data were to investigate clear vision for research questions through presenting statistical results, and describing interviews in depth, could consider. The participants in this study were female only, teachers and students from primary schools in the north sector in Riyadh. The sample size in the quantitative phase was 1,401 fifth- and sixth-grade students and 49 in-service science teachers. Qualitative phase sample sizes were Fifty-four students and 21 science teachers. Both phases of data collection were described in this chapter. Questionnaires were the data for quantitative phase, and semi-structure interviews were data for the qualitative phase. The pilot study, a vital step in validating the instruments, was explained regarding the process and its findings. The method used in data analysis in both phases was described in separate sections. T-tests and effect size were calculated to analyse the quantitative section. Manual thematic coding and validated analysis by using NVivo software to analysed qualitative section. The chapter concludes by describing how ethical concerns were addressed while conducting the research.

# CHAPTER 4

## QUANTITATIVE PHASE RESULTS (STUDENTS' DATA)

### 4.1 Introduction

This chapter presents the data analysis of the study that aims to answer the research questions by investigating a) students' perception of the extent of ICT integration in learning science, and b) the differences in students' attitudes towards ICT in science learning based on grade level. This study researched the perceptions of fifth and sixth grade students in government and private schools in the north sector of Riyadh, the capital city of Saudi Arabia, in terms of their interest, attitude, knowledge, learning, and usage of ICT in science learning. Descriptive statistics were used in reporting frequencies, means, standard deviation (SD), t values and significance values between the two grade levels for each of the scales in the Students' Attitudes Towards and Knowledge of Technology Questionnaire (SATK). The quantitative data in this study was analysed using the computer software program SPSS (Statistical Package for the Social Sciences) for Windows (Greasley, 2008). Section 4.1 presents the introduction of chapter 4; Section 4.2 describes a demographic description of the data, and Section 4.3 illustrates scale reliability. Section 4.4 presents quantitative data to answer the first research question, which aims to investigate students' perception of the use of ICT for their science learning. Section 4.5 addresses the second research question, and shows the differences between students' perceptions of interest, attitude, knowledge, learning, and usage of ICT based on grade level and school type differences. Section 4.6 presents the summary of the chapter.

### 4.2 Demographic Description

Demographics of the sample are presented before responding to the research questions. These data include the type of school, what level of skills was gained, where ICT is used, grade level, and the usage of ICT.

### *4.2.1 School type*

The number of the students in fifth and sixth grade who were voluntary participants in the study, as well as the different school types (government and private) are presented in Table 4.1. The total number of student participants in the study was 1,401 from government and private primary schools in Riyadh; 679 participants were in fifth grade and 722 were in sixth grade.

Table 4.1 Students by Type of school (*N*=1,401)

| School Type | Students | | Fifth Grade | | Sixth Grade | |
|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % |
| Government | 912 | 65.1 | 435 | 64.1 | 477 | 66.1 |
| Private | 489 | 34.9 | 244 | 35.9 | 245 | 33.9 |
| Total | 1,401* | 100 | 679 | 100 | 722 | 100 |

**N* = 1,401

### *4.2.2 ICT skill level*

In response to the questionnaire, the participants could choose their skill level as beginner, intermediate or advanced. The greatest number of student participants (51.9%) had a self-perceived advanced ICT skill level. The smallest number of participants (5.6%) had a self-perceived beginner ICT skill level. As shown in Table 4.2, fifth grade students had slightly more advanced self-perceived ICT skills (55.1%) than sixth grade students (48.9%).

Table 4.2 Student Participants: ICT Skill Level (*N*=1,401)

| ICT skill level | Students | | Fifth Grade | | Sixth Grade | |
|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % |
| Beginner | 78 | 5.6 | 49 | 7.2 | 29 | 4.0 |
| Intermediate | 577 | 41.2 | 247 | 36.4 | 330 | 45.7 |
| Advanced | 727 | 51.9 | 374 | 55.1 | 353 | 48.9 |
| Missing | 19 | 1.4 | 9 | 1.3 | 10 | 1.4 |
| Total | 1,401* | 100 | 679 | 100 | 722 | 100 |

**N*=1,401

### *4.2.3 Where ICT is used*

In response to the demographic question "Where do you use ICT?" the participants chose one of three categories: home, school or both (home and school). As shown in Table 4.3, the majority of students (1063 or 75.9%) use ICT both in school and at home. The lowest number of student participants (58 or 4.1%) use ICT in school only.

Table 4.3 Students Participants: Where ICT is Used (*N*=1,401)

| Where ICT is used | Students | | Fifth Grade | | Sixth Grade | |
|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | n | % |
| Home | 268 | 19.1 | 112 | 16.5 | 156 | 21.6 |
| School | 58 | 4.1 | 31 | 4.6 | 27 | 3.7 |
| Both | 1063 | 75.9 | 532 | 78.4 | 531 | 73.5 |
| Missing | 12 | 0.9 | 4 | 0.6 | 8 | 1.1 |
| Total | 1,401* | 100 | 679 | 100 | 722 | 100 |

* $N = 1,401$

## 4.3 Scale reliability

As discussed in section 3.8.1, three of the scales had acceptable reliability values greater than 0.70 (Cronbach, 1951).These three scales were Knowledge of ICT, Learning with ICT and Interest in ICT which had Cronbach's alpha coefficients of 0.79, 0.75 and 0.74, respectively. However, the Cronbach's alpha coefficients for the scales of Attitude towards ICT and ICT usage were slightly lower than the value of 0.70 at 0.66 and 0.68, respectively. Indeed, those reliabilities not high as researcher expected, but looking at item scale reliabilities, the removal of an item would not improve or change the reliabilities.

Table 4.4 Descriptive Statistics and Internal Consistency (Cronbach alpha reliability) for Five Scales of the Students' Attitudes Towards and Knowledge of Technology Questionnaire (*N*=1,401)

| Scale | No. of Items | Mean | SD | Cronbach's alpha coefficient |
|---|---|---|---|---|
| 1. Interest in ICT | 8 | 4.54 | 0.45 | 0.74 |
| 2. Attitude toward ICT | 5 | 4.61 | 0.52 | 0.66 |
| 3. Knowledge in ICT | 9 | 4.68 | 0.39 | 0.79 |
| 4. Learning with ICT | 10 | 4.62 | 0.40 | 0.75 |
| 5. ICT usage | 7 | 3.43 | 0.77 | 0.68 |

## 4.4 Research Question 1: How do students perceive the extent of ICT integration in their science learning?

In this section, the results are presented in Tables 4.5, 4.6, and 5.7 to answer Research Question1.

### *4.4.1 Availability of ICT in schools*

The majority of participants (> 80%) had used a data projector in the science classroom, had a computer in the classroom, or used a smart whiteboard. As shown in Table 4.5, sixth graders used data projector more than fifth graders; however, in other categories fifth graders used ICT tools more than sixth graders. A close look at the differences between fifth and sixth graders shows that the availability of computers in fifth grade classrooms is more than for sixth grade, by 9.8%.

Table 4.5 represents the distribution of the students' sample of ICT tools in schools. The ICT tools described in Table 4.5 are available in most primary schools in Riyadh. Some of these tools could assist students to learn science.

Table 4.5 Student Participants: Availability of ICT in Schools

| ICT tools at school | All Students | | Fifth Grade | | Sixth Grade | | Difference% 5th and 6th |
|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | |
| Computer (desktop or laptop) | 600 | 42.8 | 325 | 47.9 | 275 | 38.1 | +9.8% |
| Data projector | 1,144 | 81.7 | 550 | 81.0 | 594 | 82.3 | -1.3% |
| Smart whiteboard | 713 | 50.9 | 318 | 46.8 | 395 | 54.7 | -7.9% |
| Tablet/iPad | 124 | 8.9 | 72 | 10.6 | 52 | 7.2 | +3.4% |
| Printer/Scanner | 573 | 40.9 | 291 | 42.9 | 282 | 39.1 | +3.8% |
| TV/DVD player | 127 | 9.1 | 66 | 9.7 | 61 | 8.4 | +1.3% |
| Digital camera | 72 | 5.1 | 42 | 6.2 | 30 | 4.2 | +2% |
| Other | 4 | 0.3 | 4 | 0.6 | 0 | 0 | +0.6% |

### *4.4.2 Using ICT for learning science*

The objective of this set of questions was to investigate the uses of ICT in science learning through several programs and applications. These programs and applications included a word processing program, PowerPoint, email, a specialist science program, teacher website, school website or Instagram, Science and Mathematics gate called Obeikan, YouTube, Clasera, iEN, Al Manahj, and others (Hassen, Fahem, Duroosi, BBC, Nour, Noon Book, Mnhjy). Table 4.6 summarises the ICT programs and applications used for learning science, as recorded from the students' responses, and highlights the ICT programs and applications most frequently used by participants in science learning.

Table 4.6 Student Participants: ICT Programs & Apps in Learning Science

| ICT Programs & Apps | All Students | | Fifth Grade | | Sixth Grade | | Difference % 5th and 6th |
|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | |
| Word processing | 512 | 36.5 | 269 | 39.6 | 243 | 33.7 | +5.9% |
| PowerPoint | 637 | 45.5 | 325 | 47.9 | 312 | 43.2 | +4.7% |
| Email | 345 | 24.6 | 208 | 30.6 | 137 | 19.0 | +11.6% |
| Specialist science program | 286 | 20.4 | 184 | 27.1 | 102 | 14.1 | +13% |
| Your teacher website | 266 | 19.0 | 145 | 21.4 | 121 | 16.8 | +4.6% |
| School website or Instagram | 643 | 45.9 | 364 | 53.6 | 279 | 38.6 | +15% |
| Science and Math gate (Obeikan) | 351 | 25.1 | 197 | 29.0 | 154 | 21.3 | +7.7% |
| none of them | 49 | 3.5 | 18 | 2.7 | 31 | 4.3 | -1.6% |
| YouTube | 361 | 25.8 | 203 | 29.9 | 158 | 21.9 | +8% |
| Classera | 116 | 8.3 | 59 | 8.7 | 57 | 7.9 | +0.8% |
| iEN | 137 | 9.8 | 83 | 12.2 | 54 | 7.5 | +4.7% |
| Al Manahj | 70 | 5.0 | 37 | 5.4 | 33 | 4.6 | +0.8% |
| Other (Hassen, Fahem, Duroosi, BBC, Nour, Noon Book, Mnhjy) | 93 | 6.5 | 69 | 10 | 24 | 3.3 | +6.7% |

School website or Instagram. The turnout for students' participation depends on the roles the school played in education and what they offered for their students. Around 643 students use their school website or Instagram; the percentage of the difference between grades was +15% in favour of fifth grade. The gap between the two groups could be due to the younger students listening to their teacher's advice in using the school website or Instagram. Also, these tools help some parents connect with the school to follow up-to-date announcements, activities and, in some schools, a means to contact teachers and the school administration.

PowerPoint**.** Almost half of all participants in the study used PowerPoint in their learning process; 637 students (45.5% of the total) reported using PowerPoint, with the percentage difference between fifth grade and sixth grade students being +4.7% in favour of fifth grade.

Word processing**.** A word processing program was used for science learning by 512 students (36.5% of the total). Even though fifth grade students were younger than sixth grade students, they reported using word processing programs more than the sixth grade students, with a difference of +5.9%.

YouTube**.** A quarter of the sample reported using YouTube to learn science. Many explanatory videos and experiment clips are available on YouTube, which helps students to learn more and clarify misconceptions about topics. Consistent with the previous results, students in fifth grade used YouTube in science more than students in sixth grade, with a considerable difference of 8%.

Science and Mathematics gate (Obeikan education). A quarter (351 students) of the sample enjoyed using the Obeikan website while they studied or reviewed science. Fifth grade students again reported using more frequent users than sixth grade students, with a difference of +7.7%.

Email**.** Students' responses to ways of using email during the science learning process varied. Some students depend on email to communicate with their teachers and friends. Just 24.6% of the whole sample reported that they used email in their learning science process. However, there was a significant difference of +11.6% between the two groups in the study in favour of fifth grade students.

Specialist science program**.** The students who reported using the specialist science program were in fifth grade more than in sixth grade, with a variance of +11.6%.

Your teacher's website**.** Only 266 students use their teacher's website. Fifth grade students used their teacher's website more frequently that sixth grade while learning science; the percentage difference was +4.6%.

iEN**.** iEN is a new step in one of the Tatweer projects that encourage the integration of ICT in the learning process. Almost 10% of the student sample reported using iEN to learn science; however, 90% of students did not know of or use this opportunity effectively. As with all previous ICT programs and applications, the difference favoured the fifth grade by +4.7%.

### *4.4.3 Social Media Applications*

Students who responded to the study used social media applications in their daily lives. As shown in Table 4.7, Instagram and Snapchat were used by more than 900 students daily. Comparing the use of fifth grade and sixth grade students, for sixth grade participants, the most used social network was Instagram 538 (74.5%) and the difference proportion was (-9.7%); the second most used app was Snapchat. Therefore, the difference favours sixth grade students perhaps because they are more attracted to using ICT in social media than to using ICT in the learning process. That could be due to the start of the teenagers' years and seeking more social activities.

Table 4.7 Student Participants: Social Media

| Social Media | Students | | Fifth Grade | | Sixth Grade | | Difference % $5^{th}$ and $6^{th}$ |
|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | |
| Facebook | 165 | 11.0 | 78 | 11.5 | 87 | 12.0 | -0.5% |
| Twitter | 292 | 20.8 | 126 | 18.6 | 166 | 23.0 | -4.4% |
| Instagram | 978 | 69.8 | 440 | 64.8 | 538 | 74.5 | -9.7% |
| Snapchat | 922 | 65.8 | 434 | 63.9 | 488 | 67.6 | -3.7% |
| none of them | 128 | 9.1 | 67 | 9.9 | 61 | 8.4 | +1.5% |
| Other (WhatsApp) | 102 | 7.3 | 49 | 7.2 | 53 | 7.3 | -0.1% |

Participants' general responses about where they were using ICT programs and apps, and ICT tools while learning science were examined. More than 70% (75.9 %) of students reported using ICT at school and at home to learn science. This percentage could mean that students used several ICT programs and tools in combination during

their science studies. PowerPoint and word processing programs were the most students commonly reported using by students for science studies. The most commonly used ICT tools for learning science, based on participants' responses, were the computer, data projector, and smart whiteboard.

A comparison of fifth and sixth grade students and the extent to which they integrated ICT in science learning shows that fifth graders integrated ICT slightly more than sixth graders. However, participants in sixth grade used social media networks in their personal lives more than those in fifth grade.

## 4.5 Research Question 2: Based on the results of Students' Attitudes Towards and Knowledge of Technology Questionnaire (SATK)

### *a) Are there any differences based on grade level or school type? Grade level (fifth and sixth)*

Descriptive statistics for each of the scales of the SATK instrument are based on students' responses from both grades in the study. The aim of this analysis was to investigate whether there were statistically significant differences between the students' perceptions according to their grade levels for each scale; differences between means were measured by t-tests. As shown in Table 4.8, all scales of SATK had statistically significant differences in students' responses. The t-test results show that students from fifth grade had consistently higher means than sixth grade students on the SATK scales, and these differences were statistically significant ($p< 0.01$). The fifth grade mean for each scale was higher than the sixth grade mean; thus, students in fifth grade showed positive interest, attitude, knowledge, learning, and ICT usage in science learning than students in sixth grade did. The results were confirmed by computing an effect size to look at the practical differences for each scale in the survey. Accordingly, the results show that fifth grade students had higher scores on the Attitude and Knowledge scales than did sixth grade students. The Attitude scale and Knowledge scale had small effect size values (0.32, 0.31) which shows there were small but practical differences. These results revealed that there was a significant difference between fifth and sixth grade students' perceptions on integrating ICT in science learning. Students' interest in scales of ICT, learning with ICT, and ICT usage had a very small effect size. The breakdown of the means for each item comprising each scale for fifth and sixth grade students is presented in Appendix L.

Table 4.8 Item mean, item SD, and Sig (grade) differences in students' perceptions measured by SATK (modified)

| *Scale* | *No. of Items* | | *All students* | *5th* *n = 679* | *6th* *n = 722* | *t* | *Effect size* |
|---|---|---|---|---|---|---|---|
| *Interest in ICT* | 8 | Mean | 4.54 | 4.57 | 4.51 | 2.53* | 0.13 |
| | | SD | 0.45 | 0.46 | 0.44 | | |
| *Attitude towards ICT* | 5 | Mean | 4.61 | 4.69 | 4.53 | 5.52** | 0.31 |
| | | SD | 0.52 | 0.47 | 0.57 | | |
| *Knowledge of ICT* | 9 | Mean | 4.68 | 4.74 | 4.62 | 5.73** | 0.32 |
| | | SD | 0.39 | 0.33 | 0.43 | | |
| *Learning with ICT* | 10 | Mean | 4.62 | 4.68 | 4.56 | 5.81** | 0.21 |
| | | SD | 0.40 | 0.36 | 0.44 | | |
| *ICT usage* | 7 | Mean | 3.43 | 3.49 | 3.37 | 3.04** | 0.15 |
| | | SD | 0.77 | 0.78 | 0.76 | | |

***p < 0.01 *p < 0.05*

*Sample size N = 1,401 ($n_{fifth\ grade}$ = 679 and $n_{sixth\ grade}$ = 722)*

***b) School type (government and private)***

This analysis aims to examine whether there are any differences for each scale between students based on school type. The sample was collected from students attending either government or private schools. Therefore, Table 4.9 describes the statistical results for each of the SATK scales for students' responses from each school type. The differences between the means were measured by t-tests. Based on the SATK measurements, all scales had statistically significant differences in the students' responses with students from government schools had better means than students from private schools on all SATK scales. These differences were statistically significant ($p < 0.01$) for all five scales. Students in government schools also had better perceptions of ICT than did students in private schools. The effect size for each scale was determined to confirm the results.

Table 4.9 Item mean, item SD, and Sig (school type) differences in students' perceptions measured by the SATK (modified)

| *Scale* | *No. of Items* | *All Students* | | *Government School* n = *912* | *Private School* n = *489* | *t* | *Effect Size* |
|---|---|---|---|---|---|---|---|
| *Interest in ICT* | 8 | Mean | 4.54 | 4.61 | 4.41 | 8.07** | 0.44 |
| | | SD | 0.45 | 0.39 | 0.52 | | |
| *Attitude towards ICT* | 5 | Mean | 4.61 | 4.68 | 4.48 | 6.90** | 0.38 |
| | | SD | 0.52 | 0.46 | 0.61 | | |
| *Knowledge of ICT* | 9 | Mean | 4.68 | 4.74 | 4.56 | 8.60** | 0.46 |
| | | SD | 0.39 | 0.31 | 0.47 | | |
| *Learning with ICT* | 10 | Mean | 4.62 | 4.64 | 4.56 | 3.35** | 0.20 |
| | | SD | 0.40 | 0.35 | 0.48 | | |
| *ICT usage* | 7 | Mean | 3.43 | 3.48 | 3.32 | 3.86** | 0.20 |
| | | SD | 0.77 | 0.76 | 0.77 | | |

*Sample size N = 1,401 ($n_{Government\ school}$ = 912 and $n_{Private\ school}$ = 489)*
***p < 0.01 *p < 0.05*

Overall, the results show that students in government schools have better knowledge, attitude, and interest regarding ICT than students in private schools. Focusing on

effect sizes enabled an analysis of the practical differences, with the Knowledge, Attitude, and Interest scales having small effect sizes (0.46, 0.44, and 0.38, respectively). These results revealed that there was a difference between students in government schools and students in private schools regarding their perceptions on integrating ICT in science learning. However, the other two scales, learning with ICT and ICT usage, had the same effect size (0.20).

**A. Government Schools (Grade Level)**

Table 4.10 presents the extent of the differences between fifth and sixth graders at the same school type (government schools). All five SATK scales showed that fifth graders had higher means than sixth graders. The t-test results showed significant differences between students in fifth grade and students in sixth grade in government schools for all scales. Investigating the effect size value for all five scales to find the practical differences between fifth and sixth graders at the same school type showed that the Knowledge, Attitude, and Learning scales had small values (0.39, 0.38, and 0.38, respectively), thus confirming the differences between students based on grade level at government schools. The practical differences in the Interest and ICT usage scales were the lowest (0.26 and 0.18, respectively).

Table 4.10 Item mean, item SD, and Significance for grade 5 and 6 students' perceptions in government schools measured by the SATK (modified)

| *Scale* | *No. of Items* | | *Fifth Grade* $n = 435$ | *Sixth Grade* $n = 477$ | *t* | *Effect Size* |
|---|---|---|---|---|---|---|
| *Interest in ICT* | 8 | Mean | 4.66 | 4.56 | 3.65** | 0.26 |
| | | SD | 0.38 | 0.39 | | |
| *Attitude towards ICT* | 5 | Mean | 4.77 | 4.60 | 5.57** | 0.38 |
| | | SD | 0.39 | 0.50 | | |
| *Knowledge of ICT* | 9 | Mean | 4.81 | 4.69 | 5.76** | 0.39 |
| | | SD | 0.27 | 0.34 | | |
| *Learning with ICT* | 10 | Mean | 4.71 | 4.58 | 5.94** | 0.38 |
| | | SD | 0.32 | 0.37 | | |
| *ICT usage* | 7 | Mean | 3.56 | 3.42 | 2.73** | 0.18 |
| | | SD | 0.79 | 0.73 | | |

**B. Private Schools (Grade Level)**

As shown in Table 4.11, there were mixed results based on the analysis of the data from fifth and sixth graders at the private schools. Although the means for the fifth graders were a little bit more than the sixth graders for all scales, just three scales, Knowledge, Attitude, and Learning, were small statistically significantly different based on the effect size values.

Table 4.11 Item mean, item SD, and Sig (grade level) differences in students' perceptions in private schools measured by the SATK (modified)

| *Scale* | *No. of Items* | | *Fifth Grade* $n = 244$ | *Sixth Grade* $n = 245$ | *t* | *Effect Size* |
|---|---|---|---|---|---|---|
| *Interest in ICT* | 8 | Mean | 4.42 | 4.40 | 0.24 | 0.04 |
| | | SD | 0.54 | 0.51 | | |
| *Attitude towards ICT* | 5 | Mean | 4.55 | 4.41 | 2.57* | 0.23 |
| | | SD | 0.57 | 0.65 | | |
| *Knowledge of ICT* | 9 | Mean | 4.62 | 4.50 | 2.98** | 0.32 |
| | | SD | 0.38 | 0.54 | | |
| *Learning with ICT* | 10 | Mean | 4.62 | 4.51 | 2.44* | 0.23 |
| | | SD | 0.41 | 0.54 | | |
| *ICT usage* | 7 | Mean | 3.38 | 3.27 | 1.59 | 0.14 |
| | | SD | 0.75 | 0.80 | | |

These results were verified by calculating the effect size, where the Learning scale had the highest value (0.32). The Attitude and Knowledge scales had the same value (0.23), which demonstrates that there were only small differences between private school students in the fifth and sixth grades. The ICT Usage scale effect size (0.14) was smaller than the Attitude and Knowledge scales. The Interest scale had the smallest effect size (0.04), which shows that there was almost no difference in students' Interest in ICT based on grade level at private schools.

### 4.6 Summary of the Chapter

This chapter also describes the demographic of the sample and investigates the extent of students' use of ICT by examining the availability of ICT in schools, the use of ICT for learning science, and social media applications' use of ICT for learning science. Based on the results, the most available tool in primary schools was a data projector, and students used some programs and applications more than others, such as PowerPoint and word processing. Students' used Instagram as Social media application more than other application.

This chapter analysed students' results of quantitative data collected from 1,401 participants in this study. The differences in students' attitudes towards using ICT in science learning were measured based on two variables. The first variable was grade level (fifth and sixth graders); the researcher found that attitude scale and knowledge scale had small effect size values (0.32, 0.31), which shows there were practical differences in favour of fifth graders. Thus, fifth graders used ICT little bit more effectively in learning science than did sixth graders. The second variable was school type (government and private schools); the results illustrate the practical differences between student perceptions based on school type. Knowledge and Interest scales had small effect size values (0.46, 0.44) in favour of Government schools students.

However, the results show that more effort is needed to improve ICT integration by encouraging students to use ICT more effectively, to improve their learning of science. Therefore, to enhance ICT integration effectively in both grades at government and private schools, this study argues that the way that ICT is used during the learning process, and the effectiveness of ICT integration in science, are more important than the quantity of the ICT tools.

# CHAPTER 5

## QUANTITATIVE PHASE RESULTS (TEACHERS' DATA)

### 5.1 Introduction

Part of this study evaluated science teachers' perceptions of the extent of ICT integration in their current teaching processes. There were 49 science teachers who participated in the survey; 32 teachers completed the paper survey, and 17 teachers answered through an online survey. All teachers in the study were female. The teachers' survey had two parts: (1) the Teachers' Attitudes Toward and Knowledge of Technology Questionnaire (TATK) to answer Research Question 3 and Research Question 4, and (2) the Science Teaching Efficacy Beliefs Instrument (STEBI) to answer Research Question 5.

Section 5.1 introduces the chapter; Section 5.2 presents a demographic description of the data, and Section 5.3 explains the scale reliabilities (TATK and STEBI). Section 5.4 presents responses to the third research question, which investigates teachers' perceptions of the extent of ICT integration in their science teaching. Section 5.5 presents responses to the fourth research question aimed at measuring the levels of teachers' interest, attitude, and knowledge, teaching with ICT, ICT and usage in science teaching. Section 5.6 presents responses to the fifth research question, which examines teachers' perceptions of the effects of ICT integration on students' learning outcomes. Section 5.7 reports on the measurement of teachers' results based on school type differences. Section 5.8 summarises the chapter.

### 5.2 Description of Demographics

This section discusses the characteristics of the study sample. Demographic details included the type of school, ICT skills level, where ICT was used, teaching experience, age, and level of education. The sample of teachers who participated in this study taught fifth and sixth grade at the same school, so the researcher analysed the data as one group.

### *5.2.1 School type*

Table 5.1 shows the number of teachers involved in the study according to the different school types. Forty-nine of the science teachers from primary schools in Riyadh who participated in the study, 61.2% (n = 30) were from government schools and 38.8% (n = 19) from private schools.

Table 5.1 Teachers by Type of school (*N*=49)

| School Type | Teachers | |
|---|---|---|
| | *n* | % |
| Government | 30 | 61.2 |
| Private | 19 | 38.8 |
| Total | 49* | 100 |

*$N = 49$

### *5.2.2 ICT skills level*

Very few teachers ($n = 3$) self-evaluated their ICT skills as being at a beginner level. Almost half of the teachers ($n = 51$) who participated in the study self-evaluated their ICT skills level as intermediate, while a moderate number ($n = 19$) of teachers rated themselves as having advanced skills in ICT (Table 5.2).

Table 5.2 Teacher Participants' ICT Skills Levels (*N*=49)

| ICT skills level | Teachers | |
|---|---|---|
| | *n* | % |
| Beginner | 3 | 6.1 |
| Intermediate | 25 | 51.0 |
| Advanced | 19 | 38.8 |
| Missing | 2 | 4.1 |
| Total | 49* | 100 |

*$N = 49$

### *5.2.3 Where ICT is used*

The teachers' work requires that they prepare lessons every day but some teachers cannot finish all the work at school. Therefore, they complete their responsibilities at home to complete all their tasks that include lesson preparation, marking examinations, and marking students' assignments. In this study, the majority of teachers used ICT at home and school (Table 5.3). Only one teacher out of 49 teachers reported that she used ICT only at home. However, three teachers reported that they used ICT tools only at school.

Table 5.3 Teacher Participants: Where ICT Is Used (*N*=49)

| Location of ICT Use | Teachers | |
|---|---|---|
| | *n* | % |
| Home | 1 | 2.0 |
| School | 3 | 6.1 |
| Both | 44 | 89.0 |
| Missing | 1 | 2.0 |
| Total | 49* | 100 |

*$N = 49$

### *5.2.4 Teaching experience*

As shown in Table 5.4, the teachers who participated this study had different years of teaching experience; most of the sample (30, 61.2%) had 5–15 years of teaching experience while fewer teachers (17, 34.7%) had taught science for 16–25 years. Two teachers (4.1%) had more than 26 years of experience teaching science.

Table 5.4 Teacher Participants: Teaching Experience (*N*=49)

| Teaching experience | Teachers | |
|---|---|---|
| | *n* | % |
| 5-15 Years | 30 | 61.2 |
| 16-25 Years | 17 | 34.7 |
| +26 Years | 2 | 4.1 |
| Total | 49* | 100 |

*$N = 49$

### *5.2.5 Age*

Currently in Saudi Arabia, teachers start their first year of practice when they graduate from university at around 25 years of age and can work until they are 60 years old. As shown in Table 5.5, the age group most represented in the teachers who participated in the survey was between 30 and 44 years old (30, 61.2%). Just nine teachers were between 45-50 years old. A similar number, seven teachers, the smallest group, were aged 25-29 years old.

Table 5.5 Teacher Participants: Age (*N*=49)

| Age (Years) | Teachers | |
|---|---|---|
| | *n* | % |
| 25-29 | 7 | 14.3 |
| 30-44 | 30 | 61.2 |
| 45-59 | 9 | 18.4 |
| Missing | 3 | 6.1 |
| Total | 49* | 100 |

*$N = 49$

### *5.2.6 Level of Education*

As shown in Table 5.6, the great majority of science teachers had a Bachelor's degree (38, 77.6%). However, six (12.2%) teachers who had more than 15 years of experience had a Teaching Diploma (2 years post high school) in science and mathematics education. A few teachers, the smallest group in the participants (3, 6.1%) hold Master's degrees, all teachers graduated with a science background.

Table 5.6 Teacher Participants: Level of Education (*N*=49)

| Level of education | Teachers | |
|---|---|---|
| | *n* | % |
| Teaching Diploma | 6 | 12.2 |
| Bachelor | 38 | 77.6 |
| Master | 3 | 6.1 |
| Missing | 2 | 4.1 |
| Total | 49* | 100 |

*$N = 49$

### 5.3 Scale Reliability

The Cronbach's alpha coefficient for each of the five scales of TATK and STEBI are presented in Table 5.7. For TATK, three of the scales had acceptable reliability values of greater than 0.70 (Adams & Wieman, 2011). These three scales were Knowledge of ICT; Teaching with ICT; and Interest in ICT, with Cronbach's alpha coefficients of 0.84, 0.76, and 0.74, respectively. The Cronbach's alpha coefficients for the scales of Attitude towards ICT and ICT Usage, however, were slightly lower than the value of 0.70 with values of 0.63 and 0.66, respectively. Cronbach's alpha values for the STEBI scale was in two parts; first, the Personal Science Teaching Efficacy Belief modified scale (PSTEB) produced an alpha of 0.73, then, the Science Teaching Outcome Expectancy modified scale (STOE) produced an alpha of 0.66.

In order to improve Cronbach's alpha value, small numbers with teachers change are improve the reliabilities. Thus, the researcher deleted one item from some scales to improve the value. For the Interest scale, when item 5 was deleted, the Cronbach's alpha value improved to 0.83. Therefore the Interest in ICT scale has eight items instead of the nine items, as shown in Table 5.7. The most significant changes were on Attitude toward ICT scale where the value changed from 0.63 to 0.78 after item 1 was deleted, and the total number of items was five. Moreover, the Teaching with ICT scale had ten items instead of eleven items, when item 9 was deleted to improve the reliability value to 0.87. The changes in Cronbach alpha values are shown in Table 5.8.

Table 5.7 Descriptive Statistics and Internal Consistency (Cronbach's alpha Reliability) for Five Scales of the TATK and STEBI Questionnaires (*N*=49)

| Scale | No. of Items | Mean | SD | Cronbach's alpha coefficient |
|---|---|---|---|---|
| 1. Interest in ICT | 8 | 4.45 | 0.36 | 0.74 |
| 2. Attitude toward ICT | 5 | 4.16 | 0.43 | 0.63 |
| 3. Knowledge in ICT | 9 | 4.53 | 0.41 | 0.84 |
| 4. Teaching with ICT | 10 | 4.45 | 0.35 | 0.76 |
| 5. ICT usage | 7 | 3.87 | 0.59 | 0.66 |
| 6. (STEBI) 6.1 PSTEB | 12 | 3.96 | 0.40 | 0.73 |
| | 12 | 3.95 | 0.39 | 0.66 |

Table 5.8 Descriptive Statistics and Internal Consistency (Cronbach's alpha Reliability) for Five Scales of the TATK and STEBI Questionnaires (edited version) (*N*=49)

| Scale | No. of Items | Mean | SD | Cronbach's alpha coefficient |
|---|---|---|---|---|
| 1. Interest in ICT | $7_{(Q1.5\ deleted)}$ | 4.50 | 0.37 | 0.83 |
| 2. Attitude toward ICT | $4_{(Q2.1\ deleted)}$ | 4.20 | 0.52 | 0.78 |
| 3. Knowledge in ICT | 9 | 4.53 | 0.41 | 0.84 |
| 4. Teaching with ICT | $9_{(Q4.9\ deleted)}$ | 4.50 | 0.64 | 0.87 |
| 5. ICT usage | 7 | 3.87 | 0.59 | 0.66 |
| 6. (STEBI) 6.1 PSTEB | 12 | 3.96 | 0.40 | 0.73 |
| 6.2 STOE | 12 | 3.95 | 0.39 | 0.66 |

## 5.4 Research Question 3: How do teachers perceive the extent of ICT integration in their science teaching?

The current experience of ICT integration in science teaching was evaluated by investigating the extent of teachers' use of ICT. Tables 5.9, 5.10, 5.11, and 5.12 show the results of analysis of the availability of ICT in schools, use of ICT for learning science, social media applications, and integration of ICT in the teaching process.

### *5.4.1 Availability of ICT in schools*

At the time of the study, the most readily available ICT tools used in teaching science in Saudi schools, particularly in Riyadh (north sector), were data projectors. The projectors were used by 95.9% of the teachers, while just 50% used smart whiteboards when teaching science (Table 5.9).

Table 5.9 Teacher Participants: Availability of ICT in Schools

| ICT tools at school | Teachers | |
|---|---|---|
| | *n* | % |
| Computer (desktops or laptops) | 43 | 87.8 |
| Data projector | 47 | 95.9 |
| Smart whiteboards | 25 | 51.0 |
| Tablets/iPad | 19 | 38.8 |
| Printers/ Scanners | 12 | 24.5 |
| TV/ DVD player | 8 | 16.3 |
| Digital cameras | 3 | 6.1 |
| Other | 2 | 4.1 |

### *5.4.2 Teachers' use of ICT for teaching science*

In addition to the previous data on the availability of ICT in schools, the survey also examined the variety of ICT program and applications that were used in teaching science. The goal was to determine how the teacher used ICT effectively in the science classroom. The data shown in Table 5.10 illustrate three ranges of use first range (100%-70%), second range (60%-30%) and third range (20%-0%). ICT programs and applications teachers used in teaching science at the first range: PowerPoint (98%) and Word-processing (75%). Under the second range, teachers reported using Email (38.8%), Science and Math gate (Obeikan education)(36.7%) and Specialist science program (34.7%). At the third range (20%-0%) teachers reported using own website and You Tube (18.4%), Classera (6.1%) and iEN; Al Manahj; Other (2%).

Table 5.10 Teacher Participants: ICT Programs & Apps in Teaching Science

| ICT Programs & Apps | Teachers | |
|---|---|---|
| | *n* | % |
| Word-processing | 37 | 75.5 |
| Power Point | 48 | 98 |
| Email | 19 | 38.8 |
| Specialist science program | 19 | 38.8 |
| Your own website | 9 | 18.4 |
| School website or Instagram | 17 | 34.7 |
| Science and Math gate (Obeikan) | 18 | 36.7 |
| You Tube | 9 | 18.4 |
| Classera | 3 | 6.1 |
| iEN | 1 | 2 |
| Al Manahj | 1 | 2 |
| Other (Hassen, Fahem, Duroosi, BBC, Nour, Noon Book, Mnhjy) | 1 | 2 |

### *5.4.3 Social Media Applications*

Social media applications play a role in most of the teachers' daily lives and programs. Using some of these apps in the teaching process could encourage students and help them gain benefits from the teaching. For example, one respondent (13.GL1) used Twitter at the end of the class by asking the student to write about what the lesson was about and what they were learning in the lesson.

Twitter was the most popular social media application used by these science teachers who were involved in this study. As shown in Table 5.11 exactly 67.3% used Twitter in their daily lives; Instagram had a similar result—61.2%. Even though teachers had their own accounts, most schools had their own Instagram accounts that they used to upload school activities, pictures, and announcements. On the other hand, a low percentage of teachers used Facebook.

Table 5.11 Teacher Participants: Social Media

| Social Media | Teachers | |
|---|---|---|
| | *n* | % |
| Facebook | 11 | 22.4 |
| Twitter | 33 | 67.3 |
| Instagram | 30 | 61.2 |
| SnapChat | 25 | 51 |
| None of them | 5 | 10.2 |
| Other (e.g., WhatsApp) | 7 | 14.3 |

### *5.4.4 Integration of ICT in teaching process*

During a science lesson, a teacher could integrate ICT using several techniques. Based on the responses, the highest result was 81.6% of teachers reported using ICT as a supplement to their teaching by including video, pictures, and sounds to the curriculum. The percentage of teachers who reported integrating ICT in teaching science as a reinforcement of the curriculum to convey information in different ways and with practical applications was 57.1%. A similar percentage (53.1 %) of teachers reported using the Internet as a method of continuous teacher-student engagement (see Table 5.12).

Table 5.12 Teacher Participants: Integration of ICT in Teaching Process

| I integrate ICT in my teaching | Teachers | |
|---|---|---|
| | *n* | % |
| a) A supplement to the curriculum such as videos, pictures, sounds. | 40 | 81.6 |
| b) Use the Internet as a method of continuous teacher-student engagement. | 26 | 53.1 |
| c) A reinforcement of the curriculum conveys information in different ways and with practical applications. | 28 | 57.1 |

## 5.5 Research Question 4: What are the levels of interest, attitude, knowledge, and skills of science teachers in integrating ICT in teaching?

### *5.5.1 Teacher interest in ICT*

As shown in Table 5.12 presents the percentage of each item measuring teachers' interest on an ICT scale is presented in Table 5.13. This scale includes seven items; almost 100% of teacher participants agreed or strongly agreed with statements in the questions. Item 2, however, shows that 6% of respondents were neutral (*I like to read technological magazines)*.

Table 5.13 Percentage Responses: Teacher Interest in ICT Scale from TATK

| 1-Teacher interest in ICT | Percentage (%) | | | | |
|---|---|---|---|---|---|
| | SD | D | N | A | SA |
| 1. I like to know more about ICT | 0 | 2 | 0 | 26.5 | 69.4 |
| 2. I like to read technological magazines | 0 | 0 | 6.1 | 59.2 | 30.6 |
| 3. I enjoy a job in ICT | 0 | 0 | 0 | 34.7 | 63.3 |
| 4. There should be more education about technology | 0 | 0 | 2.0 | 51.0 | 46.9 |
| 6. All teachers should use ICT in teaching processes | 0 | 0 | 0 | 53.1 | 46.9 |
| 7. Working in ICT would be interesting | 0 | 0 | 0 | 36.7 | 63.3 |
| 8. With an ICT job your future is promised. | 0 | 0 | 0 | 32.7 | 67.3 |

*Note.* SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree.

### *5.5.2 Teachers' Attitudes toward ICT*

Most statements about teachers' attitudes towards ICT were rated by teachers as disagree or strongly disagree; the statements expressed that the work or the job with ICT was boring. Only Item 3 *(using ICT makes a country more prosperous)* garnered 100% responses of agree or strongly agree by teacher participants (Table 5.14).

Table 5.14 Percentage Responses: Teachers' Attitudes toward ICT Scale from TATK

| 2-Attitude toward ICT | Percentage (%) | | | | |
|---|---|---|---|---|---|
| | SD | D | N | A | SA |
| 1. You have to be smart to teach with ICT. | 0 | 4.1 | 20.4 | 61.2 | 14.3 |
| 3. Using ICT makes a country more prosperous. | 0 | 0 | 0 | 24.5 | 75.5 |
| 4. Working in ICT would be boring. | 30.6 | 59.2 | 8.2 | 2.0 | 0 |
| 5. Most jobs in ICT are boring. | 20.4 | 67.3 | 6.1 | 4.1 | 0 |

*Note.* SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree.

### *5.5.3 Teachers' Knowledge of ICT*

According to the analysis of results in Table 5.15 regarding teachers' knowledge of ICT, all responses (100%) agreed or strongly agreed with the questions in three items (4, 8, and 9) in this scale, and less than 10% of responses were neutral as shown in items (1, 2, 3 ,5 ,and 7) . Item 3 *(I think ICT is often used in science)*, however, shows that 6.1 % of respondents were disagree or strongly disagree.

Table 5.15 Percentage Responses: Teachers' Knowledge of ICT Scale from TATK

| 3-Knowledge of ICT | Percentage (%) | | | | |
|---|---|---|---|---|---|
| | SD | D | N | A | SA |
| 1. Science and ICT are related. | 0 | 0 | 2.0 | 26.5 | 71.4 |
| 2. ICT has a large influence on people. | 0 | 0 | 2.0 | 24.5 | 71.4 |
| 3. I think ICT is often used in science | 2.0 | 4.1 | 6.1 | 42.9 | 44.9 |
| 4. In everyday life, I have a lot to do with ICT | 0 | 0 | 0 | 38.8 | 59.2 |
| 5. The Ministry of Education can influence technology. | 0 | 0 | 8.2 | 57.1 | 34.7 |
| 6. In ICT, you use tools. | 2.0 | 0 | 0 | 44.9 | 51.0 |
| 7. ICT is mean to make our life more comfortable. | 2.0 | 0 | 2.0 | 36.7 | 59.2 |
| 8. Using ICT helps improve teacher's teaching. | 0 | 0 | 0 | 34.7 | 65.3 |
| 9. ICT use improves technical skills for teachers | 0 | 0 | 0 | 34.7 | 63.3 |

*Note.* SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree

### *5.5.4 Teaching with ICT*

The majority of teachers' responses regarding the statements about teaching with ICT were almost 100% agree and strongly agree. However, item 8 (*My students use ICT in their tasks)* shows that 8.2 % of respondents were neutral and 4.1% were disagree (Table 5.16).

Table 5.16 Percentage Responses: Teachers' Responses about Teaching with ICT Scale from TATK

| 4-Teaching with ICT | Percentage (%) | | | | |
|---|---|---|---|---|---|
| | SD | D | N | A | SA |
| 1. I find teaching science with ICT interesting. | 0 | 0 | 2.0 | 32.7 | 65.3 |
| 2. I can teach faster through using the ICT tools. | 0 | 0 | 0 | 30.6 | 67.3 |
| 3. I find ICT- supported science class to be active. | 0 | 0 | 0 | 34.7 | 65.3 |
| 4. I am able to update my knowledge using ICT. | 0 | 0 | 2.0 | 32.7 | 65.3 |
| 5. I find the audio and visual effects in the content matter to be appealing. | 0 | 0 | 2.0 | 34.7 | 61.2 |
| 6. I am motivated to teach by using ICT in the science classroom. | 0 | 0 | 0 | 51.0 | 49.0 |
| 7. I enjoy when teaching science by using ICT. | 0 | 0 | 0 | 49.0 | 49.0 |
| 8. My students use ICT in their tasks. | 0 | 4.1 | 8.2 | 61.2 | 26.5 |
| 10. ICT improves my teaching of science. | 0 | 0 | 0 | 51.0 | 46.9 |

*Note.* SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree.

### *5.5.5 Teachers' ICT Usage*

Mixed results are shown in Table 5.17 regarding teachers' use of ICT during their teaching experience. For items 1, 4, 5, and 7, more than 90% of teachers responded that they often and almost always used ICT as a tool, found out information about the course, prepared lessons, and obtained information from the internet. On the other hand, analysis of items 2, 3, and 6 shows that more than 20% seldom and almost never used ICT in these ways. These three items indicated that there were miscommunications with students and other teachers through technology.

Table 5.17 Percentage Responses: Teachers' Responses about ICT Usage Scale of TATK

| 5-ICT Usage: I use the ICT… | Percentage (%) | | | | |
|---|---|---|---|---|---|
| | AN | S | ST | O | AA |
| 1. as tools in teaching science. | 0 | 2.0 | 6.1 | 38.8 | 51.0 |
| 2. to communicate with students. | 30.6 | 38.8 | 10.2 | 12.2 | 8.2 |
| 3. to answer students' questions. | 4.1 | 18.4 | 18.4 | 30.6 | 28.6 |
| 4. to find out information about the course. | 0 | 4.1 | 4.1 | 26.5 | 65.3 |
| 5. to prepare lesson note for students. | 2.0 | 4.1 | 8.2 | 30.6 | 55.1 |
| 6. to take part in online discussions with other teachers. | 8.2 | 18.4 | 18.4 | 32.7 | 22.4 |
| 7. to obtain information from the internet. | 0 | 4.1 | 2.0 | 28.6 | 65.3 |

Note: AN= Almost Never; S= Seldom; ST= Sometimes; O=Often; AA= Almost Always

## 5.6 Research Question 5: How do science teachers perceive the effects of ICT integration on students' learning outcomes?

### *5.6.1 Personal Science Teaching Efficacy Belief Scale (PSTE)*

A complete version of teacher responses is located in Table 5.18. Teacher participants in this study responded with 100% either agreeing or strongly agreeing that teachers are continually finding better ways to teach science with ICT integration (Item 2); they also agreed or strongly agreed that—with ICT integration into science teaching—they knew the steps necessary to teach science concepts effectively (Item 4). Similarly, teachers agreed or strongly agreed that when teaching science using ICT, they usually welcomed student questions (Item 22) which concentrates on the effectiveness of teaching strategies when teaching science. The majority of respondents (98%) agreed or strongly agreed that they understood science concepts well enough to be effective in teaching primary science using ICT (Item 11); they typically were able to answer students' science questions (Item 17).

Table 5.18 Percentage Responses: Teacher Responses to Modified Personal Science Teaching Efficacy Belief Scale (PSTE)

| Personal Science Teaching Efficacy Belief Scale (PSTE) | Percentage (%) | | | | |
|---|---|---|---|---|---|
| | SD | D | N | A | SA |
| 2. I am continually finding better ways to teach science with ICT integration. | 0 | 0 | 0 | 57.1 | 42.9 |
| 4. With ICT integration into science teaching, I know the steps necessary to teach science concepts effectively. | 0 | 0 | 0 | 63.3 | 34.7 |
| 5. I am not very effective in using ICT into monitoring science experiments. | 12.2 | 53.1 | 14.3 | 16.3 | 2.0 |
| 7. I generally teach science by using ICT ineffectively. | 18.4 | 65.3 | 10.2 | 4.1 | 0 |
| 11. I understand science concepts well enough to be effective in teaching primary science via using ICT. | 0 | 0 | 2.0 | 55.1 | 42.9 |
| 16. I find it difficult to explain to students why science experiments work. | 26.5 | 59.2 | 6.1 | 6.1 | 2.0 |
| 17. I am typically able to answer students' science questions. | 0 | 0 | 2.0 | 67.3 | 30.6 |
| 18. I wonder if I have the necessary skills to teach science with using ICT. | 10.2 | 40.8 | 20.4 | 20.4 | 8.2 |
| 20. Given a choice, I would not invite the principal to evaluate my ICT integration into science teaching. | 16.3 | 63.3 | 2.0 | 8.2 | 10.2 |
| 21. When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better by using ICT. | 4.1 | 44.9 | 18.4 | 22.4 | 10.2 |
| 22. When teaching science by using ICT, I usually welcome student questions. | 0 | 0 | 0 | 55.1 | 44.9 |
| 23. I don't know what to do to turn students on to science. | 24.5 | 61.2 | 8.2 | 2.0 | 4.1 |

*Note.* SD = Strongly disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree.

Eighty percent and less of teachers disagreed or strongly disagreed that they generally taught science by using ICT ineffectively (Item 7). Teachers disagreed or strongly disagreed that they found it difficult to explain to students why science experiments work (Item 16); also, they disagreed or strongly disagreed with the statement that they do not know what to do to encourage students to enjoy science (Item 23). Sixty percent of teacher participants disagreed or strongly disagreed with a statement that they were not very effective in using ICT to monitor science experiments (Item 5). They also disagreed or strongly disagreed that they wondered if they had the necessary skills to teach science using ICT (Item 18). Additionally, teachers disagreed or strongly disagreed (60%) that they would not invite the principal to evaluate their ICT integration into science teaching (Item 20). Almost half of the teachers (49%) disagreed or strongly disagree that when a student has difficulty understanding a science concept, they were usually at a loss as to how to help the student understand the concept better by using ICT.

### *5.6.2 Science Teaching Outcome Expectancy Scale (STOE)*

Table 5.19 provides the results of the teachers' responses to the modified STOE items. For Item 1, 100% of teachers agreed or strongly agreed that when a student does better than usual in science, it is often because the teacher exerted a little extra effort by integrating ICT into science teaching. The majority of teachers agreed or strongly agreed that if parents commented that their child was showing more interest in using ICT in science at school, it was probably due to the performance of the child's teacher (Item 15). Moreover, they also agreed or strongly agreed (97.9%) that when a low-achieving child progressed in science, it was usually due to the extra attention given by the teacher (Item 10). Teachers strongly agreed (91.8%) that the inadequacy of a student's science background could be overcome by good teaching (Item 8). Most teachers (87.8%) strongly agreed that when the science grades of students improved, it was most often due to their teacher finding a more effective teaching approach by using ICT (Item 3).

Additionally, teachers agreed or strongly agreed (79.6%) that the teacher was generally responsible for the achievement of students in science (Item 13); they also agreed or strongly agreed (77.5%) that students' achievement in science was directly

related to their teachers' effectiveness in ICT integration into science teaching (Item 14). Fifty-five percent of teachers agreed or strongly agreed that if students were underachieving in science, it was most likely due to ineffective ICT integration into science teaching (Item 6). For Item 12 and Item 19, almost the same percentages disagreed or strongly disagreed that increased effort in integrating ICT into science teaching produced little change in some students' science achievement (Item 12, 81.7%), and that effectiveness in integrating ICT into science teaching had little influence on the achievement of students with low motivation (Item 19, 81.6%). Most of the teachers (73.4%) disagreed or strongly disagree that even teachers with good science teaching abilities cannot help some children learn science (Item 24). Nevertheless, 48% of the teachers agreed or strongly agreed that the low science achievement of some students could not generally be blamed on their teachers (Item 9). However, 46% of teachers disagreed or strongly disagreed with this statement.

Table 5.19 Responses on Science Teaching Outcome Expectancy Scale (STOE)

| Science Teaching Outcome Expectancy Scale (STOE) | Percentage (%) | | | | |
|---|---|---|---|---|---|
| | SD | D | N | A | SA |
| 1. When a student does better than usual in science, it is often because the teacher exerted a little extra effort by integrating ICT into science teaching. | 0 | 0 | 0 | 51.0 | 49.0 |
| 3. When the science grades of students improve, it is most often because their teacher has found a more effective teaching approach by using ICT. | 0 | 2.0 | 10.2 | 63.3 | 24.5 |
| 6. If students underachieve in science, it is most likely due to ineffective ICT integration into science teaching. | 0 | 20.4 | 24.5 | 40.8 | 14.3 |
| 8. The inadequacy of a student's science background can be overcome by good teaching. | 2.0 | 0 | 6.1 | 36.7 | 55.1 |
| 9. The low science achievement of some students cannot generally be blamed on their teachers. | 2.0 | 44.9 | 12.2 | 18.4 | 22.4 |
| 10. When a low-achieving child progresses in science, it is usually due to the extra attention given by the teacher. | 0 | 0 | 2.0 | 51.0 | 46.9 |
| 12. Increased effort in integrating ICT into science teaching produces little change in some students' science achievement. | 18.4 | 63.3 | 6.1 | 10.2 | 2.0 |
| 13. The teacher is generally responsible for the achievements of students in science. | 6.1 | 4.1 | 10.2 | 59.2 | 20.4 |
| 14. Students' achievement in science is directly related to their teachers' effectiveness in ICT integration into science teaching. | 4.1 | 0 | 18.4 | 55.1 | 22.4 |
| 15. If parents comment that their child is showing more interest in using ICT in science at school, it probably due to the performance of the child's teacher. | 0 | 2.0 | 0 | 49.0 | 49.0 |
| 19. Effectiveness in integrating ICT into science teaching has little influence on the achievement of students with low motivation. | 12.2 | 69.4 | 8.2 | 4.1 | 6.1 |
| 24. Even teachers with good science teaching abilities can't help some kids learn science. | 16.3 | 57.1 | 16.3 | 8.2 | 2.0 |

Note. SD = Strongly disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree.

### 5.7 Teachers results based on School Type Differences between Government and Private schools

Science teachers who participated in this study were from two different school types. Some of the teachers work in government schools and others in private schools. Therefore, it was essential to examine whether teachers' perceptions differed according to their school type. The analysis summarised in Table 5.20 investigated whether there were any differences between teachers' perceptions of integrating ICT in science teaching based on their school type (government and private schools).

Table 5.20 Descriptive statistics and t-test values for school type differences in teachers' perceptions measured by the TATK and STEBI (modified)

| Scale | No. of Items | | All Teachers N=49 | Government School n=30 | Private School n=19 | t | Effect Size |
|---|---|---|---|---|---|---|---|
| Interest in ICT | 8 | Mean | 4.45 | 4.41 | 4.49 | 0.68 | -0.22 |
| | | SD | 0.36 | 0.32 | 0.43 | | |
| Attitude towards ICT | 5 | Mean | 4.16 | 4.22 | 4.06 | 1.23 | 0.37 |
| | | SD | 0.43 | 0.43 | 0.43 | | |
| Knowledge of ICT | 9 | Mean | 4.53 | 4.56 | 4.49 | 0.48 | 0.17 |
| | | SD | 0.41 | 0.40 | 0.44 | | |
| Teaching with ICT | 10 | Mean | 4.45 | 4.44 | 4.46 | 0.25 | -0.05 |
| | | SD | 0.35 | 0.33 | 0.38 | | |
| ICT usage | 7 | Mean | 3.87 | 3.75 | 4.07 | 1.88 | -0.54 |
| | | SD | 0.59 | 0.59 | 0.52 | | |
| (STEBI) PSTEB | 12 | Mean | 3.96 | 3.96 | 3.96 | 0.10 | 0 |
| | | SD | 0.40 | 0.38 | 0.44 | | |
| STOE | 12 | Mean | 3.95 | 4.04 | 3.82 | 1.95 | 0.56 |
| | | SD | 0.39 | 0.29 | 0.49 | | |

$^{**}p < 0.01$ $^{*}p < 0.05$ ($N$=49, 30 teachers from government schools &19 teachers from private schools)

The analysis used t-tests and measured the effect size for all seven scales (five TATK scales and two STEBI scales). There were no statistically significant differences between teachers in the two different school types for any scale. These statistical results were confirmed by computing the effect size. Thus, scales with differences go with the effect sizes. The effect size of the Science Teaching Outcome Expectancy (STOE) scale was 0.56, which verifies that there was a practical difference between teachers from government and private schools. Similarly, the effect size for the attitude scale was 0.37, and it was 0.17 for the knowledge scale. The effect size for the Personal Science Teaching Efficacy Belief (PSTEB) scale was

zero, meaning that there was no practical difference between teachers in the different school types. On the other hand, the ICT usage, teaching with ICT, and interest in ICT effect size values (-0.54, -0.22, and -0.05, respectively) showed that there were practical differences in favour of the private school teachers though these differences were of small or medium size.

### 5.8 Summary of the Chapter

This chapter has explained the results of the analysis of the teacher participants' responses (quantitative phase) in this study. Of the 49 science teachers who participated, 61.2% were from a government school, and 38.8% were from a private school. A majority of the sample (61.2%) had between 16 and 25 years of teaching experiences and held a bachelor degree (77.6%). The results were analysed as one group and the differences in teachers' perceptions of ICT integration in science based on school type were measured. One of the aims of the study was to investigate teachers' perceptions, and the extent of ICT integration in their science teaching, by exploring the availability of ICT in schools, teachers' use of ICT applications and programs, and social media applications. Based on the results, the most available ICT tools were computers and data projectors (87.8%, 95.9%), while word processing and PowerPoint were the programs most used by the teachers. Twitter and Instagram were the social media applications most used by teachers.

This chapter responded to resaerch question four (Research Question 4), examining science teachers' levels of interest, attitude, knowledge, and skills in integrating ICT into their teaching of science. The results of data analysis showed that the majority of the teachers were interested in using ICT in their teaching process, and that their attitudes towards ICT were positive. Teachers' highly positive perception of their knowledge of ICT demonstrates that almost all participants were teaching science with ICT. However, teachers' use of ICT differed in some aspects and were similar in others. For instance, most of the teachers used ICT as a tool for searching for information and for organizing the lessons.

# CHAPTER 6

## STUDENTS' INTERVIEW RESULTS

### 6.1 Introduction

This chapter evaluates the impact of ICT integration in science classes in primary schools (Research Question 1), examining students' perception of the use of ICT for their science learning through analysis of qualitative data. In this phase, the results were gathered from interviews with 54 fifth and sixth grade students in government and private schools in the north sector of Riyadh, Saudi Arabia's capital city. The interviews consisted of questions to elicit students' perceptions of ICT integration in science learning; the benefits of using ICT in science classrooms; concerns about ICT integration; and suggestions for improving ICT integration in primary school science learning. All interview transcripts have been translated from Arabic to English. Section 6.1 introduces the chapter. Section 6.2 investigates students' perceptions of ICT integration in science learning. There were four main themes created based on interviews analysis: ICT Integration; Benefits of ICT Integration; Disadvantages in using ICT; Students' suggestions about improving ICT integration in science. Section 6.3 summarises the chapter.

### 6.2 Students' perceptions of ICT integration in science learning

It is essential to ask primary-level students their opinions on using ICT in their learning processes in order to understand their views and the current extent of ICT use in schools. Accordingly, students in this study were asked to interpret their understanding of and opinions regarding the role of integrated ICT in their current learning experiences. The students' answers regarding the extent of ICT integration in science learning were divided into the following themes: ICT Integration (Section 6.2.1), Benefits of ICT Integration (Section 6.2.2), Disadvantages (concerns) Regarding ICT Integration (Section 6.2.3), and Suggestions to Improve Learning Processes (Section 6.2.4). Figure 3.5 in Section 3.9.2 represents the hierarchy chart of the main themes and subthemes based on coding of student responses based on NVivo.

Table 6.1 Themes based on analysing of students' interviews

| Themes or categories | Sub-themes or sub-categories | Secondary sub-themes |
|---|---|---|
| ICT Integration | *Teacher's role* | Presentation, Knowledge enrichment, Research |
| | *Enhance learning outcomes* | Applications, Remembering, Searching, Understanding |
| | *Applications* | Al Manahij, Obeikan, Classera, iEN |
| | *Students' usage of ICT* | Homework |
| | *Availability in schools* | Projector |
| Benefits | *Ease of use* | Understanding, Different representations, Enjoyment, Communication, Availability, |
| | *Understanding* | Different representations, Remembering, Enjoyment, Independent search. |
| | *Interest level* | Enjoyment, Interactivity |
| | *Knowledge* | Different representations, Independent search |
| Disadvantages | *Wasting time* | |
| | *Health issues* | |
| | *Lack of clarity* | |
| | *Technical issues* | |
| Suggestions | *Devices* | |
| | *Educational activities* | |
| | *Time* | |
| | *Co-teaching* | |

### *6.2.1 ICT Integration*

Based on participants' responses, the researcher concluded that ICT integration in science lessons at the upper primary level is effective. The researcher created sub-themes to differentiate the answers of the students within the main theme of integration. ICT integration into primary school science education appears in several forms: teacher's role, enhance learning outcomes, the use of applications, Students' usage of ICT, and Availability of ICT in schools (see Table 6.1 and Figure 3.5).

**a) Teacher's Role**

The role of the teacher in ICT integration is as a facilitator and a motivator to encourage and guide students to use ICT for their science learning. Teachers from both private and government schools facilitated and motivated their students to

enhance their science learning by integrating ICT in the lessons, through their lesson presentations (teacher's role as facilitator), knowledge of enrichment (teacher's role as motivator), and research (teacher's role as motivator).

**Students' Presentations.** A common activity in most schools that participated in the study was the 'Little Teacher Project.' In this teaching approach, the science teacher's role as facilitator requires each student to prepare a lesson and present it in front of the class as a teacher. Several examples emerged from both grades in government (G) and private (P) schools. A fifth grader said: *"The teacher provides activities and students do the presentation [Little Teacher Project]"* (35.5.GB5). A sixth grade student said*:*

> *The science teacher encourages the students to do presentations and explain the lesson via PowerPoint. I did a typical lesson on the earth orbit lesson with a group of students, and we explained the lesson using PowerPoint. The students interacted with me and the school principal attended the lesson.* (39.6.GB9)

A co-student said *"she [the teacher] asks us to use the [Little Teacher Project] for topics of science, math, and English. In science, we prepare the lesson, explain it, and the teacher observes us. It is a wonderful experience"* (40.6. GB10). Similar experiences were elicited from other students; for instance, a fifth grader said "*the teacher says using technology is better. She asked us to make a lesson using PowerPoint, and I presented it in front of my classmates"* (4.6.PA4). Another student in the same grade in another said *"the teacher asks us to do research, make a lesson, and do a presentation using PowerPoint to explain it, and there is an interaction between the students"* [Little Teacher Project] (19.5.PB4). One student from the same school in sixth grade said *"she encourages us to make a lesson and do a presentation"* [Little Teacher Project] (28.6.PB13).

Students' responses showed that most teachers encouraged their students to present a lesson using the Little Teacher Project, in order to develop their self-efficacy, communication skills, and enhance their creativity and motivation.

**Enriching Knowledge.** Using ICT in learning can enrich students' knowledge if they use ICT resources correctly. Some students emphasised that their teachers

helped develop their knowledge and motivated them to be independent learners. A fifth grade student stated that *"she [the teacher] asks us to look for new enrichment information to get more benefit from the lesson"* (31.5.GB1). Another interviewee from the same grade said: *"we go to the computer lab where we make brochures; I made one about the food chain and the environmental system, and we are learning a lot"* (3.5.PA3). Another participant in fifth grade said: *"Our science teacher encourages the students to use technology. For example, I searched sexual and asexual reproduction. The teacher said, who wants to search, and this is a site you can use, so she helped us"* (22.5. PB7). A student in sixth grade responded that *"with some topics, the teacher asks us to search using the net, searching for the lesson and summarising its information"* (27.6.PB12). A sixth grade student said: *"[Our teacher] encourages us to use sites that explain science, for example when using Obeikan"* (36.6.GB6). A student from the same grade at another government school noted that they used Obeikan for *"making brochures, searching for extra knowledge for the lesson, such as studying stars and comets"* (54.6.GH4).The majority of upper primary level students engaged with science to enrich their knowledge through searching, creating assignments, and summarising.

**Research.** The teacher motivated her students by asking them to do research that can be challenging because the research process requires more time than is available for the usual daily homework. Some teachers encouraged students to research by rewarding them with certificates, prizes and bounce points, but responses suggested that some students did not do the research. On the other hand, there were students who enjoyed and were interested in doing research and tried their best to get the rewards. One student in fifth grade said, *"the teacher asks us to do research. Some students like working with computers and they interact and enjoy it. But the lazy students do not like to do more work and learn more"* (32.5.GB2). An interviewee in the same grade commented that, *"Our science teacher asks us for research or looks for specific information and rewards us for that with points to get an excellence certificate"* (21.5.PB6). Her classmates responded that, *"Sometimes the teacher asks us to research a certain topic; sometimes I do it, but if I am busy I cannot"* (17.5.PB2). Similarly, a sixth grader said that, *"the teacher asks us to do research on a topic and get extra points"* (49.6.GH3).

Encouraging students to do research is essential for developing critical thinking and writing skills, as well as improving their knowledge and comprehension (Florea & Hurjui, 2015). More attention is needed in ways of using ICT to support students in all grades, depending on students' ability, to research science subjects.

Requiring students to do a presentation (such as through the Little Teacher Project), and to enrich their knowledge through research, is intended to improve their learning outcomes and educational level because students become more independent learners. Therefore, the teacher's role in integrating ICT in science learning is central in encouraging students to interact with technology.

**b) Enhance learning outcomes**

Based on interviewees' experience in using ICT in science, the researcher divided students' responses into four sub-themes: applications, remembering, searching, and understanding.

**Applications.** Several upper primary level school students relied on the use of some applications to help them improve their achievement levels. Moreover, using educational applications encourages some students to be independent learners. A fifth grade student said, *"I go to the APP store and download math and science applications, to prepare myself for the exam. I wish I had my iPad with me so I could show you; I have learned a lot"* (2.5.PA2).

A student from the same class stated:

> *I have applications for all subjects; the one for science, I love it so much. I downloaded what earthquakes do to stones and how they explode. I asked a lot of questions about Science. I like it when my father teaches me; I go to the hospital to learn about lots of things, whether scientific or not. My father is a surgeon; I love him so much* (3.5.PA3).

Another participant from the same classroom said:

> *We do our homework through Classera. Sometimes, if we do homework and see a video and answer what is required to earn extra points, there is a sense of challenge — who will get more points? Therefore, my grades have become*

*higher, because I read what is required and do my homework in Classera.* (9.6.PA9)

A fifth grade student said, *"If one of the students doesn't understand the lesson, the teacher uses technology or some programs to help the student understand better for the test"* (38.6.GB8). Another student at the same school added that she and her classmates were *"using educational programs, for example, iEN and Obeikan, and searching for extra information"* (31.5.GB1).

Students from both private and government schools emphasised that using some applications could improve their educational level.

**Remembering.** Several interviewees mentioned that their Remembering improved and they could remember information better. For instance, a student in fifth grade said, *"I study at home on my iPad; my results get better, and I remember information"* (22.5. PB7). Her classmate said, *"It [ICT] helps us to remember the information and not forget it"* (18.5.PB3). A participant in fifth grade said: *"It [ICT] helps us to remember the information and not forget it and it gives me knowledge about life"* (33.5.GB3).

**Searching.** Numerous interviewees mention that searching through ICT for information for difficult lessons helped them to have a better understanding. One student in fifth grade said, "*I study from the book; then I go to my PC to get more details, then I revise. I do get full marks"* (1.5.PA1). A participant in fifth grade said, *"It is not necessary for the teacher to play videos. I use them myself and search for them to learn more and enhance my skills. This has a positive effect on my grades"* (29.5.PD1). A student in sixth grade commented that *"I learn by searching for and understanding information for difficult lessons and printing it, because reading lessons from the paper is better than using screens"* (39.6.GB9). Another student in the same grade said *"I use [technology] if teachers ask us to do brochures and I don't understand the lesson in class. I can use educational channels on the net. Then I understand"* (42.6.GC1).

**Understanding.** Ascertaining whether students have developed a good understanding is not easy to measure. Integrating ICT in science lessons can help to avoid some misunderstandings of difficult concepts or lessons. A student at fifth

grade level said, *"My grades become better, I understand science better by using technology"* (6.5.PA6). Motivation is an important factor in students' engagement with lessons. Some students found that ICT improved their motivation in science classes, so that they were able to enhance their learning outcomes. For example, a sixth grade student said, *"I interact in class with the teacher because she uses a projector. It is very motivating in class. I understand more, and I get better results in the exam"* (18.5.PB3). A sixth grade student compared the traditional and current ways of teaching: *"My old school did not use technology, Science was very difficult, and I didn't like it. But here, they use smart boards. I like English and science. I feel that I get benefits from learning with technology"* (26.6. PB11). One student in sixth grade shared her experience before using ICT and said, *"With the programs, activities, and videos teachers send, I can understand better. Before we would take homework home, and we didn't understand it, and we told the teacher that we forgot to do the homework"* (8.6.PA8). Her classmate shared how she was able to improve her marks: *"I can prepare lessons; I can answer more questions, and practice. This has improved my grades"* (28.6.PB13). A sixth grade student said, *"Technology helps me to have a better understanding. We have a teacher that presents us with pictures, and they become imprinted in my mind"* (44.6.GF1). A student in the same grade said, *"I use sites and educate myself because they give simplified explanations and videos that make lessons easy"* (35.5.GB5).

Based on students' responses, it is evident that using some educational applications and researching them to find explanations leads to good remembering and better understanding. Therefore, students can improve their level of education or achievements when ICT is effectively integrated.

**c) Applications**

There were several applications that are used by students in primary schools. The value of using these applications could help the student to expand her knowledge, improve her understanding, and assists her in doing tasks. Al Manahij, Obeikan, Classera, and iEN are some applications that students use in learning science.

**Al Manahij.** Fifth and sixth graders interviewed used this application for several reasons, to prepare and revise lessons. Also, to keep the track of lessons with their

friends if the students were absent from class. Students were encouraged to enrich their knowledge by reading or searching for related videos.

A student fifth grade school said

> *With my iPad, sometimes I prepare the lesson earlier. Also, if I am absent, I can study the lesson at home. Sometimes, I feel it is better than books because I sit in a quiet place and my understanding is better.* (32.5.GB2).

Another response from the same class was, *"On my iPad, there are a lot of videos that help me to understand"* (33.5.GB3). A sixth grade student compared two kinds of applications she used: *"We [she and her classmates] use iEN and Al Manahej, but I use Al Manahej more because it is like books on my iPad"* (53.6.GD3).

**Obeikan.** Using applications during the learning processes can help to engage students in science, and encourage them to learn independently and develop their skills. One fifth grade student said *"I search and study using the Obeikan program, it's very helpful, and I told my friend about it"* (24.5.PB9). A student in sixth grade said: *"I choose the lessons I don't understand, and I study them with it [Obeikan]"* (51.6.GD1). A student at the same level school said *"There are activities for lessons. I use it to train myself"* (50.6.GH4).

**Classera.** From the student interviews, it emerged that only one private school used Classera effectively in science learning. In the classes at this school, the teacher uploads the materials daily and students have to follow what she asks them to do. Most of the participants from this school agreed that using Classera was effective for their science study. For example, one of the fifth graders said:

> *I see the videos my teacher sent using Classera each day. In Classera, there is the weekly plan and many things like videos, homework, and learning plans. If you miss a worksheet, you can find it and print it via Classera. I sign into Classera, and I watch all the videos; if I don't understand something I text my teacher to explain it to me.* (2.5.PA2)

A brief response from her classmate mentioned that, *"Through Classera I can ask the teacher about the homework and anything I don't understand"* (5.5.PA5). A sixth grade student stated that:

> *The teacher presents part of the videos, but I go to Classera to see the full version of the video; it's easier than the book because the book has too many definitions. The teacher sends the homework, exams, and worksheets via Classera, and we answer them. I print them at my home and answer them at exam time.* (15.6.PA15)

**iEN.** During the data collection period early in 2016, iEN was a new program from Tatweer. Even though there had been only a few months of using this platform, some students recognised the effectiveness of using iEN in science. Many students were motivated and engaged by using iEN during their study of science. A fifth grade participant said *"I use it [iEN] to revise lessons"* (35.5.GB5). Another participant in sixth grade said that *"It is a useful website [iEN]; it explains lessons"* (41.6.GB1). Another student at the same level said *"I use it mostly for Math and Science; it is a site that explains [the subjects] in an ideal way"* (45.6.GF2).

In early 2016, Al Manahij and Obeikan were the applications that most students used while learning science in fifth and sixth grades in both government and private schools. As for Classera, in that period and based on a limited sample, only one private school from all schools that participated in the study used Classera in an effective way in the science classroom. The latest program by Tatweer was iEN; some interviewees from government schools used iEN and found it effective in their learning experience.

**d) Students' usage of ICT**

Students' use of ICT in their learning can help them to improve their development skills and to study independently. Homework is a sub-theme of the use of ICT in science.

**Homework.** Mixed responses were given regarding different methods of using ICT for homework. For example, students used it to search, create portfolios, and as an alternative to using a book that the student did not have. A student in sixth grade said that *"If there's a difficult question I search for the answer but I never copy and paste because it's plagiarism and doesn't benefit me or the other students"* (40.6. GB10). A fifth grade student spoke with enthusiasm about using ICT for her homework: *"We always make a portfolio about the lesson and write down all that we have learned using The Publisher program on the computer. The portfolio I made was*

*about classifying the animals according to the animal kingdom lesson"* (13.6.PA13). A co-student said, *"Doing homework in Classera is easier than using books"* (7.6.PA7). Another classmate said that *"I go to Classera and print the worksheet or short tests, and then I answer all the questions"* (8.5.PA8). Her classmate added, *"I do my homework with Classera. For example, I have an exam tomorrow. The teacher will give us a work sheet on Classera and we will answer it. If you get full marks, it means you understand everything"* (12.5.PA12). A student in fifth grade from a private school said *"If I forget my book at school, I do my homework on the iPad in front of my Mum and then the teacher doesn't punish me"* (21.5.PB6).

However, one interviewee in fifth grade said:

> *I don't use it too much for my homework unless I don't know an answer to some question. When I come back from school, I summarise the lesson through PowerPoint and review the lesson at the weekend. I got benefits from the [ICT] presentation in two subjects, science and computing.* (19.5.PB4)

**e) Availability of ICT in schools**

Providing schools with ICT tools and integrate effectively to assess teaching and learning processes. The number of ICT tools not important as the knowledge that how and when ICT integration asses the learning process. The most ICT tool available in the current sample was a data projector. One student mention that using the project in some lessons beneficial "*The projector is very good, if we don't understand the lesson such as, How animal eat, how the system of environmental, how volcanoes explode and how earthquakes disintegrate lessons, the teacher immediately views some related videos to help us understand better. I go over my iPad whenever I'm at my house to watch videos about earthquakes."* (2.5.PA2)

Other student stated that *"When the teacher uses the projector, helps me to remember the lesson."* (31.5.GB1)

### *6.2.2 Benefits of ICT Integration*

The students identified several benefits of integrating ICT in science learning. The researcher categorised these answers into four major themes and further sub-themes. The four themes were: Ease of use, Understanding, Interest level, and Knowledge (see Table 3.6 and Figure 3.5).

**a) Ease of use**

Delivering complex information about a new concept so that the greatest number of students understand that concept can be complicated and time consuming. Integrating ICT in science classrooms, such as by using videos or pictures, can simplify the information that is taught so learners can comprehend it better and faster. The responses from participants in the current study regarding the ease of ICT use have been divided into five sub-themes: enjoyment, understanding, communication, availability, and varied media.

**Enjoyment.** Most students interviewed do not want to spend long hours studying. They prefer ways of learning that are fast and easy, especially in difficult subjects like science, that involve many concepts and lessons and require more effort from students for a thorough understanding. Using ICT as a tool to explain lessons saves time, and allows students to enjoy the learning process. One student in a fifth grade class compared her experiences before and after using ICT, saying:

> *I love science, and using technology has made it better and easier, and I've learned more. For example, when I was in the first grade, the teacher explained lessons using the traditional board and it wasn't enjoyable for me… but using the Smartboard, I can understand more and don't forget the information*. (21.5.PB6)

A sixth grade student at the same school explained that *"the lesson becomes clearer and more enjoyable, whereas when she [the teacher] only uses the board, the lesson will be boring"* (27.6.PB12).

**Understanding.** ICT use in classrooms can help students understand their lessons with greater ease, and encourages the unmotivated, or those students with learning difficulties. A fifth grader asserted that *"it's [ICT is] easier and delivers the information quickly, and I understand more, and I remember the teacher's explanations in the test"* (24.5.PB9)*;* and *"videos and pictures make understanding easier"* (3.5.PA3). Some fifth graders explained in simple terms that with ICT, *"we understand better and faster"* (32.5.GB2). Sixth graders stated that *"using ICT in science makes the explanation easier for the teacher, and the students understand the lesson"* (34.6.GB4). Similar opinions from other participants were noted: *"it [ICT] makes the lesson easier for students to understand; they understand more than*

*when things are explained in the traditional way"* (52.6.GD2). One interviewee mentioned that *"it [ICT] eases the subject for those who have difficulty in learning, and they understand better because of the pictures and videos or special programs for them"* (45.6.GF2).

**Communication.** An important component to improving the learning process is the communication between teacher, students and parents. Effective communication in primary schools can clarify important information for all participants. Using ICT facilitates easier communication between stakeholders. In their interviews, some of the students in the present study emphasised that using ICT made the communication between student and teacher easier, improving the relationship between both parties. A fifth grade participant observed that *"ICT allows me to communicate with my teacher more and it makes the lesson easy"* (5.5.PA5); while another fifth grade student stated that, *"it [ICT] makes communication with the teacher easier, and it helps us to do our homework more easily as well"* (31.5.GB1).

**Availability.** ICT makes information and materials freely available to students, which encourages them to learn at the times most suitable to them. Several sixth grade interviewees stated that *"it [ICT] makes the information available; for example, if I am slow in memorising lessons, I just print the information or I write it down in a PowerPoint, and then I will remember it"* (20.5.PB5). A private school fifth grader said that, *"if you get sick in the future, you will know [the material] because you will be able to search for it before you go to the hospital"* (11.5.PA11).

**Different representations.** A large number of interviewees reported that using ICT made the learning process fast and easy. One student stated that:

> *It [ICT] facilitates the lesson, and it's faster and clearer when we view the lesson. Without the technology, there is no reaction from the students, because if the teacher is only using the book, the lesson becomes harder and the ideas become difficult to understand. The use of the technology makes it easier for the teacher to write a lesson; she writes it once and saves it, then uses it several times.* (27.6.PB12)

According to a sixth grade student, *"the learning process is improved by the use of videos. It becomes easier and clearer than the teacher's explanations"* (16.6.PB1).

Another sixth grade student from noted that *"science through technology becomes easier. For example, a microscope shows us the cells, and the projector makes the explanation easier for the teacher"* (37.6.GB7).

In this era, in which information is always available, enjoying the process of learning new information leads to a better understanding of topics, and fosters good relationships between students and teachers. ICT aids this by making the learning process clear, fast and easy.

**b) Understanding**

Most of the students stated that their main reason for wanting to use ICT to learn was that it helped them better understand school material. This implies that difficult lessons can be made clearer by integrating ICT to explain science concepts. Students associated their understanding with their enjoyment, ability to remember the material, ability to search for information independently, and the use of varied media to explain a concept. Accordingly, the researcher created the following sub-themes to document the students' explanations of their understanding.

**Enjoyment.** A fifth grade student said that *"ICT helps me to understand the lesson; lessons become more interesting and easier"* (33.5.GB3). A sixth grade student said ICT makes *"students understand better, and it makes learning enjoyable"* (9.6.PA9); another said it helped them *"understand more, and … enjoy studying with technology"* (13.6.PA13).

**Remembering.** One of the benefits of using ICT in primary schools is that it helps students not only understand but also remember information. This is because information that is memorised without a good understanding is easier to forget. A fifth grade student reported that *"science lessons are more understandable and unforgettable when I use technology"* (21.5.PB6); another student said, *"it's [ICT is] easier and delivers the information quickly, and I understand more, and I remember the teacher's explanations in the test which helps me to understand better, so when I go back home, I remember the explanation while I'm studying"* (24.5.PB9). A sixth grade participant had a similar opinion: *"I understand the lesson in a much better way, and it is more memorable"* (48.6.GH2); while another interviewee said, *"I can understand and remember information in the exam"* (52.6.GD2).

**Independent search.** Students reported that using ICT when studying science encourages them to be independent learners and search for information themselves, to avoid misunderstanding concepts. A fifth grade student explained that

> *When I need to understand something, I Google it. I don't play; I told my parents that I need an iPad because it helps me to learn and understand. It is important for me; I want to be excellent and be a doctor in the future.* (2.5.PA2)

A sixth grade student said, *"If I don't understand from the teacher's explanation, I search for information about the lesson to understand it better"* (53.6.GD3).

**Different representations.** Several interviewees explained that using ICT in addition to traditional methods when learning science improved their understanding of the learned concepts. A fifth grade student stated:

> *It [ICT] helps to deliver the information correctly and clearly. Misunderstandings might happen, or some of the girls may not understand the explanation when the teacher uses the board, but if she [the teacher] uses the videos and images, then the lesson will be clearer to us.* (26.6.PB11)

Another student from a sixth grade class claimed that ICT *"attracts students to study and helps them in understanding"* (41.6.GB1).

These associations between understanding the material taught and enjoying the learning, the ability to memorise, the ability to search for information independently, and the use of varied media to explain concepts, all reinforce that using ICT is perceived by students to help their understanding of science.

**c) Interest level**

Most students in the current generation want to enjoy learning, but to do so they need creative strategies to engage them in class. Some students in the present study stated that traditional ways of learning are boring and that they preferred to integrate ICT into their learning processes. The categorised student responses related to interest levels fall into two sub-themes: enjoyment and interactivity.

**Enjoyment.** Fifth and sixth grade students in both private and government schools all shared the view that using ICT when learning science makes the process

enjoyable. Fifth graders said that *"if the teacher uses games and videos, the class becomes enjoyable because books are boring"* (4.5.PA4); her classmate agreed, and said, *"Using technology in the learning process is more fun. Studying with books only is boring"* (14.6.PA14). Another student noted *"I enjoy using technology and studying at the same time"* (20.5.PB5). Another sixth grade student noted that *"Using a projector makes learning easy and interesting; viewing videos, images, and sound attracts us to the lesson and we concentrate better and follow the teacher more"* (26.6.PB11). A sixth grader asserted that *"[ICT] makes the learning easier for the students and the teachers and it also makes the learning process enjoyable"* (49.6.GH3).

**Interactivity.** Some sixth graders stated that ICT integration enhanced interactivity during science class, and that increased their interest in learning. It was also noted that using ICT in science lessons improved students' confidence in the classroom. This was demonstrated by a sixth grade student, who observed that *"it [ICT] makes the class more active and gives the student the chance to ask and answer more . . . without the technology, the students might feel shy and answer wrongly"* (36.6.GB6). Similarly, a student in the same grade said *"[ICT] encourages students to participate and they can ask if they don't understand"* (37.6.GB7). One student in a government school explained that *"lessons become easier and more active. Students become more interactive in class"* (36.6.GB6). Another student said of ICT that *"learning is more attractive and we get more benefits"* (25.6.PB10).

Upper primary students can compare traditional ways of teaching with emerging methods. These students identified their level of interest as important in engaging them to learn and to love a subject; they reported that the learning process is more enjoyable and interactive when ICT is used.

**d) Knowledge**

Expanding students' knowledge leads to improved student learning outcomes. Using ICT can encourage students to extend their knowledge by performing independent searches (depending on their skill levels in using ICT). In the present study, the student interviewees reported that ICT integration improved their knowledge of the topics studied. To better process their responses, the researcher created two sub-

themes under the knowledge theme: independent search, and different representations.

**Independent search.** Using ICT to search for additional information or seek explanations of difficult concepts aided students in their study of science. Fifth graders reported that *"I feel happy when I search on the Internet and find extra information"* (23.6.PB8)*;* and *"science is my favourite subject, so I like to search for information, and I like the speed and fun [of using ICT]"* (19.5.PB4). A fifth grade student said *"I search on the internet to find answers for difficult questions, and then I paraphrase them in my own words"* (33.5.GB3).

**Different representations.** Several fifth graders participating in the present study stated that using ICT improved their knowledge of science. One participant said that ICT *"gives me more information and I get more benefit; we can learn more information about the lesson"*(1.5.PA1). Another student described ICT as *"an interesting way of getting information"*(30.5.PD2). Even at eleven years old, these students realised that expanding their knowledge through searching for extra information could improve their understanding of complex subjects.

### *6.2.3 Disadvantages in using ICT*

Although many advantages of ICT integration in the learning processes were identified from the students' responses, several disadvantages also emerged from the interviewees' points of view. Fifth and sixth graders were able to identify two sides to using ICT in their current experience. The researcher created four sub-themes in the disadvantages theme: wasting time, health issues, lack of clarity, and technical issues (see Table 3.6 and Figure 3.5).

**a) Wasting time**

> **"**Time is like a sword. If you do not cut it, it will cut you" [traditional proverb]. Time is a very important dimension in a person's development, and it is not easy to divide one's time and avoid wasting it in the current age when there are lots of technological games and media applications. Teaching children to actively and effectively use their time is a challenge. However, interviewee responses showed that fifth and sixth graders were aware that ICT could waste their time if they used it ineffectively. A fifth grader said: *"Some students waste their time on the technology*" (31.5.GB1). Another student in sixth grade explained, *"I am neutral*

*regarding using technology because some students are using it negatively. Unless there is a way that the teacher can control student's access, so they cannot access non-academic sites."* An interviewee in sixth grade said, *"Instagram and Snapchat waste the students' time, but the students must learn science for a better future"* (39.6.GB9).

Using technological devices and social media can affect students' sense of time and lead them to be addicted to using technology to escape the demands of daily life and learning, and thus, may have negative effects on their learning outcomes.

**b) Health issues**

Using computers and iPads for a long time on a daily basis can have negative impacts on health; for example, prescription glasses may be needed because of impaired vision. Some students may get headaches from concentrating on the screen even though they are using ICT to enrich their knowledge. Several interviewees mentioned that ICT could hurt their eyes. For instance, a student in fifth grade said: *"It hurts my eyes a little bit"* (6.5.PA6). A sixth grader at same school added: *"If I use it for more than an hour at a time my eyes and head hurt"* (13.6.PA13). Another student in sixth grade at a government school explained that *"computers are harmful to health, damages the eyes and encourages laziness"* (44.6.GF1). A student in the same grade said: *"If I use a computer continuously it gives me a headache"* (48.6.GH2). Her classmate said, *"It hurts my eyes and ears if the sound is high"* (49.6.GH3).

Upper primary level students realise that using technological devices can affect their health even though they use them for learning. Therefore, the teachers should help students manage their time with ICT tools to avoid negative effects on their health.

**c) Lack of clarity**

ICT integration may not always be helpful because ICT use can become confusing for the learner. For instance, a sixth-grade student stated, *"When the teacher turns the light off, some students feel sleepy"* (4.6.PA4). Her classmate added, *"[ICT] makes us confused sometimes"* (9.6.PA9). Another student from the same grade said, *"Sometimes the sounds or videos are not clear"* (16.6.PB1). A sixth grader explained that *"Sometimes the teacher will rush the lesson and that will put me under pressure, so I can't understand very well. Sometimes the device does not*

*work"* (25.6.PB10). A sixth grader said: *"The sound and images might not be clear, so we can't understand the information very well"* (46.6.GF3).

When using ICT in the classroom, it is essential to make sure that the materials are suitable for the students' level of understanding. Further, the visibility and the sound of devices need to be clear to achieve the aims of ICT use.

**d) Technical issues**

The most common problem that could hinder effective ICT use in schools is technical issues. A couple of students mentioned that a disadvantage of using ICT is technical problems. A student in fifth grade explained that *"If the device is damaged we will lose the information, so you have to save the information on a CD"* (17.5.PB2). Her classmate added, *"It's annoying if the internet connection is slow"* (19.5.PB4).

The ICT disadvantages identified by students in fifth and sixth grades reflect that this generation of primary school students are able to see the two sides of ICT integration in science learning. Taking care of time and health are important aspects for positive development of members of society. Using ICT to enhance learning with minimal technical issues can contribute to education of students for a strong society.

The benefits of using ICT in the learning process, based on interviewees' responses, are summarised as: improvement of students' understanding, ease of use, raising interest levels, and developing knowledge. The current state of ICT integration in Saudi Arabia has been reviewed by analysing the study participants' experiences with the use of educational applications, the effect of the teacher's role in their ICT usage, and the effect of ICT integration on students' learning outcomes. Delivering the students' point of view to the decision makers can contribute to more effective ICT integration in the teaching of science in Saudi Arabia. The students' suggestions, as expressed and recorded here, should be noted in policies and practices to improve the learning process. Based on the majority of interviewee responses, both the advantages and disadvantages of using ICT are relevant to the process of integrating ICT in science education in primary schools.

### *6.2.4 Students' suggestions about improving ICT integration in science*

Students' suggestions are pertinent because their users' points of view can suggest ways of improving the learning system in Saudi Arabian schools. Most of the participants had similar suggestions, but some students made interesting points, for example, co-teaching time, and educational activities (see Table 3.6 and Figure 3.5).

**a) Co-teaching**

A sixth-grade student thought that students' use of devices could be better controlled; for instance, if there were two teachers supervising them: *"[we could] use the internet, and have two teacher assistants to supervise and control students' access and use of technology"* (38.6.GB8).

**b) Time**

A sixth-grade student emphasised that time was an issue. She suggested: *"Increase the class time for science, so we have time to understand and get more topics"* (28.6. PB13).

**c) Educational activities**

A couple of students in different grade levels suggested that extra educational activities were needed in science class. For example, a fifth-grade student said, *"[the teacher should] provide more sites for science and encourage students to learn more using technology"* (10.5.PA10). A sixth-grade student said, "*[our teachers gives us] an activity via computer after each lesson; this is done now. However, I would like the number of activities to be increased, to ensure we have a full understanding of the lesson"* (26.6. PB11).

**d) Devices**

The majority of interviewees suggested that extra devices should be provided in the classrooms. The most common devices they mentioned were computers and iPads. A student from fifth grade said, *"Please provide computers and laptops instead of books - books get lost"* (4.6.PA4). A student in the same grade level suggested: *"Please provide more microscopes, because two is not enough. Also, we need more computer devices"* (17.5.PB2). Her classmate said: *"Please provide iPads to get away from the heavy school bags, and as a tool to simplify learning"* (18.5.PB3). Another participant in the same class explained:

> *Each school must have lots of technical devices. I would like to be an inventor when I am older. I will create a device and call it Book; all curricula will be there from grade 1 to 12. Any updates will be reflected. It will be used in all schools. It will include e-Pen. It will be one device that will be used by the student from the first year she enters the school until she graduates from secondary school. I also suggest that exams should be online using EDMODO. Like in secondary school, my sister in grade 11 is using it. They locate the date and time, and the correction is automatic after the exam.* (20.5.PB5)

A fifth-grade student requested *"Please provide us with iPads. For example, when the teacher asks us to read about a specific topic, and when there is time in class, we can read and have a competition"* (31.5.GB1). Some students suggested that schools should have Smartboards; a participant in sixth grade said:

> *It would be good to have Smartboards in all classes (we only have Smartboard in the math class and science labs). Also, please provide iPads, as our bags are heavy and cause back pain. IPads motivate students to learn and decreases the number of low achieving students.* (35.5.GB5)

A classmate also requested iPads but acknowledged that *"it is difficult to control students. Therefore, projectors and Smartboards would be better"* (36.6.GB6). Another interviewee at the same school said: *"Please provide computer devices, e.g., ten devices in each class. Because then if I don't understand something, I can do something about it. Now, we only have one device in our class, and this is not enough"* (41.6.GB1). A sixth-grade student requested iPads claiming that *"learning is boring without technology"* (46.6.GF3). A student at the same grade level suggested: *"Use devices instead of books and bags. Because they are heavy. Not to use [the device] for entertainment but to make learning easy. We are in a time of [technological] development"* (47.6.GH1).

The most common suggestion from most interviewees was to provide more devices in the classroom in order to increase the opportunity for all to integrate ICT into their learning experiences. However, there were other interesting and useful suggestions such as using a co-teaching method, increasing lesson time for science, and offering extra activities. Using different applications in science learning can enhance

students' motivation to learn science. Some students interviewed appeared to be using ICT effectively as a tool for doing homework. The teacher's role is central, and the students were keen to follow their teachers' instructions. In general, the responses to the interviews showed that students' learning outcomes can be positively affected by integrating ICT effectively.

### 6.3 Summary of the Chapter

This chapter has discussed students' points of view based on their current experience in using ICT in the science classroom. The majority of responses expressed similar positive attitudes towards integrating ICT. The students explained the benefits of using ICT in learning science as: improvement of students' understanding, ease of using ICT, high interest level, and expansion of students' knowledge. According to the students' responses, ICT integration in science is represented at several methods: applications, ICT usage in learning science, teachers' role, and the enhancement of learning outcomes. The researcher asked participants to suggest ideas to improve ICT integration in science classrooms. Although almost all students who participated in the study had a positive attitude and high interest in using ICT devices in their learning process, they were aware of some disadvantages of using ICT devices .

# CHAPTER 7

## TEACHERS' INTERVIEW RESULTS

### 7.1 Introduction

This chapter presents data collected from interviews with the selected science teachers in the primary schools. The interviews consisted of Research Question 3 targeted at evaluating current teachers' perceptions of: ICT integration in science teaching; the benefits of integrating ICT; concerns about using ICT; and suggestions for the development of ICT integration in schools. Section 7.1 introduces the chapter. Section 7.2 discusses the teachers' views of ICT integration based on their current experience, which divided to four themes, ICT integration in teaching process which includes six subthemes and the benefits of ICT integration. Follow with presents teachers' suggestions for improving the effective use of ICT in science as a third theme. Also, summarises the fourth theme, disadvantages of using ICT, based on the teachers' point of view. Section 7.3 summarises the chapter.

### 7.2 Teachers' perceptions of ICT integration in science teaching

One aim of the study was to investigate teachers' perceptions of using ICT in their current teaching processes by asking them to explain their experience of using ICT and to give their opinions regarding the role of integrated ICT in their teaching experiences. The teachers' responses were divided into the following categories: ICT Integration (Section 7.2.1), Benefits of ICT Integration (Section 7.2.2), Disadvantages (concerns) Regarding ICT Integration (Section 7.2.3), and Suggestions to Improve ICT Integration (Section 7.2.4). As shown at Table 7.1 and Figure 3.7 represented themes based on analysing teachers' interviews and the Hierarchy chart represent the main themes, sub-themes, and nodes of teachers' responses to interviews based on NVivo software.

Table 7.1 Themes based on analysing teachers' interviews

| Themes or categories | Sub-themes or sub-categories |
|---|---|
| ICT Integration | *Students' learning outcomes* |
| | *Improved teaching skills* |
| | *School's role* |
| | *Teachers' usage of ICT* |
| | *Students' usage of ICT* |
| | *Applications* |
| Benefits | *Ease of use* |
| | *Enjoyment* |
| | *Understanding* |
| Disadvantages | *Time* |
| | *Lack of clarity* |
| | *Technical issues* |
| Suggestions | *Devices* |
| | *Continuous professional development* |
| | *Different representations* |

### *7.2.1 ICT Integration*

The majority of science teachers (81.6%) in the selected primary schools are eager to integrate ICT in education processes and use several methods to do so (see section 5.4.4). In this study, participants shared lots of examples to explain how ICT can be used effectively in science. Using NVivo, the researcher created six themes based on interviewees' responses, representing the extent of ICT integration in their current teaching experience (see Figure 3.7). the first theme was *students' learning outcomes*: some teachers explained how ICT integration could have a positive impact on students' educational level and the main point was because using ICT help students to have better understanding in science; encourage students to be self-learners; and integrating ICT in science lesson can engage students attention. The second theme was *improving the teaching skills*: several teachers mentioned that

they have to improve their teaching skills by using ICT in teaching science by conducting independent searchers; some teachers attend workshop to develop their teaching skills; others searched by themselves and attended workshops that the schools offer them. The third theme was the *schools' role* which is significant to encourage teachers to integrate ICT in their teaching by offering professional development seminars and providing ICT devices. The fourth theme was *teachers' usage of ICT*; some teachers explained how they integrated ICT tools in the teaching process, most commonly with multimedia (videos and picture) to have different representations of the topic. The fifth theme was *students' usage of ICT*; in this theme ten teachers mentioned some examples on how students' using ICT in their learning process. The sixth theme was related to *applications* that aid teachers in their teaching process.

**a) Students' learning outcomes**

ICT integration can improve students' learning outcomes because using ICT could raises students' educational level, encourages them to be independent learners, and attracts students' attention.

**Improving students' educational level.** Most of the teachers agreed that using ICT can improve students' grades because it helps them to understand better. Furthermore, some teachers mentioned that using ICT in the learning process enhances students' remembering. One of the interviewees who taught science for seven years in a private school said that, *"[ICT] makes their results better because the technology helps them to understand better"* (8.PE1). Similarly, another teacher with seven years of experience stated, *"Of course it makes the subjects easy to understand, and some students bring pictures related to the lesson"* (19.GF1). Another teacher with four years' experience believed that ICT *"Increases the efficiency of the students and they achieve the highest results"* (10.PE3). A teacher with 22 years teaching experience said, *"[ICT] makes the information clear and helps the students to remember very fast"* (1.PA1). A teacher who had taught science for five years mentioned that, "*The students' marks reflect how much they're able to understand the subject"* (9.PE2). On the other hand, a teacher with seven years of experience in a private school said,*"It can have little effect; actually it depends on the student, if they are studying or not; 40% is up to the teachers and 60% is up to the students"* (7.PC1).

**Independent learners.** Some teachers considered that using ICT to learn science encouraged students to be self-learners even though they were in primary school. It is important for students to become independent learners, rather than relying on the teacher or their parents. A teacher with seven years' teaching experience in a private school said that *"[Using ICT] makes the students depend on themselves"* (11.PE4). Another participant with 21 years of experience answered: *"Of course it [ICT] improves them, because they search by themselves"* (13.GL1). Similarly, a teacher who had taught science for more than 30 years said that *"[ICT] makes the students depend on other things than the teacher, because some students feel that the teachers are boring and put them under pressure"* (21.GB2).

**Attracting attention.** Several teachers emphasised that using ICT attracted students' attention and helped them to have a better understanding of science, which improved the students' learning outcomes. A teacher with three years' experience stated that ICT *"raises the students' level [of learning], attracts their attention; it helps the students to understand better, and it also helps the teacher to know the students' weaknesses and to be sure that they are reading correctly"* (2.PA2). Similarly, a teacher who taught science for four years explained the effect of using ICT on students' learning outcomes:

> *[I] could see that the students had better understanding; [ICT] attracted their attention and because of that it affected their results in a positive way, and the class became excited. Also, [ICT] reduces the effort needed of the teachers during class.* (3.PB1)

Her colleague had a similar point of view *"[ICT] attracts students, helps them and they enjoy learning with it"* (5.PB3).

**b) Improved teaching skills**

A common factor of ICT for teachers regards the opportunity that ICT presents for improving their teaching skills. Some of these interviewed teachers explained that they developed their skills by searching independently. Others stated that they developed their teaching skills by attending workshops. However, three teachers said that they improved their teaching skills by using both independent searching and attending workshops.

**Independent searching.** Six participants, three from private schools and three from government schools, mentioned that they searched for new information and were updated as much as they could manage. Although they were from different types of schools, they had similar perspectives on this point. Private school interviewees spoke of how they improved their teaching skills; a teacher with three months' experience said she did so *"By searching and trying to simplify the complicated information especially for elementary students to help them to understand it easily"* (5.PB3). A teacher with five years' experience said she improved her skills *"Through searching or reading the information then simplifying it, to say it in an easy way, especially for students in elementary school"* (4.PB2). A teacher with seven years' experience stated she updated her skills *"Through keeping up with learning sites and learning to use them in class"* (11.PE4). The government school teachers had a similar opinion. One teacher who had taught science for 13 years said that it was important to *"Keep up with everything that is new and keep renewing your information"* (14.GK1). A teacher with 20 years' experience explained:

> *I improved myself by myself, I didn't attend any course in the school. I like to increase my information so I can answer all my students' questions, especially those who are excellent and want to ask many questions. Sometimes I know the answer but I want to know more about it, so I request the student who asked to search more on the internet and then explain the answer to her colleagues.* (17.GC1)

A teacher with 21 years of experience said that *"The more you have knowledge, the more you are going to use technology in the right way"* (13.GL1).

**Workshops.** Some teachers from both government and private schools responded that they improved their teaching skills by attending workshops and courses. For example, two teachers from private schools, one with four years and the other with seven years of teaching experience, stated that they improved their teaching skills *"Through training courses and workshops"* (10.PE3 & 12.PE5). Two teachers from government schools, one with 19 years and the other with 26 years of teaching experience, had a similar response to how they improved their teaching skills *"Through attending courses and providing devices and tools"* (15.GK2 & 20.GB1). However, one teacher from a government school who had 18 years' teaching

experience said, *"I have a limited experience because I only use projectors"* (18.GC2).

**Both searching and workshops.** Three teachers stated that they enriched their knowledge by searching and attending workshops to develop their teaching skills. For example, a teacher with seven years' experience said that she *"Searches about everything that is new that serves the educational process and I attend workshops"* (8.PE1). Similarly, a teacher who had taught for four years stated, *"I improved myself by searching and attended courses in school and learned how to use Smartboards"* (3.PB1). A teacher who had taught science for 22 years explained:

> *When I worked in a private school before I didn't know how to use a computer but I taught myself. I faced some difficulties in preparing lessons and sometimes I cried from the pressure, but I improved myself by asking my colleagues; after that I attended courses in the school.* (1.PA1)

**c) School's role**

Teachers' performance can be affected by the role of school administration. Therefore, if schools ask teachers to integrate ICT into their teaching process, they should be prepared to provide the ICT devices and offer professional development seminars in order to introduce the technology tools and teach the staff how to use them. Thus, the researcher created two sub-categories under the school role category: Professional Development and Devices.

**Professional Development.** Providing workshops to teachers in the different areas that they need to develop in is vital for developing their teaching skills. Some teachers stated that school management encouraged them to integrate ICT into their teaching to develop the educational process. How well they did this affected their yearly performance as teachers. A teacher with seven years' experience said that *"The most important things to improve the school are to encourage the teachers to use technology in their classrooms is through workshops, and for the teachers' plans to include evidence of their implementation"* (8.PE1). A teacher with 18 years of teaching experience said, *"Integrating technology in education affects the teachers' yearly functional performance and encourages them to use technology in their teaching"* (18.GC2).

To sum up, providing ICT tools for the classroom is not sufficient to ensure effective ICT integration in science education. Schools need to offer workshops and encourage teachers to use the technology to improve the educational system. Based on these teachers' responses, the roles of schools, improving teaching skills, and students' learning outcomes were the main categories, each with sub-categories. Students' usage of ICT could be affected by their teachers' usage of ICT, which is related to applications and educational websites. All the previous classifications fall under the main category, which is ICT integration.

**Devices.** Several participants commented that their school provided them with devices and repaired them if there were any problems. For example, one of the teachers who had taught for 22 years said, *"The administration always encourages us and provides Classera programs and they always check if the teachers are using it or not"* (1.PA1). A teacher with five years' teaching experience mentioned that her school *"Encourages us a lot by providing devices and fixing them and provides the tools that the teachers need"* (4.PB2). Her colleague with just three months' experience added: *"They encourage us by providing devices in every classroom such as Smartboards and tools"* (5.PB3).

**d) Teachers' usage of ICT**

ICT tools are available in government and private schools. Provision of different ICT tools in the classroom does not necessarily improve the education process unless the teachers use them in appropriate and effective ways. Some teachers in this study explained how they used ICT devices and others just mentioned what tools are available in the classroom. For example, a teacher with 20 years of teaching experience said:

> *I bring an IPad with me sometimes but it takes time, because every student wants to use the iPad, but there's not enough time. The projectors give all the students the chance to use it [ICT], and because of that teachers prefer it. I present pictures that the book doesn't have, like Mother Bear, to attract them.* (17.GC1)

Similarly, a teacher with three years' experience explained:

> *[I use] laptops, projectors to play videos, documentaries, and sometimes experiments that are hard to do in the lab. I use iPads to practice some strategies; I found it useful, but it's hard to use IPad because not all the students have it.* (6.PD1)

Use of the teacher's IPad and sharing the learning materials with each student tends to waste the class time. In this study, there were similar learning environments with some variation in access to devices (See Section 5.4.1); the teachers preferred to use the data projector so that all students could see the presented materials at the same time. Another interviewee with 22 years' teaching experience described her practice in the use of ICT in class: *"I use iPad, projectors and interactive whiteboard, but in my opinion Smartboard is very helpful, especially for elementary students, because I can attract their attention by engaging them in games"* (1.PA1).

This teacher (1.PA1) found from her experience in using several devices in her class that the Smartboard was very effective for teaching and learning science. Therefore, the effectiveness of using ICT in science class depends on the methods that the teacher uses, and how well it works with her students. In other words, effectiveness does not depend on the number of devices in the class, but on how much benefit both teachers and students gain from the use of these devices.

Teachers from two government schools interpreted the benefits of using ICT while explaining the lessons to the students. A teacher with 21 years' teaching experience described how she used ICT:

> *The scientific movies, the scientific experiments such as reproduction and cell division. The students had an exercise in their books about cell division; it wasn't clear to them. But they understood when they saw a movie about cell division and embryo development. Their knowledge about cell division grew when they saw the movie.* (13.GL1)

Another teacher who had taught science for 13 years said that she used *"... projectors, microscopes, while the students are doing an experiment on a slide, or watching animation videos on YouTube for the digestive system or blood cells; that helps them to remember the experiment, using laptops and microscope"* (14.GK1).

Some participants described their practice briefly; for example, a teacher with seven years' experience from a private school stated that she used *"projectors, Smartboard and PowerPoint"* (PC1). Another teacher with seven years teaching experience said, *"I use projectors and I'm supposed to use the Smartboard, but I don't know how to use it"* (19.GF1).

**e) Students' usage of ICT**

There were mixed responses from interviewees regarding students' usage of ICT. Some teachers asked their students to do some searching and research and apply it to their lesson preparation [for example, the Little Teacher Project]. Other teachers did not force their students to use technology during the learning process. Some teachers said that the students' parents did not allow them to use technology during weekdays. One teacher with 20 years' experience explained:

> *The students prepare PowerPoint saved on a CD, sometimes they prepare more than one, so I introduce the first one and we give comments on it and thank the student, then the second one etc. .... Also, we have [little teacher project], where the students act as teachers and explain the lesson.* (16.GC1)

A teacher with 13 years' experience said that *"The students might present in front of the class or as a group and my role is to guide them [Little Teacher Project]"* (14.GK1). Another teacher who taught science for five years said that *"students do research and make brochures"* (4.PB2). A teacher from another private school who had seven years' experience mentioned that *"Most of the students are using technology on Classera"* (7.PC1). A teacher who had taught science for 21 years explained that *"We have activities called science and writing, science and society; we ask students to search on the Internet and solve a problem. Also, the book tells them to go back to the Obeikan site"* (13.GL1). A teacher who taught science for seven years stated, *"I ask students to do research and working papers but I don't force them"* (19.GF1). Some teachers had different experiences with their students; for example, a teacher who worked for 18 years said that *"A few of the students use the internet to search for extra information but I think the parents haven't encouraged them to use technology"* (18.GC2). Similarly, a teacher with 26 years of experience said *"No, because the parents don't accept it"* (20.GB1).

These two teachers (18.GC2 & 20.GB1) had similar experiences when their students' parents did not allow their children to use computers or search on the internet at home. Therefore, students' parents' play a vital role in students' usage of ICT.

**f) Applications**

There are common applications and educational sites that used by teachers from government and private schools in Saudi Arabia; for example, Obeikan, and Math and Science Lighthouse (Manarat AlOloum & Alriyadyat) websites: http://www.mathandsci.org/vb/. There are other applications that are used by teachers according to their student's needs. Some participants use several applications while teaching science; for instance, a teacher who taught science for seven years explained that she uses: *"Experiments on YouTube; I use Obeikan at home to search for information, and I use Classera to do some tasks. I set daily or weekly homework and videos [for the students;, and finally, there are discussion rooms that some students interact in" (7.PC1). Another teacher with five years' teaching experience shared what she used during teaching science:*

> *Math and Science Lighthouse (Manarat AlOloum & Alriyadyat) and Obeikan sites. I encourage my students to search at the beginning of every class; for example, I tell them new strange things like, there's a plant that eats insects, and then I tell them to research a specific video in YouTube."* (4.PB2)

Similarly, a teacher with 21 years' teaching experience said that *"I use Obeikan to verify my information. In the students' book, it's written in the footer, 'go back to Obeikan site.' According to the new iEN application not all the students have a background of using it [iEN application]"* (13.GL1). However, a teacher with 17 years' experience had another point of view regarding Obeikan: *"I don't find enough information in the Obeikan site so I search in Google to find information that fits the age of the students and the curriculum"* (16.GD1).

### *7.2.2 Benefits of ICT Integration*

Based on the teachers' responses, many benefits of ICT integration in teaching science were identified for both students and teachers. The researcher categorised participants' points of view as follows: Ease of use, Enjoyment, and Understanding (see Table 3.7 and Figure 3.7).

**a) Ease of use**

One of the aims of ICT integration is to enhance students' learning strategies with the teacher as facilitator, and add diversity and attractive factors to the learning process. The majority of interviewees had similar perceptions regarding ICT integration in science classes. Using ICT can simplify the teaching and learning processes as well. Participants commented that ICT makes explanations of complex material easier for teachers and students. It also increases the class's enjoyment of lessons, and improves their ability to remember information. Despite the differences between years of experience and school type, teachers' responses were similar. For instance, one participant with 22 years' experience said that ICT *"Helps the teacher to explain easily and the students to understand faster"* (1.PA1). A teacher with three months' experience stated that ICT *"Makes it easier for students and teachers, rather than talking all the time, we can simplify the information"* (5.PB3). A brief and inclusive response from a teacher who had taught for five years said that *"[ICT] delivers the information in an easy, fast and simple way*." (9.PE2). Other teachers had a similar view; one of the interviewees who had taught for 13 years said that *"It makes teaching easier, shortens the time, helps the students memorise information, expands students' perception and benefits them" (14.GK1). Another participant with 17 years' experience said that "It makes teaching easier for me, benefits the students more, lets the students ask more questions, and I can keep the class active"* (16.GD1). A teacher with more than 30 years' experience explained her current experience:

> *It helps me very much to explain using technology rather than using the traditional methods. Every class is different, some classes help me to teach using technology, but other classes waste time. I played a video while teaching the good classes, but I couldn't play it in the naughty ones because of a large number of students in the class and they wasted time.* (21.GB2)

A brief response from a participant who has taught science for 18 years was, *"[ICT] shortens the teachers' efforts and time, and provides valuable information."* (18.GC2). In summary, ICT integration is perceived to not only make the educational process easier for students, but also facilitates teachers' effective use of their teaching time.

**b) Enjoyment**

Teachers of primary level students need to use attractive tools and methods to engage students in science; using ICT during lessons enhances students' enjoyment while they are learning. Several participants shared their point of view based on their experience as science teachers. A participant with four years of teaching experience said that *"The class becomes exciting and the students participate more. Also, students get the ideas through videos or games with less effort"* (3.PB1). Another participant who taught science for three years commented that with ICT, the students were:

> *More excited, but I don't rely on technology 100% because I might forget my laptop or the projector breaks down. It's a way to help explain lessons. Moreover, some students get bored during the class, but whenever I play a video, they get excited.* (2PA2).

A teacher who has taught science for 20 years explained her experience in integrating ICT:

> *I love teaching my students and I enjoy integrating technology with teaching, it makes teaching easier and it saves time. Rather than wasting time opening the book on a certain page I open it using my projector. This way helps us to follow the lesson together and helps to get their attention.*
>
> *It helps me a lot to present the experiments that I can do in the class, like sulphur and the division process in cell experiments. The sulphur experiment is toxic, and I explain the experiment to them by viewing pictures.* (16.GC1)

On another topic, besides the enjoyment that can be experienced when ICT is integrated in science teaching, it can also enhance students' safety during the lessons. Especially when the lesson includes experiments that need some hazardous elements, such as sulphur, which are difficult for young children to use. Therefore, presenting a video or picture for the experiment's steps can help the teacher to explain the experiments to her students.

**c) Understanding**

Students' understanding is a vital factor in achieving the aims of the learning process. Teachers in this study emphasised that ICT integration helps students to

have a better understanding. A teacher with three years' experience said, *"I'm so happy using technology while teaching because it helps the students to understand in a better way"* (2. PA2). Her colleague with five years' experience added *"[ICT] improves a lot, especially for students who learn by listening or others by seeing things"* (4.PB2). A teacher with seven years' experience stated that, *"The students can do the interactive experiments on their IPads or researches that help them to improve their understanding"* (8.PE1). A teacher with 18 years' experience mentioned that *"Using ICT helps student have better understanding, but our use of the technology is still limited"* (18.GC2). This participant, with a variety of experience, agreed that using ICT could improve students' understanding of science.

### *7.2.3 Disadvantages in using ICT*

Teachers certainly perceived that using ICT in primary school science classes enhanced the educational process. However, interviewees' responses identified several issues that hindered the benefits of ICT integration in schools. Therefore, the researcher created three sub-categories of disadvantages, based on common answers: Time, Lack of clarity, and Technical issues (see Table 3.7 and Figure 3.7).

**a) Time**

Each lesson differs in the time and the effort needed to deliver content to the students. Teachers need to prepare the lesson well to cover all the main ideas and achieve all the goals that are planned for the lesson. However, numerous participants said that using ICT during the class could need extra time in some cases; one teacher with 20 years' experience remarked, *"Sometimes it needs more time"* (17.GC1). A similar issue was identified by another teacher in a private school, who had taught science for three years, *"Sometimes the technology needs time and the time for the class might not be enough"* (6.PD1).

**b) Lack of clarity**

There may be some ambiguity regarding incorrect use of ICT in educational processes, and this may affect learning outcomes negatively. A teacher with three years of experience said, *"If the lighting is dim [when viewing a video for example] it makes the students sleepy, and the writing skills of the students tend to deteriorate"* (2.PA2). A teacher with 13 years of experience mentioned that, *"The student might search and find wrong information. In some schools it's hard for*

*parents to see the teachers face to face because the main contact with the teachers is via emails"* (14.GK1).

**c) Technical issues**

Some participants agree that one of the factors hindering successful integration is that technical problems may arise with the ICT tools. Several interviewees from private schools had similar perceptions on this point. For instance, a teacher with three years' experience said that *"The devices get damaged and they need time to fix them"* (2.PA2). A private school teacher with 13 years' experience mentioned that *"users damaged the devices sometimes"* (3.PB1). Two teachers mentioned the need to provide fast speed internet connection in schools. A teacher with seven years' experience mentioned that *"ICT needs strong internet connections and extra time"* (8.PE1). Her colleague stated that *"Connection is slow or sometimes the students forget their iPad"* (12. PE5).

### *7.2.4 Teachers' suggestions about improving ICT integration in science*

Teachers' recommendations are an important factor in improving ICT integration in school. The researcher asked the participants for their perspectives and suggestions; several said that they wanted to develop ICT integration to be more effective in teaching science in primary schools. Therefore, the researcher created three sub-categories that summarised teachers' suggestions: Devices, Continuous professional development, and Different Representations (see Table 3.7 and Figure 3.7).

**a) Devices**

Based on interviewees' responses, there is still the need for more ICT tools in both government and private schools. Teachers from both types of school had the same suggestions regarding devices. One teacher said that, *"All the classrooms should have computers and projectors"* (2.PA2). Another teacher said, *"My suggestion is to provide Smartboards, projectors and prepare the lab with all the important tools"* (3.PB1). Other teachers commented on the need for extra devices. One participant with 13 years' teaching experience said that the school should *"Provide labs that have all the tools like computers and Internet to encourage the student to search, especially in their free time"* (14.GK1). Another teacher with 20 years' teaching experience recommended that the school *"Provide projectors and computers in all the classrooms"* (17.GC1).

One teacher said the school should "Provide devices and tools and examine the teachers' experience with the technology" (20.GB1).

**b) Continuous professional development.**

Several participants emphasised that offering professional development opportunities constantly will encourage the teachers to develop their skills. Access to educational databases can enhance and enrich teachers' knowledge. One interviewee with five years' teaching experience said:

> *Activate the technology in private and public schools and offer courses. I took a course about how to use Smartboard in the school. Teachers can learn by themselves in their homes as well. I learn from home or from a teacher who teaches secondary students, but if there are courses outside the school it would be better.* (4.PB2)

A brief response from another teacher who had worked for five years was: *"Offer continuous training courses to improve the teachers' ability [to teach]"* (9.PE2). Another way to develop skills regularly is to use educational databases, as some interviewees suggested. For example, a recommendation from a teacher with seven years of experience in a private school was, *"There is a need to open and register at educational websites"* (11.PE4). Similarly, a teacher who taught science for 21 years explained *"Provide the right learning resources and tools, and have the teachers attend courses"* (13.GL1).

**c) Different representations**

Most interviewees commented that ICT integration should be improved in primary schools by providing more devices and offering access to educational platforms. However, several teachers suggested other ideas. For example, one teacher with seven years' experience said, *"I wish the [administration] would provide classrooms especially for science subjects so that the students come there rather than the teacher going to their classrooms"* (7.PC1). Another participant with the same years of experience made three suggestions on the need for: *"Providing a strong connection, training teachers on the latest applications that can be used, and registering for some applications"* (8.PE1). A teacher with 17 years' experience said, *"My suggestion is that they should focus on the teachers and decrease the number of classes from their teaching Tables"* (16.GD1). A teacher with 18 years'

experience recommended *"Reduce the curriculum, provide many options and give the teachers the chance to choose what technology they want to use, and do not limit it to the courses in the educational field only"* (18.GC2).

Although the teachers interviewed differed in their years of teaching experience and school type, they had similar suggestions regarding effective ICT integration in science: offering extra ICT tools and regular workshops were the most common suggestions.

### 7.3 Summary of the Chapter

This chapter has presented science teachers' perspectives on their current experience in integrating ICT in the science teaching process. Analysis of 21 interviews with these primary school teachers revealed some common points of view about the benefits of using ICT, the methods for ICT integration in the science classroom, and some suggestions for improving the effective use of ICT. However, as well as the many advantages of ICT integration that teacher participants identified, there were some disadvantages perceived in the integration of ICT in science teaching.

To conclude, teachers' perceptions of ICT integration in science education were based on their use of ICT in the classroom and the learning outcomes they had achieved. Although the sample of teachers was selected from different types of schools and they had a variety of years' teaching experience, from three months to more than 30 years, they had similar points of views. From these results, it can be concluded that these science teachers in primary schools who participated in this study perceive the importance of using ICT in science teaching but identifying some barriers that limited their full and effective use.

# CHAPTER 8

## COMPARISON BETWEEN PARTICIPANTS' PERCEPTIONS OF ICT INTEGRATION IN SCIENCE

### 8.1 Introduction

This study used triangulation to cross-verify data obtained with mixed methods from the students and teachers (see Section 3.2). This chapter analyses the triangulated findings from students' and teachers' responses to compare their perceptions of ICT integration in science, which were explored through quantitative surveys and qualitative interviews. Following this introduction, Section 8.2 compares the quantitative results for students and teachers. Section 8.3 compares the qualitative results for students and teachers according to four themes: ICT integration, benefits of the use of ICT, disadvantages, and suggestions. Section 8.4 summarises the chapter.

### 8.2 Comparison of quantitative results for students and teachers

The quantitative results of students' and teachers' perceptions are compared in terms of scale reliability, the availability of ICT in schools, and use of ICT applications for learning and teaching science.

#### *8.2.1 Scale reliability*

In this study, the researcher used Cronbach's alpha coefficient to measure internal consistency. Table 8.1 presents the Cronbach's alpha coefficient for each of the five scales for the Students' and Teachers' Attitudes Towards and Knowledge of Technology Questionnaire. The value of Cronbach's alpha suggested for each scale be 0.7 or higher to measured as reliable (Bland & Altman, 1997). In the current study, all values are similar across scales for both students and teachers. Three scales were Interest in ICT; Knowledge of ICT; and Learning/ Teaching with ICT, with Cronbach's alpha coefficients greater than 0.70. The Cronbach's alpha coefficients for the other scales were slightly lower than the value of 0.70 (See Section 4.3 and Section 5.3).

Table 8.1 Descriptive statistics and internal consistency (Cronbach alpha reliability) for five scales of the Students' and Teachers' Attitudes Towards and Knowledge of Technology Questionnaire

| Scale | No. of Items | Students | | | Teachers | | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | α | Mean | SD | α |
| 1. Interest in ICT | 8 | 4.54 | 0.45 | 0.74 | 4.45 | 0.36 | 0.74 |
| 2. Attitude toward ICT | 5 | 4.61 | 0.52 | 0.66 | 4.16 | 0.43 | 0.63 |
| 3. Knowledge of ICT | 9 | 4.68 | 0.39 | 0.79 | 4.53 | 0.41 | 0.84 |
| 4. Learning/ Teaching with ICT | 10 | 4.62 | 0.40 | 0.75 | 4.45 | 0.35 | 0.76 |
| 5. ICT usage | 7 | 3.43 | 0.77 | 0.68 | 3.87 | 0.59 | 0.66 |

SD: Standard deviation; α: Cronbach's alpha coefficient.

### *8.2.2 Availability of ICT in schools*

Table 8.2 presents a comparison between students' and teachers' responses regarding the availability of ICT in schools. The results for students and teachers are explained in details in Section 4.4.1 and Section 5.4.1.

Table 8.2 Comparison of student and teachers' responses regarding perceived availability of ICT in schools

| ICT tools in schools | Students | | Teachers | |
|---|---|---|---|---|
| | *n* | % | *n* | % |
| Computer | 600 | 42.8 | 43 | 87.8 |
| Data projector | 1,144 | 81.7 | 47 | 95.9 |
| Smart whiteboard | 713 | 50.9 | 25 | 51.0 |
| Tablet/iPad | 124 | 8.9 | 19 | 38.8 |

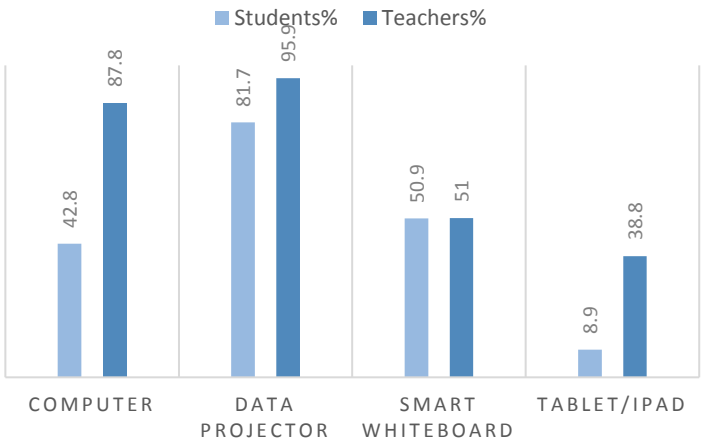


Figure 8.1 Student and Teachers Participants: Availability of ICT in schools

While the availability of ICT tools differed from one school to other, the majority of schools had a data projector in their classrooms. Mixed results allowed the comparison between students' and teachers' responses. The perceived availability of computers in classrooms differed between students and teachers. Less than half (42.8%) of students claimed that the computer was available in the classroom, while most (87.8%) of the teachers stated that a computer was available in the classroom. Students' and teachers' responses regarding the availability of a data projector in the classroom showed the highest percentage (81.7% and 95.9% respectively). Almost half of the student sample mentioned that a smart whiteboard was available in the classroom (50.9%) compared to over half of the teachers (51.0%). Based on students' and teacher responses, the lowest percentage of ICT tools' availability in schools was for tablets/iPads; 8.9% of students said they were available, whereas 38.8% of teachers said they had use of one.

### *8.2.3 Using ICT applications in science*

Table 8. 3: Student and teacher participants using ICT applications for learning and teaching science. Students' and teachers' use of ICT applications in science is discussed in detail in Section 4.4.2 and Section 5.4.2.

Table 8.3 Student and teacher participants using ICT applications for learning and teaching science

| ICT Programs & Apps | Students | | Teachers | |
|---|---|---|---|---|
| | *n* | % | *n* | % |
| Word processing | 512 | 36.5 | 37 | 75.5 |
| PowerPoint | 637 | 45.5 | 48 | 98 |
| Specialist science program | 286 | 20.4 | 36 | 73.5 |
| Obeikan Education | 351 | 25.1 | 17 | 34.7 |
| YouTube | 361 | 25.8 | 9 | 18.4 |
| Classera | 116 | 8.3 | 3 | 6.1 |
| iEN | 137 | 9.8 | 1 | 2 |

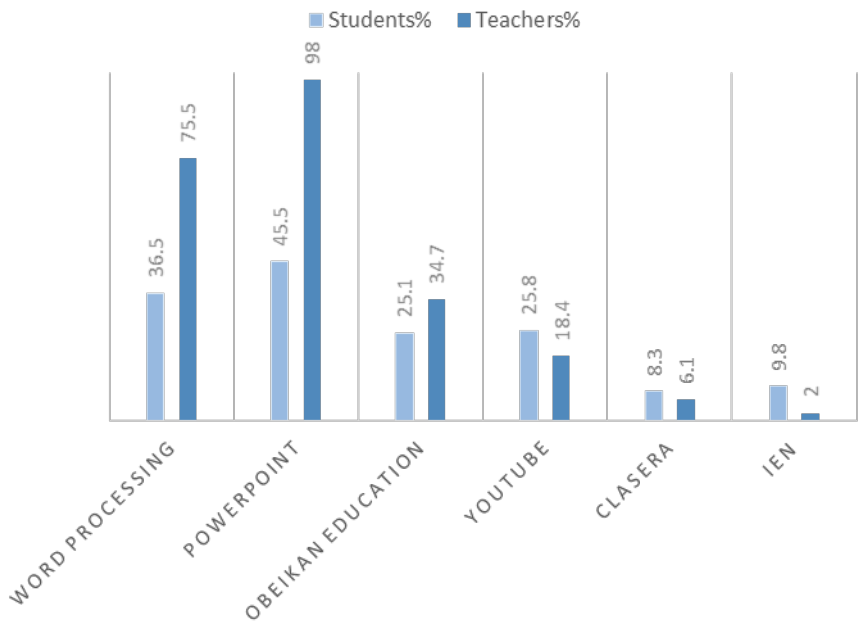


Figure 8.2 Student and Teacher participants: Using ICT applications for learning and teaching science

Use of ICT applications and programs in science varied. The most used ICT applications by teachers and students were PowerPoint and word processing. Teachers used PowerPoint more than students, because the majority of teachers prepared their lessons on a daily basis (98%). Some students used PowerPoint slides to prepare some presentations, for example in the Little Teacher project (45.5%). Word processing was the second common application used by teachers and students (75.5% and 36.5%). Similar to PowerPoint usage, teachers used word processing much more than students. Obeikan and YouTube had a middle level of usage. Among the teachers, 34.7% used Obeikan education compared to 25.1% of students. More students than teachers used *YouTube* (25.8% of students compared to 18.4% of teachers). There was a low level of use of Classera and iEN applications. Few schools joined and implemented Classera, hence its limited use: just 8.3% of students and 6.1% of teachers. iEN, the National Education Portal, was a new initiative at the time of this study; hence the low percentage of students (9.8%) and teachers (2%) using iEN.

### 8.3 Comparison between qualitative results for students and teachers

Figure 8.3 represents these data, drawn mainly from the interview responses, supported by some questionnaire findings.

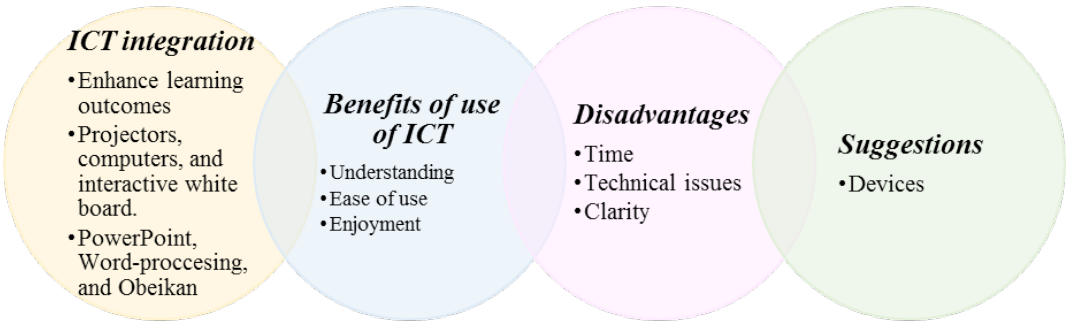


Figure 8.3 Themes of students' and teachers' responses in qualitative survey

Comparison of the qualitative results of students and teachers' perceptions of ICT integration in science showed a similarity in students' and teachers' responses based on four main themes: ICT integration, benefits of use of ICT, disadvantages, and suggestions (See Section 6.2 and Section 7.2), as illustrated in Figure 8.3. The interview data for students is discussed in detail in Chapter 6 and in chapter 7 for teachers. There were similarities between some quantitative and qualitative findings from students' and teachers' results. Table 8.4 presents a comparison between students' and teachers' responses. There was a similarity between some teachers' and students' perceptions of integrating ICT in science learning. Under each main theme, there were one or more common sub-themes. For example, the common sub-themes under ICT integration were enhance learning outcomes, PowerPoint, word processing, and Obeikan. Understanding, ease of use, and enjoyment, were the common sub-themes under the theme of benefits. Common sub-themes under disadvantages in using ICT were time, technical issues, and clarity. For the theme of suggestions, the responses from both students and teachers recommended that more devices be provided.

Table 8.4 Comparison between students' and teachers' qualitative findings

| Themes | Students' responses | Teachers' responses |
|---|---|---|
| ICT integration | | |
| *Enhance learning outcomes* | "I interact in class with the teacher because she uses a projector. It is very motivating in class. I understand more, and I get better results in the exam" (18.5.PB3).<br>"My grades become better, I understand science better by using technology" (6.5.PA6). | "[I] could see that the students had better understanding; [ICT] attracted their attention and because of that it affected their results in a positive way, and the class became excited. Also, [ICT] reduces the effort needed of the teachers during class" (3.PB1). |
| *PowerPoint, Word-processing, and Obeikan* | "The teacher asks us to do research, make a lesson, and do a presentation using PowerPoint to explain it, and there is an interaction between the students" [Little Teacher Project] (19.5.PB4)<br>"[Our teacher] encourages us to use sites that explain science, for example using Obeikan" (36.6.GB6). | The students prepare PowerPoint saved on a CD, sometimes they prepare more than one, so I introduce the first one and we give comments on it and thank the student, then the second one etc. …. Also, we have [Little Teacher project], where the students act as teachers and explain the lesson" (17. GC1).<br>"I use Obeikan to verify my information. In the students' book, it's written in the footer, 'go back to Obeikan site.' According to the new iEN application not all the students have a background of using it [iEN application]" (13. GL1). |
| Benefits of use of ICT | | |
| *Understanding* | "It [ICT] helps to deliver the information correctly and clearly. Misunderstandings might happen, or some of the girls may not understand the explanation when the teacher uses the board, but if she [the teacher] uses the videos and images, then the lesson will be clearer to us" (26.6.PB11). | "I'm so happy using technology while teaching because it helps the students to understand in a better way" (2. PA2).<br>"[ICT] improves learning a lot, especially for students who learn by listening or others by seeing things" (4.PB2). |

*Table 8.4 (continues)*

| | | |
|---|---|---|
| *Ease of use* | "It [ICT] facilitates the lesson, and it's faster and clearer when we view the lesson. Without the technology, there is no reaction from the students, because if the teacher is only using the book, the lesson becomes harder and the ideas become difficult to understand. The use of the technology makes it easier for the teacher to write a lesson; she writes it once and saves it, then uses it several times." (27.6.PB12). | "Helps the teacher to explain easily and the students to understand faster" (1. PA1).<br>"It makes teaching easier for me, benefits the students more, lets the students ask more questions, and I can keep the class active" (16.GD1). |
| *Enjoyment* | "I enjoy using technology and studying at the same time" (20.5.PB5).<br>"[ICT] makes the learning easier for the students and the teachers and it also makes the learning process enjoyable" (49.6.GH3). | "I love teaching my students and I enjoy integrating technology with teaching, it makes teaching easier and it saves time. Rather than wasting time opening the book on a certain page I open it using my projector. This way helps us to follow the lesson together and helps to get their attention.<br>It helps me a lot...." (17.GC1). |
| Disadvantages | | |
| *Time* | "Some students waste their time on the technology" (GB1). | "Sometimes the technology needs time and the time for the class might not be enough" (6.PD1). |
| *Technical issues* | If the device is damaged we will lose the information, so you have to save the information on a CD" (17.5.PB2). | "The devices get damaged and they need time to fix them" (2.PA2). |
| *Clarity* | "The sound and images might not be clear, so we can't understand the information very well" (46.6.GF3). | "If the lighting is dim [when viewing a video for example] it makes the students sleepy, and the writing skills of the students tend to deteriorate" (2.PA2). |
| Suggestions | | |
| *Devices* | "Provide Smartboards in all classes (we only have Smartboard in the math class and science labs). Also, provide iPads, as our bags are heavy and cause back pain. And it motivates students to learn and decreases the number of low achieving students" (35.5.GB5).<br>"Provide iPads to get away from the heavy school bags, and as a tool to simplify learning" (18.5.PB3). | "My suggestion is to provide Smartboards, projectors and prepare the lab with all the important tools" (3.PB1).<br>"Provide projectors and computers in all the classrooms" (17.GC1). |

## 8.4 Summary of the Chapter

This chapter has compared the student and teacher participants' perceptions of ICT integration in science. The results were compared according to data analysis type (quantitative and qualitative). First, the quantitative results of students' and teachers' responses were compared, highlighting that the scale reliabilities for each of the five scales of the questionnaire were acceptable to carry out the research. The researcher found similar values for students and teachers. Mixed results were found for the availability of ICT in schools, more than 80% of teachers chose that projector and computers available in schools; more than 50% of teachers and students chose that Smart whiteboard available in the schools. Similarly, mixed results were found for the use of ICT applications in science. More than 90% of the teachers selected PowerPoint application that used in preparing lessons. Similarly more than 70% of the teachers used Word-processing while teach science. However, more than 25% of the students' used YouTube in learning science. The qualitative results for students and teachers were then compared; participants had similar responses in all four main themes: ICT integration, benefits of use of ICT, disadvantages, and suggestions. Participants' responses to each sub-theme showed similarities in some sub-themes, as shown in Figure 8.3. The following chapter will present the main findings for each of the five research questions and conclude the study.

# CHAPTER 9

## DISCUSSION, CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

### 9.1 Introduction

Technology plays an important role in the development of education worldwide. To that end, Saudi Arabia has supported the development of education using technology with a huge budget (Tatweer, 2014a). However, there are only a few published studies that have investigated the use of technology in primary schools in Saudi Arabia (Al-Alwani 2005; Almaghlouth 2008; Al Sulaimani 2010; Oyaid, 2009) and no studies that have evaluated the impact of ICT integration in science by students and teachers in primary schools. Explicitly, this study aims to evaluate the impact of ICT integration in science classes in primary schools by investigating students' and teachers' perceptions of the use of ICT for their science learning and teaching. This chapter presents the answers to the five research questions based on the quantitative and qualitative data collected for this study. In this mixed method study, the data were obtained from responses to the instruments and the interviews with students and teachers. This chapter contains nine sections. Section 9.1 introduces the information provided in the chapter. From Section 9.2 to Section 9.6 discusses the main findings of Response to the five Research Questions. Section 9.7 presents the limitations of the study. Section 9.8 considers the implications of the study, and Section 9.9 offers recommendations for this field of practice.

### 9.2 Main findings of Response to Research Question 1: Students' perceptions of ICT integration in their science learning

Several of the study's results illuminate the students' current perceptions of ICT integration in science education in response to Research Question 1. How do students perceive the extent of ICT integration in their science learning? The researcher categorised the students' perceptions into four areas: ICT Integration, Benefits of using ICT, Disadvantages of using ICT, and Suggestions for using (see Section 6.2).

### *9.2.1 ICT Integration*

The main findings for students' perceptions of ICT integration in science learning includes four sub-categories: a) Teacher's role, b) Enhancing students' learning outcomes, c) Applications, d) Students' usage of ICT and e) Availability of ICT.

a) *Teacher's role* (see Section (a) 6.2.1) -regarding using ICT in science the students asserted that their science teacher encourages them to create PowerPoint presentations, write research via word processing, and enrich their knowledge by searching for information on related topics.

b) *Enhancing learning outcomes* (see Section (b) 6.2.1)-most of the students noted that using ICT improved their understanding of science, and others used some applications that offered extra exercises and enriched information. Also, some students found that the use of videos or pictures simplified the lessons and helped them remember the information when they were answered the examination.

c) *Applications* (see Section (c) 6.2.1 and see Section 4.4.2, Table 4.6) -the most common applications that were used in learning science based on qualitative phase were Classera, Al-Manahij, iEN National Education Portal, and Obeikan. Based on the data collected during the quantitative phase, Obeikan was the application that students used most while learning science

d) *Students' usage of ICT* (see Section 4.4.2 and Section (d) 6.2.1) as shown in the quantitative data results and from qualitative data results, conclude that most students used PowerPoint and word processing program to do their homework.

e) *Availability of ICT* (see Section (e) 6.2.1 and see Section 4.4.1), the results from the qualitative phase and the quantitative phase were the same: a projector is a tool that is most often available in classrooms.

### *9.2.2 Benefits of using ICT*

The benefits category had four sub-categories: a) Ease-of-use, b) Understanding, c) Interest level and d) Knowledge (See section 6.2.2). The common theme of the four sub-categories is: integrated ICT enhances the students' Understanding and Enjoyment of learning science were found to be the common themes at benefits category. The students emphasised that using ICT in learning science enhanced their understanding of the subject matter and enjoy while learning science.

a) *Ease-of-use* (see Section (a) 6.2.2) - the majority of the student participants agreed that they could more easily understand science by using ICT. They also enjoyed using technology to learn science because they could understand the lesson more quickly and with less effort. Moreover, teachers or students can use an e-library and educational databases to obtain information; they can also use interactive blackboards to communicate with their teacher and other students (Sivakumar, 2014)

b) *Understanding* (see Section (b) 6.2.2) - the students asserted that using technology helped them understand and remember the information; they became independent researchers and enjoyed the process of learning, which led to greater understanding. These findings are similar to the results reported in several studies (Grabe & Grabe, 2007; Skinner & Preece, 2003). According to Robertson and Al-Zahrani (2012) ICT can improve students' deep understanding of subjects and students can enhance their higher-order thinking through engaging in solving problems with ICT.

c) *Students' interest level* (see Section (c) 6.2.2), numerous students stated that students were interested in integrating ICT because they realised the importance of using ICT in the learning process. Thereby, students can interact effectively in the classroom, and that can learn science easily.

d) *Knowledg*e (see Section (d) 6.2.2) - the students asserted that searching for new information to enrich their knowledge was an interesting, enjoyable and motivating way to learn science. This finding is consistent with previous work in other countries. According to Gillespie (2014), using technology allows students to seek related resources, such as images and videos. Integrating ICT into the learning process can support the development of new knowledge and promote the students' skills (Bransford, 2000; Grabe & Grabe, 2007; Loveless, 2003; Murphy, 2006; Newton & Rogers, 2003). Oyaid (2009) argues that ICT can help students build on their previous knowledge and understanding when learning new concepts. As well as enrich knowledge through critical thinking, problem solving, and discussion of experiments (See Section 2.5).

### *9.2.3 Disadvantages of using ICT*

Although integrating ICT into science education has several advantages, the students identified several disadvantages of using technology (see Section 6.2.3). A number of primary school students felt that using ICT could be a waste of their time (see

Section (a) 6.2.3). Bransford (2000) found that students felt that searching the Internet or choosing fonts and colours for their writing was a waste of their time, distracting them from reviewing the information they learned in their lessons. Moreover, the overuse of technology tools could have an impact on health issues (see Section (b) 6.3.2). Further, a few students emphasised that there can be technical issues associated with ICT tools (see Section 6.3.2).

### *9.2.4 Suggestions for using ICT*

Most of the students' recommendations on how to better integrate ICT into science education in Saudi Arabia can be summarised in one brief but important suggestion: make more devices available in the classroom (see Section 6.2.4). Indeed, integrating ICT in science can motivate students to understand multiple representations of natural scientific processes and enhance their development of learning skills (Almalki & Williams, 2012).

## 9.3 Main findings of Response to Research Question 2: Differences on SATK results between students based on grade level and school type

Administration of the questionnaire and analysis of the items from Students' Attitudes Towards and Knowledge of Technology Questionnaire (Incantalupo, Treagust, & Koul, 2014) were used to respond to Research Question2: Based on the results of Students' Attitudes Towards and Knowledge of Technology Questionnaire (SATK), are there any differences based on grade level or school type?

### *9.3.1 Are there any differences based on grade level on SATK results?*

This study measured student's interest in ICT, attitude towards ICT, knowledge in ICT, learning with ICT, and ICT usage, based on grade level (see Section (a) 4.5). The aim of the questionnaire was to investigate were there any major differences between fifth and sixth graders in their interest, attitude, knowledge, learning with ICT, and students ICT usage. The results (Table 4.8) revealed that there were statistically significant differences between grades level based on students' responses for the five scales of SATK. A closer analysis of the results by computing the effect size for all scales showed that just there were small effect size results for two scales, attitudes and knowledge, in favour of fifth grade (see Table 4.8). That is, fifth grade students' attitudes and knowledge in regard to ICT were a little more positive than

were sixth grade students; the other three scales smaller effect size less than 0.3. Several studies have emphasised that students in different grade levels engage with ICT differently (Barmby, Kind, & Jones, 2008). In this study, students' interest and attitude towards integrating ICT in learning science decreased when they become older as shown in other studies (Balta & Duran, 2015; Hasni & Potvin, 2015; Knezek et al., 2013) (See Section 2.5.2).

### *9.3.2 Are there any differences based on school types on SATK results?*

The aim of this analysis was also to examine whether or not there were major statistically significant differences between the students' perceptions based on school type, namely government and private schools (see Section (b) 4.5). Even though the mean differences in each sale were small between government and private schools' responses (see Table 4.9), there were statistically significant differences for all scales of SATK. However, the effect size for each scale to measure the practical differences between knowledge, attitude, and interest scales were small (0.46, 0.44, and 0.38, respectively). These results revealed that there was a slight difference between students in government schools and students in private schools regarding their perceptions on integrating ICT in science learning. The small difference between students from government and private schools was attributed to the participants being from the same sector (a northern sector in Riyadh), therefore the students came from families with a similar standard of living. Therefore, due to the small differences between students of government and private schools, the researcher decided to analyse the qualitative data for students as one group (see Section 3.6.2).

## 9.4 Main findings of Response to Research Question 3: Teachers' perception of ICT integration in their science teaching

The results from both qualitative and quantitative data were used to respond to Research Question 3: How do teachers perceive the extent of ICT integration in their science teaching? A qualitative analysis of the semi-structured teachers' interviews indicated a positive impact of ICT integration in science. The thematic analysis of the qualitative data (see Table 3.7) presented teachers' perceptions based on their current experience of the effective of ICT integration in the teaching process. Some quantitative data provided a measurement of the current availability of ICT tools in schools, use of ICT for learning science, and integration of ICT in the teaching

process (see Section 5.4). Four major themes that categorise the teachers' responses are: ICT Integration, Benefits of ICT Integration, Disadvantages (concerns) Regarding ICT Integration, and Suggestions to Improve ICT Integration (see Sections 7.2). Some quantitative data provided a measurement of the current availability of ICT tools in schools, use of ICT for learning science, and integration of ICT in the teaching process (see Section 5.4).

### *9.4.1 ICT Integration*

The main findings for teachers' perceptions of ICT integration in science teaching was organised around six sub-categories: a) Students' learning outcomes, b) Improving the teaching process, c) Schools' role, d) Teachers' usage of ICT, e) Students' usages of ICT, and f) Applications (see Figure 3.7).

a) *Students' learning outcomes* (see Section (a) 7.2.1) – the majority of teachers stated that ICT integration expanded students' learning outcomes because it raises students' educational level, encourages them to be independent learners, and attracts students' attention.

b) *Improving the teaching process* (see Section (b) 7.2.1) -most teacher interviewees explained that they searched online resources to improve their teaching skills independently.

c)*The Schools' role* (see Section (c) 7.2.1 and see Section 5.5.4 )- many teachers stated that the school administration encouraged teachers to use ICT in their teaching process and offered professional development workshop and making ICT tools available but around 20% of the teachers were not satisfied with the schools' provision of ICT tools in the classrooms.

d) *Teachers' usage of ICT* (see Section (d) 7.2.1) – teachers varied to the degree in which they used ICT tools in the classroom, often depending on availability (see Table 5.8 and Section 5.4.2). Similar results based on a Kuwaiti study found that educational software and projector use were two of the highest occurring categories shown in the analysis in measuring the kind of ICT tools which teachers use in the classroom (Al-Harbi, 2014).

e) *Students' ICT usage* (see Section (e) 7.2.1) - teachers asked their students to use ICT, for instance, to research a specific topic, or make a class presentation.

f) *Applications* (see Section (f) 7.2.1 and Section 5.4.2) - Obeikan and Math and Science Lighthouse (Manarat AlOloum & Alriyadyat) were the applications that was most used.

### *9.4.2 Benefits of using ICT*

The majority of teachers who participated in this study perceived that using ICT in the teaching process was beneficial for both teachers and students. Teachers' responses were divided into three sub-categories: a) Ease of use, b) Enjoyment, and c) Understanding (see Section 7.2.2). All these sub-categories were related in terms of achieving the aims of the learning and teaching process.

a) *Ease of use of ICT* (see Section (a) 7.2.2) - teachers emphasised that using ICT in science lessons could simplify some complex lessons so that less time and effort was required. According to prior research (Ghavifekr & Rosdy, 2015; Jamieson-Procter et al., 2013; Jorge et al., 2003; Young, 2003), the use of ICT in teaching helps teachers to design their lesson plans in a creative, attractive, and interesting way that can motivate students and improve their learning outcomes.

b) *Enjoyment* (see Section (b) 7.2.2) -the majority of teachers agreed that they enjoyed using ICT to teach science and their students enjoyed the classes as well. Students' enjoyment while using ICT in science enhanced their understanding (see Section 7.2.2.2). Based on other related literature, students' enjoyment of lessons with computers also improved their motivation to learn (Bullock, 2001; Cox, Cox, & Preston, 2000; Kreutz & Rhodin, 2016).

c) *Understanding* (see Section (c) 7.2.2)- most teachers agreed that using ICT improved students' understanding by motivating students to learn by using an interesting and attractive teaching methods in science. This results is consistent with previous studies what argue that effective ICT integration in the classroom is vital in improving students' understanding. According to Su (2011), students can develop a better understanding of a chemistry lesson and improve their attitude towards chemistry learning by effective ICT integration in classroom.

### *9.4.3 Disadvantages of using ICT*

Even though this research found positive impact when teachers used ICT in their science teaching, (see Chapter 5, Section 5.4 and Chapter 7, Section 7.2.2), several factors that hindered a more effective use of technology. On in other words

disadvantages from the teachers' point of view as time, lack of clarity, and technical issues- were identified as the main factors that negatively affected the success of ICT integration (see Section 7.2.3). Similar results were found in previous research in Australia and Turkey, where technical issues became a main difficulty in most schools. These issues negatively affected the teaching and learning process because teachers were not able to use the computer temporarily duo to the need for them to be repaired (Jamieson-Proctor et al., 2013; Türel & Johnson, 2012) (See Section 2.5.1). The importance of technical support to assist teachers to use ICT in junior high school schools in the seventh graders classroom has been realized in the Netherlands, United Kingdom and Malta (Yang & Wang 2012).

### *9.4.4 Suggestions for using ICT*

The majority of the teachers' interviews suggested providing more devices, and continuous professional development workshops (see Section 7.2.4). The results are in line with research findings by Agbatogun (2017) who recommended that teachers should attend professional development workshops to upgrade their skills about the integration of ICT in teaching and learning process.

The most common factors that can negatively affect teachers' use of ICT, based on several Saudi studies, were lack of training, lack of access to technology, and more time to look at ICT sources (Al Mulhim, 2012). The results of the current study are consistent with these findings from six or more years ago that highlighted the most common factors that hinder integrate ICT effectively. Thus, more attention and action is needed from the Ministry of Education to develop students and teachers for the technology age. Despite the presence of these obstacles, currently, there are some students and teachers who effectively integrate ICT in their learning and teaching process. Therefore, to encourage them and motivate others, there may be a need to raise levels of support and encouragement through awards and honouring outstanding students and teachers.

## 9.5 Main findings of Response to Research Question 4: TAKT results for science teachers integrating ICT in teaching

The aim of this Research Question 4 was to examine teachers' level of interest, attitude, knowledge, and ICT usage in their current teaching process. The results were analysed to see if there were any major differences between teachers from

government and private schools. The researcher measured the t-test and effect size, but the results showed that there were no statistically significant differences between teachers in the two different school types (see Table 5.19). Therefore, the researcher analysed the teachers' responses as one group, to examine their a) levels of interest, b) attitude, c) knowledge and d) ICT usage.

a) *Levels of interest* (see Section 5.5.1) - almost the whole sample had a high interest in ICT integration, because almost 100% of the teachers agreed or strongly agreed with each statement on all items on the interest scale.

b) *Attitudes towards ICT* (see Section 5.5.2), almost all teachers had a high attitude of ICT. Several researches argue that teachers attitude towards ICT play vital role in effectiveness of ICT integration. For example a study conducted in Damascus, Jordan to measured teachers' attitude toward using ICT-based technology in learning, found that teachers have high positive attitudes toward technology.

c) *Knowledge of ICT* (see Section 5.3.3) -, results showed that almost 100% of teachers agreed or strongly agreed with all statements, therefore they were aware of the uses of ICT in science.

d) *ICT usage* (see Section 5.4 and Section (e) 7.2.1). For four items out of seven for this scale, more than 90% of the teachers used ICT as a tool - a result confirmed by observations available tools existing in classrooms and the program and applications teachers used in their teaching. Furthermore, the result is supported by the qualitative data However, responses to item 2 showed that there was not much communication between teachers and students via the technology (see Section 5.5.5).

## 9.6 Main findings of Response to Research Question 5: Teachers perception of the effects of ICT integration on students' learning outcomes

Research Question 5 was answered from the results of measuring responses by a) the Personal Science Teaching Efficacy Belief Scale (PSTE), and b) the Science Teaching Outcome Expectancy Scale (STOE) from modified STEBI scales (see Section 5.6).

a) Based on the results from the modified PSTE, almost all teachers had positive self-efficacy in using ICT in science teaching. Some of the statements were negative and others positive; however, almost 100% of the teachers' sample responded positively to all items on this scale (see Section 5.6.1).

b) A similar method was used for the findings from the STOE scale. Regarding the positive statements, almost all teachers agreed or strongly agreed that ICT integration improves students' learning outcomes. However, in response to the negative statements, some teachers were neutral, and most disagreed or strongly disagreed (see Section 5.6.2). This result supports some parts of the interview analysis in that most of the teachers stressed that integrating ICT could increase students' learning outcomes in science (see Section (a) 7.2.1). A previous study designed to investigate ICT integration into teaching science and its impact on teachers' self-efficacy, regarding enhancing teaching performance, and thus, students' learning outcomes, showed that teachers' performance in teaching science improved because they had positive self-efficacy with a resulting development in students' learning outcomes (Robertson & Al-Zahrani, 2012) (See Section 2.5).

## 9.7 Limitations of the study

There were several limitations to this study in the process of collecting data from students and teachers. All schools that participated in this study were in the northern sector in Riyadh. The researcher attempted to conduct the questionnaire for all students (fifth and sixth graders) at all selected schools. Three limitations of this study, referred to the student sample, the, teacher sample, and common issues of both students and teachers.

### *9.7.1 Student Sample*

Sample collection depended on the students' availability and their time tables. A further limitation was that during the qualitative data collection, most of the sample were students from sixth grade and mostly from private schools. The reason that more were from sixth grade was that usually in government schools, sixth graders have extra lessons or they have a longer school day (seven lessons daily). The reason the sample from private schools was larger than the government schools' sample was that there was more flexibility to conduct interviews with students, and also usually the daily school time was longer than in government schools (eight lessons daily). In general, the interview answers were short and direct; in some cases students had time to explain and expand their interpretation, but other students had limited time, and the researcher had to rush to cover as many of the main questions as possible. The

administration of all schools did not allow video recording while doing the interviews, but accepted audio recording.

### *9.7.2 Teacher Sample*

There were several limitations in the teachers' sample. Firstly, some teachers who participated in this study taught fifth and sixth grade at the same school. Secondly, while conducting interviews, some teachers had limited time to answer the interviews questions, so the interview answers were short. Most of the teachers accepted to be interviewed during their free time or lunchtime. Thirdly, for personal reasons some of the teachers did not accept to have the interview recorded. Therefore, the researcher wrote their interview responses. This was more time consuming than recording the interview.

### *9.7.3 Common issues for students and teachers*

There were two limitations common to students and teachers. First, in the quantitative data, there are small differences between fifth and sixth grade students but no major ones, and this is why the qualitative data was analysed together with the quantitative. Secondly, the researcher only knew what the students and teachers said, but did not know what was going on in the classrooms, so these results present a picture of perceived current classroom practice, but it might be not 100% accurate. The researcher only reported what participants said; it might be that students and teachers wanted to show interest and give socially desirable information. Generally, the researcher did not evaluate the impact of ICT integration for both genders in Saudi Arabia but focused on female students and teachers.

## 9.8 Implications of the study

Although the study was based on most works conducted in western countries, a similarity was found between the current results and findings obtained in the western setting. This semblance highlights the similarities and difficulties facing the integration of technology in Saudi primary schools and therefore suggests that this study plays an important role in the future development of ICT integration in Saudi Arabia.

In general, the level of integration of technology by the primary school teachers suggests that they use technology as a tool for presenting and clarifying scientific

concepts effectively. The researcher has summarised the implications in three sections, for students' results, for teachers' results, for research.

### *9.8.1 Implications for students*

In this research, one of the main findings was that there were only minor differences in responses between students from fifth and sixth grade and government and private schools. The small differences could be because there was only one grade level between the samples. The small differences between school types can be explained thus: the sample was collected from the northern sector in Riyadh, where almost all students came from a similar economic background; further, all the government schools that participated were in good quality buildings and provided the same primary ICT tools as private schools usually provided.

The researcher concluded from this study that most students are interested in the integration of technology in science and that they have a positive attitude towards ICT. This is illustrated by their interest for learning more about science through doing research and enriching their knowledge via some ICT programs and applications, in order to improve their educational level. The most important finding was that ICT was claimed to improve understanding and thus enhances learning outcomes. However, despite the many benefits of their experience, there are disadvantages to the current use of ICT and factors that may delay its continuous use. For example, health issues result from the use of equipment for a long time, and problems result from the lack of technical support. The common suggestions from the students were to provide more devices in the classroom to increase the positive impact of ICT integration in science lessons.

### *9.8.2 Implications for teachers*

Science teachers who participated in this study generally were interested in integrating ICT while teaching and they held a positive attitude towards ICT. These factors suggested that teachers held a good level of knowledge and that could be represented in their use of technology during the teaching process. Teachers' self-efficacy beliefs about the use of ICT in science teaching were measured, and the researcher found that the majority of the teachers had good experiences that could increase their self-efficacy and impact positively to increase students' learning outcomes. The main factors that teachers perceived in using ICT in the science

classroom were that students' learning outcomes were improved, and using some ICT tools made the teaching processes easy and enjoyable at the same time. The most vital response was that most of the teachers use technology because it improved students' understanding and avoided misconceptions. The teachers attempted to gain the benefits of ICT integration as much as they could. However, there were some difficulties that teachers faced that could have a negative impact on their integrated use of ICT; for instance, time limits and technical issues.

### *9.8.3 Implications for Research*

The research implications are important in numerous ways. Mainly, to the best of the researcher's knowledge, not many Saudi studies have evaluated students' or teachers' perceptions of ICT integration in similar types of research; most existing studies focus on secondary and high schools. The attempt of the current work to minimise this literature gap in Saudi Arabia is a substantial accomplishment and adds to the research on primary schools. Another significance of the study is the adoption of mixed methods of questionnaire and interview, which were modified to allow for the collection of data that are relevant to the Saudi setting (It was the first time of most of the participants to complete questionnaires and participate in interviews.). Thus, this study expressed students' and teachers' opinions and perceptions of ICT integration and shared recommendations for the improvement of ICT integration in Saudi primary schools.

Although the study was based on most works conducted in western countries, a similarity was found between the current results and findings obtained in the western setting. This semblance highlights the similarities and difficulties facing the integration of technology in Saudi primary schools and therefore suggests that this study plays an important role in the future development of ICT integration in Saudi Arabia.

## 9.9 Recommendations

The major significance of this study is that it evaluated the experiences of female upper primary level students and teachers in primary schools in Riyadh, Saudi Arabia when they are integrating information and communications technology (ICT) into the science learning. This research presented these individuals' perceptions of ICT in Saudi primary schools and investigated several factors that improve and hinder ICT integration in science learning. The findings of this study will inform the decision makers in the Ministry of Education in Saudi Arabia and the Tatweer and Vision 2030 departments regarding the current situation and the perceptions of students and science teachers of ICT integration. The findings are considerably important for the improvement of teachers and reveal various factors that motivate students and teachers to integrate ICT into their learning and teaching of science, respectively. More significantly, this study is unique because it examined female participants only.

The researcher recommended improving ICT integration in science teaching and learning by getting the benefit from the learning management system. Therefore, teacher, students and parents could be as one group to improve students learning outcomes. Indeed, the applied of learning management system as Classera had started in Saudi Arabia, however, the effort needed to expand the implementation and adoption of the learning management system in government and private schools in Saudi Arabia (Alahmari & Kyei-Blankson, 2018). Due to the rapid improving ICT integration in education, stakeholder needs to attend continuous professional development to improve their skills and can get the beneficial from the ICT tools and know how and when to integrate the technology effectively. Thus, the main recommendations are New Digital Portfolios and Continuous professional development.

### *9.9.1 New Digital Portfolios*

The study found that ICT integration in primary schools is at similar levels in both government and private schools. However, one private school used the Classera interactive platform that connected students, teachers, and parents in the learning process. The qualitative results showed that integrated digital portfolios could improve learning skills and communication skills. Therefore, the parent role is vital

in the success of the use of ICT; some teachers explained that some parents hindered the effective of use of ICT in learning by not allowing their children to use technology during weekdays (see Section (e) 7.2.1). Thus, the researcher recommends that all types of schools implement the use of digital portfolios such as Classera and Seesaw, and nationally, iEN. Using these or similar applications could support effective cooperative learning.

### *9.9.2 Continuous professional development*

To ensure better learning, teachers and students must be supported in developing their use of technology. This could be achieved by offering continuous professional development. An important to assess the impact of ICT integration on teaching and learning. Also, is not usually enough to support teachers and students in getting the best out of ICT through verbal workshops alone; it is vital to assess their effective use of the equipment, and try to get the best out of the ICT in order to improve learning process. For example, if the school offers a new program or digital portfolios, teachers and students must have an in-depth workshop that explains how and why to use the new program, and make sure that they know how to use it effectively in their teaching and learning process.

These strategies will support the focus on achieving some of the aims of Saudi 2030 Vision in education; by 2020 the aim is to improve curriculum and teaching methods, develop a learning environment that enhances talent and innovations, and enrich values and skills for students (Minstry of Education, 2017).

For future studies, the researcher recommends conducting the same kind of evaluation, not only in the northern sector in Riyadh, but also in the south, west, and east. The study could also be conducted in other cities to find out the differences between results. Further, this study should be conducted in boys' schools. The parents' role is vital, therefore an evaluation of the students', teachers', and parents' perceptions of the effectiveness of using ICT in science could be implemented in future research. Finally, the researcher recommends a new study measure rural versus urban schools and other variations to gain a full national picture of ICT integration in science classes in primary schools.

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Name:

School:

**Appendix A**

**Students' Questionnaires (Pilot Study Version)**

**Evaluate the effectiveness of ICT integration in teaching and learning science in upper primary level school in Saudi Arabia**

Your school has been selected to participate in this research. This survey asks questions about your perceptions of the ICT integration in science learning.
This survey comes in two sections. Section A is made up of general questions about yourself. Section B will focus on your interest in using ICT and measure your attitude and knowledge and skills towards ICT.
In this survey I use the term "ICT" to refer to information communication technology in education tools, such as databases and spreadsheets, desktops/laptops, tablets/iPads, Internet and CD-ROMs, digital cameras, emails, online discussions, Smart Boards etc..
Thank you in advance for your time to answer this survey.

***Section A: Personal details and role in the school***

**Is your school under Tatweer project?** ☐ **Yes** ☐ **NO**

**Grade Level**

☐ Fifth grade ☐ Sixth grade

**School type**

☐ Government ☐ Privet ☐ International

**I use ICT tools at**

☐ Home ☐ School ☐ Both

**Describe your ICT skills level**

☐ Beginner ☐ Intermediate ☐ Advanced

**ICT tools you use in school science**

☐ Computer (desktops or laptops)
☐ Data projector
☐ Smart whiteboards
☐ Tablets/iPad
☐ Printers/ Scanners
☐ TV/ DVD player
☐ Digital cameras
☐ Other…….

**ICT applications you use for learning**

☐ Word-processing
☐ Power Point
☐ Email
☐ Internet access
☐ Specialist science program
☐ Your teacher website
☐ school website
☐ Science and Mathematics gate (Obeikan education)
☐ none of them
☐ Other…….

**Social media applications you use**

☐ Face book ☐ LinkedIn ☐ Twitter ☐ Instagram
☒ Snap Chat ☐ none of them ☐ other……

***Section B: Students Attitude, knowledge, and skills towards ICT***

**1- Student interest in ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. I like to know more about ICT. | 5 | 4 | 3 | 2 | 1 |
| 2. I like to read technological magazines. | 5 | 4 | 3 | 2 | 1 |
| 3. I enjoy learning by using ICT. | 5 | 4 | 3 | 2 | 1 |
| 4. There should be more education about technology. | 5 | 4 | 3 | 2 | 1 |
| 5. I enjoy repairing things at home. | 5 | 4 | 3 | 2 | 1 |
| 6. All students should use ICT in learning processes. | 5 | 4 | 3 | 2 | 1 |
| 7. Working in ICT would be interesting. | 5 | 4 | 3 | 2 | 1 |
| 8. With an ICT job your future is promised. | 5 | 4 | 3 | 2 | 1 |

**2-Attitude towards ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. You have to be smart to learn with ICT. | 5 | 4 | 3 | 2 | 1 |
| 2. I do not understand why anyone would want a job in ICT. | 5 | 4 | 3 | 2 | 1 |
| 3. You can study with ICT only when you are good at both mathematics and science. | 5 | 4 | 3 | 2 | 1 |
| 4. Using ICT makes a country less prosperous. | 5 | 4 | 3 | 2 | 1 |
| 5. Working in ICT would be boring. | 5 | 4 | 3 | 2 | 1 |
| 6. Most jobs in ICT are boring. | 5 | 4 | 3 | 2 | 1 |

**3-Knowledge and skills of ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. Science and ICT are related. | 5 | 4 | 3 | 2 | 1 |
| 2. In ICT, you can think up new things. | 5 | 4 | 3 | 2 | 1 |
| 3. ICT has a large influence on people. | 5 | 4 | 3 | 2 | 1 |
| 4. I think ICT is often used in science. | 5 | 4 | 3 | 2 | 1 |
| 5. In everyday life, I have a lot to do with ICT. | 5 | 4 | 3 | 2 | 1 |
| 6. The Ministry of Education can have influence on technology. | 5 | 4 | 3 | 2 | 1 |
| 7. In ICT, you use tools. | 5 | 4 | 3 | 2 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 8. ICT is meant to make our life more comfortable. | 5 | 4 | 3 | 2 | 1 |
| 9. Using ICT helps improve student's learning. | 5 | 4 | 3 | 2 | 1 |
| 10. ICT use improves technical skills for students. | 5 | 4 | 3 | 2 | 1 |

**4- Learning with ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. I find learning science with ICT interesting. | 5 | 4 | 3 | 2 | 1 |
| 2. I am able to learn faster through using the ICT tools. | 5 | 4 | 3 | 2 | 1 |
| 3. I find ICT- supported science class to be active. | 5 | 4 | 3 | 2 | 1 |
| 4. I am able to update my knowledge using ICT. | 5 | 4 | 3 | 2 | 1 |
| 5. I find the audio and visual effects in the content matter to be appealing. | 5 | 4 | 3 | 2 | 1 |
| 6. I am motivated to learn by using ICT in science classroom. | 5 | 4 | 3 | 2 | 1 |
| 7. I enjoy when learn science by using ICT. | 5 | 4 | 3 | 2 | 1 |
| 8. I use ICT to do my tasks. | 5 | 4 | 3 | 2 | 1 |
| 9. Our school is doing a good job of putting ICT tools in to the classroom. | 5 | 4 | 3 | 2 | 1 |
| 10. ICT improves my learning of science. | 5 | 4 | 3 | 2 | 1 |
| 11. Using ICT in science improve my performance. | 5 | 4 | 3 | 2 | 1 |

**5- ICT Usage:** I use the ICT…

| | Almost Always | Often | Some times | Seldom | Almost Never |
|---|---|---|---|---|---|
| 1. as tools to type my assignments. | 5 | 4 | 3 | 2 | 1 |
| 2. to email assignments to my teacher. | 5 | 4 | 3 | 2 | 1 |
| 3. to ask the teacher questions. | 5 | 4 | 3 | 2 | 1 |
| 4. to find out information about the course. | 5 | 4 | 3 | 2 | 1 |
| 5. to read lesson notes prepared by the teacher. | 5 | 4 | 3 | 2 | 1 |
| 6. to take part in online discussions with other students. | 5 | 4 | 3 | 2 | 1 |
| 7. to obtain information from the internet. | 5 | 4 | 3 | 2 | 1 |

:Name

:School

**Appendix B**

**Teachers' Questionnaires (Pilot Study Version)**

**Evaluate the effectiveness of ICT integration in teaching and learning science at upper primary level school in Saudi Arabia**

Your school has been selected to participate in this research. This survey asks questions about your perceptions of the ICT integration in science teaching.
This survey comes in three sections. Section A is made up of general questions about yourself. Section B will focus on your interest in using ICT and measure your attitude and knowledge and skills towards ICT. Section C will focus on your self-efficacy towards ICT integration and outcome expectancy.
In this survey I use the term "ICT" to refer to information communication technology in education tools, such as databases and spreadsheets, desktops/laptops, tablets/iPads, Internet and CD-ROMs, digital cameras, emails, online discussions, Smart Boards etc..
Please complete the following questions accurately and honestly.
Thank you in advance for your time to answer this survey.

## *Section A: Personal details and role in the school*

**Is your school under Tatweer project?** ☐ **Yes** ☐ **No**

**Age**

☐ 25- 29 ☐ 30-44 ☐ 45-59 Years

**Level of education degree**

☐ Diploma ☐ Bachelor ☐ Master

**Year of teaching experience**

☐ 5-15 ☐ 16- 25 ☐ +26

**ICT tools you use in school science**

☐ Computer (desktops or laptops)
☐ Data projector
☐ Smart whiteboards
☐ Tablets/iPad
☐ Printers/ Scanners
☐ TV/ DVD player
☐ Digital cameras
☐ Other…….

**Describe your computer skills level**

☐ Beginner
☐ Intermediate
☐ Advance

**ICT experience**

☐ 5 Years ☐ 10 Years ☐ +15

**Type of school**

☐ Government ☐ Privet ☐ International

**Socio economic status**

☐ High ☐ Medium ☐ Low

**ICT applications you use for teaching**

☐ Word-processing
☐ Power Point
☐ Email
☐ Internet access
☐ Specialist science program
☐ Your teacher website
☐ school website
☐ Science and Mathematics gate (Obeikan education)
☐ none of them
☐ Other…….

**I integrate ICT in my teaching**, Tick all that apply

☐ a supplement to the curriculum, such video, pictures, sounds.
☐ Use the Internet as a method of continuous teacher- student.
☐ A reinforcement of the curriculum convey information in different ways and practical applications

**Social media applications you use**

☐ Face book ☐LinkedIn ☐ Twitter ☐ Instagram
☐ Snap Chat ☐ none of them ☐ other……

***Section B: Teachers Attitude and knowledge and skills towards ICT***

**1-Teacher interest in ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. I like to know more about ICT | 5 | 4 | 3 | 2 | 1 |
| 2. I like to read technological magazines | 5 | 4 | 3 | 2 | 1 |
| 3. I enjoy a job in ICT | 5 | 4 | 3 | 2 | 1 |
| 4. There should be more education about technology | 5 | 4 | 3 | 2 | 1 |
| 5. I enjoy repairing things at home | 5 | 4 | 3 | 2 | 1 |
| 6. All teachers should use ICT in teaching processes | 5 | 4 | 3 | 2 | 1 |
| 7. Working in ICT would be interesting | 5 | 4 | 3 | 2 | 1 |

**2-Attitude towards ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. You have to be smart to teach with ICT. | 5 | 4 | 3 | 2 | 1 |
| 2. I do not understand why anyone would want a job in ICT. | 5 | 4 | 3 | 2 | 1 |
| 3. You can teach with ICT only when you are good at both mathematics and science. | 5 | 4 | 3 | 2 | 1 |
| 4. Using ICT makes a country less prosperous. | 5 | 4 | 3 | 2 | 1 |
| 5. Working in ICT would be boring. | 5 | 4 | 3 | 2 | 1 |
| 6. Most jobs in ICT are boring. | 5 | 4 | 3 | 2 | 1 |

**3-Knowledge and skills of ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. Science and ICT are related. | 5 | 4 | 3 | 2 | 1 |
| 2. In ICT, you can think up new things. | 5 | 4 | 3 | 2 | 1 |
| 3. ICT has a large influence on people. | 5 | 4 | 3 | 2 | 1 |
| 4. I think ICT is often used in science | 5 | 4 | 3 | 2 | 1 |
| 5. In everyday life, I have a lot to do with ICT | 5 | 4 | 3 | 2 | 1 |
| 6. The Ministry of Education can have influence on technology. | 5 | 4 | 3 | 2 | 1 |
| 7. In ICT, you use tools. | 5 | 4 | 3 | 2 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 8. ICT is mean to make our life more comfortable. | 5 | 4 | 3 | 2 | 1 |
| 9. Using ICT helps improve teacher's teaching. | 5 | 4 | 3 | 2 | 1 |
| 10. ICT use improves technical skills for teachers | 5 | 4 | 3 | 2 | 1 |

**4-ICT Usage:** I use the ICT…

| | Almost Always | Often | Some times | Seldom | Almost Never |
|---|---|---|---|---|---|
| 1. as tools in teaching science. | 5 | 4 | 3 | 2 | 1 |
| 2. to communicate with students. | 5 | 4 | 3 | 2 | 1 |
| 3. to answer students' questions. | 5 | 4 | 3 | 2 | 1 |
| 4. to find out information about the course. | 5 | 4 | 3 | 2 | 1 |
| 5. to prepare lesson note for students. | 5 | 4 | 3 | 2 | 1 |
| 6. to take part in online discussions with other teachers. | 5 | 4 | 3 | 2 | 1 |
| 7. to obtain information from the internet. | 5 | 4 | 3 | 2 | 1 |

**5-Teaching with ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. I find teaching science with ICT interesting. | 5 | 4 | 3 | 2 | 1 |
| 2. I am able to teach faster through using the ICT tools. | 5 | 4 | 3 | 2 | 1 |
| 3. I find ICT- supported science class to be active. | 5 | 4 | 3 | 2 | 1 |
| 4. I am able update my knowledge using ICT. | 5 | 4 | 3 | 2 | 1 |
| 5. I find the audio and visual effects in the content matter to be appealing. | 5 | 4 | 3 | 2 | 1 |
| 6. I am motivated to teach by using ICT in science classroom. | 5 | 4 | 3 | 2 | 1 |
| 7. I enjoy when teach science by using ICT. | 5 | 4 | 3 | 2 | 1 |
| 8. My students uses ICT in their tasks. | 5 | 4 | 3 | 2 | 1 |
| 9. Our school is doing a good job of putting ICT tools in to the classroom. | 5 | 4 | 3 | 2 | 1 |
| 10. ICT improves my teaching of science. | 5 | 4 | 3 | 2 | 1 |
| 11. Using ICT in science improve my performance. | 5 | 4 | 3 | 2 | 1 |

***Section C: Science teachers' self-efficacy towards ICT integration and outcome expectancy from (STEBI)***

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. When a student does better than usual in science, it is often because the teacher exerted a little extra effort by integrating ICT into science teaching. | 5 | 4 | 3 | 2 | 1 |
| 2. I am continually finding better ways to teach science with ICT integration. | 5 | 4 | 3 | 2 | 1 |
| 3. When the science grades of students improve, it is most often due to their teacher having found a more effective teaching approach by using ICT. | 5 | 4 | 3 | 2 | 1 |
| 4. With ICT integration into science teaching, I know the steps necessary to teach science concepts effectively. | 5 | 4 | 3 | 2 | 1 |
| 5. I am not very effective in using ICT into monitoring science experiments. | 5 | 4 | 3 | 2 | 1 |
| 6. If students are underachieving in science, it is most likely due to ineffective ICT integration into science teaching. | 5 | 4 | 3 | 2 | 1 |
| 7. I generally teach science by using ICT ineffectively. | 5 | 4 | 3 | 2 | 1 |
| 8. The inadequacy of a student's science background can be overcome by good teaching. | 5 | 4 | 3 | 2 | 1 |
| 9. The low science achievement of some students cannot generally be blamed on their teachers. | 5 | 4 | 3 | 2 | 1 |
| 10. When a low achieving child progresses in science, it is usually due to extra attention given by the teacher. | 5 | 4 | 3 | 2 | 1 |
| 11. I understand science concepts well enough to be effective in teaching primary science via using ICT. | 5 | 4 | 3 | 2 | 1 |
| 12. Increased effort in integrating ICT into science teaching produces little change in some students' science achievement. | 5 | 4 | 3 | 2 | 1 |
| 13. The teacher is generally responsible for the achievement of student in science. | 5 | 4 | 3 | 2 | 1 |
| 14. Students achievement in science is directly related to their teachers' effectiveness in ICT integration into science teaching. | 5 | 4 | 3 | 2 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 15. If parents comment that their child is showing more interest in using ICT in science at school, it probably due to the performance of the child teacher. | 5 | 4 | 3 | 2 | 1 |
| 16. I find it difficult to explain to students why science experiments work. | 5 | 4 | 3 | 2 | 1 |
| 17. I am typically able to answer students' science questions. | 5 | 4 | 3 | 2 | 1 |
| 18. I wonder if I have the necessary skills to teach science with using ICT. | 5 | 4 | 3 | 2 | 1 |
| 19. Effectiveness in integrating ICT into science teaching has little influence on achievement of students with low motivation. | 5 | 4 | 3 | 2 | 1 |
| 20. Given a choice, I would not invite the principal to evaluate my ICT integration into science teaching. | 5 | 4 | 3 | 2 | 1 |
| 21. When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better by using ICT. | 5 | 4 | 3 | 2 | 1 |
| 22. When teaching science by using ICT, I usually welcome student questions. | 5 | 4 | 3 | 2 | 1 |
| 23. I don't know what to do to turn students on to science. | 5 | 4 | 3 | 2 | 1 |
| 24. Even teachers with good science teaching abilities can't help some kids learn science. | 5 | 4 | 3 | 2 | 1 |

Name:

School:

**Appendix C**
**Students' Questionnaires (Main Study Version)**
**Evaluate the effectiveness of ICT integration in teaching and learning science in upper primary level school in Saudi Arabia**

Your school has been selected to participate in this research. This survey asks questions about your perceptions of the ICT integration in science classes.
This survey comes in three sections. Section A is made up of general questions about yourself. Section B will measure your attitudes toward and knowledge of ICT.
In this survey I use the term "ICT" to refer to information communication technology in education tools, such as databases and spreadsheets, desktops/laptops, tablets/iPads, Internet and CD-ROMs, digital cameras, emails, online discussions, Smart Boards etc..

Thank you in advance for your time to answer this survey.

## *Section A: Personal details and role in the school*

**Is your school under Tatweer project? ☐ Yes ☐ NO**

**Grade Level**
☐ Fifth grade ☐ Sixth grade

**School type**
☐ Government ☐ Privet ☐ International

**I use ICT tools at**
☐ Home ☐ School ☐ Both

**Describe your ICT skills level**
☐ Beginner ☐ Intermediate ☐ Advanced

**ICT tools you use in school science**
☐ Computer (desktops or laptops)
☐ Data projector
☐ Smart whiteboards
☐ Tablets/iPad
☐ Printers/ Scanners
☐ TV/ DVD player
☐ Digital cameras
☐ Other…….

**ICT applications you use for learning**
☐ Word-processing
☐ Power Point
☐ Email
☐ Internet access
☐ Specialist science program
☐ Your teacher website
☐ school website
☐ Science and Math gate (Obeikan education)
☐ none of them
☐ Other…….

**Social media applications you use**
☐ Face book ☐LinkedIn ☐ Twitter ☐ Instagram
☐ Snap Chat ☐ none of them ☐ other……

## *Section B: Students Attitudes toward and knowledge of ICT*

### 2- Student interest in ICT

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. I like to know more about ICT. | 5 | 4 | 3 | 2 | 1 |
| 2. I like to read technological magazines. | 5 | 4 | 3 | 2 | 1 |
| 3. I enjoy learning by using ICT. | 5 | 4 | 3 | 2 | 1 |
| 4. There should be more education about technology. | 5 | 4 | 3 | 2 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 5. I enjoy repairing things at home. | 5 | 4 | 3 | 2 | 1 |
| 6. All students should use ICT in learning processes. | 5 | 4 | 3 | 2 | 1 |
| 7. Working in ICT would be interesting. | 5 | 4 | 3 | 2 | 1 |
| 8. With an ICT job your future is promised. | 5 | 4 | 3 | 2 | 1 |

**2-Attitude toward ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. You have to be smart to learn with ICT. | 5 | 4 | 3 | 2 | 1 |
| 2. No one would want a job in ICT. | 5 | 4 | 3 | 2 | 1 |
| 3. Using ICT makes a country more prosperous. | 5 | 4 | 3 | 2 | 1 |
| 4. Working in ICT would be boring. | 5 | 4 | 3 | 2 | 1 |
| 5. Most jobs in ICT are boring. | 5 | 4 | 3 | 2 | 1 |

**3-Knowledge of ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. Science and ICT are related. | 5 | 4 | 3 | 2 | 1 |
| 2. ICT has a large influence on people. | 5 | 4 | 3 | 2 | 1 |
| 3. I think ICT is often used in science. | 5 | 4 | 3 | 2 | 1 |
| 4. In everyday life, I have a lot to do with ICT. | 5 | 4 | 3 | 2 | 1 |
| 5. The Ministry of Education can have influence on technology. | 5 | 4 | 3 | 2 | 1 |
| 6. In ICT, you use tools. | 5 | 4 | 3 | 2 | 1 |
| 7. ICT is meant to make our life more comfortable. | 5 | 4 | 3 | 2 | 1 |
| 8. Using ICT helps improve student's learning. | 5 | 4 | 3 | 2 | 1 |
| 9. ICT use improves technical skills for students. | 5 | 4 | 3 | 2 | 1 |

**4- Learning with ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. I find learning science with ICT interesting. | 5 | 4 | 3 | 2 | 1 |
| 2. I am able to learn faster through using the ICT tools. | 5 | 4 | 3 | 2 | 1 |
| 3. I find ICT- supported science class to be active. | 5 | 4 | 3 | 2 | 1 |
| 4. I am able to update my knowledge using ICT. | 5 | 4 | 3 | 2 | 1 |
| 5. I find the audio and visual effects in the content matter to be appealing. | 5 | 4 | 3 | 2 | 1 |
| 6. I am motivated to learn by using ICT in science classroom. | 5 | 4 | 3 | 2 | 1 |
| 7. I enjoy when learn science by using ICT. | 5 | 4 | 3 | 2 | 1 |
| 8. I use ICT to do my tasks. | 5 | 4 | 3 | 2 | 1 |
| 9. Our school is doing a good job of putting ICT tools in to the classroom. | 5 | 4 | 3 | 2 | 1 |
| 10. ICT improves my learning of science. | 5 | 4 | 3 | 2 | 1 |

**5- ICT Usage:** I use the ICT…

| | Almost Always | Often | Some times | Seldom | Almost Never |
|---|---|---|---|---|---|
| 1. as tools to type my assignments. | 5 | 4 | 3 | 2 | 1 |
| 2. to email assignments to my teacher. | 5 | 4 | 3 | 2 | 1 |
| 3. to ask the teacher questions. | 5 | 4 | 3 | 2 | 1 |
| 4. to find out information about the course. | 5 | 4 | 3 | 2 | 1 |
| 5. to read lesson notes prepared by the teacher. | 5 | 4 | 3 | 2 | 1 |
| 6. to take part in online discussions with other students. | 5 | 4 | 3 | 2 | 1 |
| 7. to obtain information from the internet. | 5 | 4 | 3 | 2 | 1 |

Thank you

Teacher Name:

School:

**Appendix D**

**Teachers' Questionnaires (Main Study Version)**

**Evaluate the effectiveness of ICT integration in teaching and learning science at upper primary level school in Saudi Arabia**

Your school has been selected to participate in this research. This survey asks questions about your perceptions of the ICT integration in science classes.
This survey comes in three sections. Section A is made up of general questions about yourself. Section B will measure your attitudes toward and knowledge of ICT. Section C will focus on your self-efficacy toward ICT integration and outcome expectancy.
In this survey I use the term "ICT" to refer to information communication technology in education tools, such as databases and spreadsheets, desktops/laptops, tablets/iPads, Internet and CD-ROMs, digital cameras, emails, online discussions, Smart Boards etc..
Please complete the following questions accurately and honestly.
Thank you in advance for your time to answer this survey.

***Section A: Personal details and role in the school***

**Is your school under Tatweer project?** ☐ **Yes** ☐ **No**

**Age**

☐ 25- 29 ☐ 30-44 ☐ 45-59 Years

**Level of education degree**

☐ Diploma ☐ Bachelor ☐ Master ☐ PhD

**Year of teaching experience**

☐ 5-15 ☐ 16- 25 ☐ +26

**ICT tools you use in school science**

☐ Computer (desktops or laptops)
☐ Data projector
☐ Smart whiteboards
☐ Tablets/iPad
☐ Printers/ Scanners
☐ TV/ DVD player
☐ Digital cameras
☐ Other…….

**Describe your computer skills level**

☐ Beginner
☐ Intermediate
☐ Advance

**ICT experience**

☐ 5 Years ☐ 10 Years ☐ +15

**Type of school**

☐ Government ☐ Privet ☐ International

**I use ICT tools at**

☐ Home ☐ School ☐ Both

**ICT applications you use for teaching**

☐ Word-processing
☐ Power Point
☐ Email
☐ Internet access
☐ Specialist science program
☐ My own website
☐ school website
☐ Science and Math gate (Obeikan education)
☐ none of them
☐ Other…….

**I integrate ICT in my teaching**, Tick all that apply

☐ a supplement to the curriculum, such video, pictures, sounds.
☐ Use the Internet as a method of continuous teacher- student.
☐ A reinforcement of the curriculum convey information in different ways and practical applications

**Social media applications you use**

☐ Face book ☐ LinkedIn ☐ Twitter ☐ Instagram
☐ Snap Chat ☐ none of them ☐ other……

***Section B: Teachers Attitudes toward and knowledge of ICT***

**1-Teacher interest in ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. I like to know more about ICT | 5 | 4 | 3 | 2 | 1 |
| 2. I like to read technological magazines | 5 | 4 | 3 | 2 | 1 |
| 3. I enjoy a job in ICT | 5 | 4 | 3 | 2 | 1 |
| 4. There should be more education about technology | 5 | 4 | 3 | 2 | 1 |
| 5. I enjoy repairing things at home | 5 | 4 | 3 | 2 | 1 |
| 6. All teachers should use ICT in teaching processes | 5 | 4 | 3 | 2 | 1 |
| 7. Working in ICT would be interesting | 5 | 4 | 3 | 2 | 1 |
| 8. With an ICT job your future is promised. | 5 | 4 | 3 | 2 | 1 |

**2-Attitude toward ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. You have to be smart to teach with ICT. | 5 | 4 | 3 | 2 | 1 |
| 2. No one would want a job in ICT. | 5 | 4 | 3 | 2 | 1 |
| 3. Using ICT makes a country more prosperous. | 5 | 4 | 3 | 2 | 1 |
| 4. Working in ICT would be boring. | 5 | 4 | 3 | 2 | 1 |
| 5. Most jobs in ICT are boring. | 5 | 4 | 3 | 2 | 1 |

**3-Knowledge of ICT**

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. Science and ICT are related. | 5 | 4 | 3 | 2 | 1 |
| 2. ICT has a large influence on people. | 5 | 4 | 3 | 2 | 1 |
| 3. I think ICT is often used in science | 5 | 4 | 3 | 2 | 1 |
| 4. In everyday life, I have a lot to do with ICT | 5 | 4 | 3 | 2 | 1 |
| 5. The Ministry of Education can have influence on technology. | 5 | 4 | 3 | 2 | 1 |
| 6. In ICT, you use tools. | 5 | 4 | 3 | 2 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 7. ICT is mean to make our life more comfortable. | 5 | 4 | 3 | 2 | 1 |
| 8. Using ICT helps improve teacher's teaching. | 5 | 4 | 3 | 2 | 1 |
| 9. ICT use improves technical skills for teachers | 5 | 4 | 3 | 2 | 1 |

## 4-Teaching with ICT

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. I find teaching science with ICT interesting. | 5 | 4 | 3 | 2 | 1 |
| 2. I am able to teach faster through using the ICT tools. | 5 | 4 | 3 | 2 | 1 |
| 3. I find ICT- supported science class to be active. | 5 | 4 | 3 | 2 | 1 |
| 4. I am able update my knowledge using ICT. | 5 | 4 | 3 | 2 | 1 |
| 5. I find the audio and visual effects in the content matter to be appealing. | 5 | 4 | 3 | 2 | 1 |
| 6. I am motivated to teach by using ICT in science classroom. | 5 | 4 | 3 | 2 | 1 |
| 7. I enjoy when teach science by using ICT. | 5 | 4 | 3 | 2 | 1 |
| 8. My students uses ICT in their tasks. | 5 | 4 | 3 | 2 | 1 |
| 9. Our school is doing a good job of putting ICT tools in to the classroom. | 5 | 4 | 3 | 2 | 1 |
| 10. ICT improves my teaching of science. | 5 | 4 | 3 | 2 | 1 |

## 5-ICT Usage: I use the ICT…

| | Almost Always | Often | Some times | Seldom | Almost Never |
|---|---|---|---|---|---|
| 1. as tools in teaching science. | 5 | 4 | 3 | 2 | 1 |
| 2. to communicate with students. | 5 | 4 | 3 | 2 | 1 |
| 3. to answer students' questions. | 5 | 4 | 3 | 2 | 1 |
| 4. to find out information about the course. | 5 | 4 | 3 | 2 | 1 |
| 5. to prepare lesson note for students. | 5 | 4 | 3 | 2 | 1 |
| 6. to take part in online discussions with other teachers. | 5 | 4 | 3 | 2 | 1 |
| 7. to obtain information from the internet. | 5 | 4 | 3 | 2 | 1 |

***Section C: Science teachers' self-efficacy toward ICT integration and outcome expectancy from (STEBI)***

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 1. When a student does better than usual in science, it is often because the teacher exerted a little extra effort by integrating ICT into science teaching. | 5 | 4 | 3 | 2 | 1 |
| 2. I am continually finding better ways to teach science with ICT integration. | 5 | 4 | 3 | 2 | 1 |
| 3. When the science grades of students improve, it is most often due to their teacher having found a more effective teaching approach by using ICT. | 5 | 4 | 3 | 2 | 1 |
| 4. With ICT integration into science teaching, I know the steps necessary to teach science concepts effectively. | 5 | 4 | 3 | 2 | 1 |
| 5. I am not very effective in using ICT into monitoring science experiments. | 5 | 4 | 3 | 2 | 1 |
| 6. If students underachieving in science, it is most likely due to ineffective ICT integration into science teaching. | 5 | 4 | 3 | 2 | 1 |
| 7. I generally teach science by using ICT ineffectively. | 5 | 4 | 3 | 2 | 1 |
| 8. The inadequacy of a student's science background can be overcome by good teaching. | 5 | 4 | 3 | 2 | 1 |
| 9. The low science achievement of some students cannot generally be blamed on their teachers. | 5 | 4 | 3 | 2 | 1 |
| 10. When a low achieving child progresses in science, it is usually due to extra attention given by the teacher. | 5 | 4 | 3 | 2 | 1 |
| 11. I understand science concepts well enough to be effective in teaching primary science via using ICT. | 5 | 4 | 3 | 2 | 1 |
| 12. Increased effort in integrating ICT into science teaching produces little change in some students' science achievement. | 5 | 4 | 3 | 2 | 1 |
| 13. The teacher is generally responsible for the achievement of student in science. | 5 | 4 | 3 | 2 | 1 |
| 14. Students achievement in science is directly related to their teachers' effectiveness in ICT integration into science teaching. | 5 | 4 | 3 | 2 | 1 |
| 15. If parents comment that their child is showing more interest in using ICT in science at school, it probably due to the performance of the child teacher. | 5 | 4 | 3 | 2 | 1 |
| 16. I find it difficult to explain to students why science experiments work. | 5 | 4 | 3 | 2 | 1 |
| 17. I am typically able to answer students' science questions. | 5 | 4 | 3 | 2 | 1 |
| 18. I wonder if I have the necessary skills to teach science with using ICT. | 5 | 4 | 3 | 2 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 19. Effectiveness in integrating ICT into science teaching has little influence on achievement of students with low motivation. | 5 | 4 | 3 | 2 | 1 |
| 20. Given a choice, I would not invite the principal to evaluate my ICT integration into science teaching. | 5 | 4 | 3 | 2 | 1 |
| 21. When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better by using ICT. | 5 | 4 | 3 | 2 | 1 |
| 22. When teaching science by using ICT, I usually welcome student questions. | 5 | 4 | 3 | 2 | 1 |
| 23. I don't know what to do to turn students on to science. | 5 | 4 | 3 | 2 | 1 |
| 24. Even teachers with good science teaching abilities can't help some kids learn science. | 5 | 4 | 3 | 2 | 1 |

Thank you Alaahr2@gmail.com

اسم الطالبة:

Curtin University

**تقييم فاعلية دمج تقنية الاتصالات و المعلومات في تعليم منهج العلوم للصفوف العليا من المرحلة الابتدائية في المملكة العربية السعودية**

اختيرت مدرستك للمشاركة في هذا البحث الذي يهدف لتقييم فعالية دمج واستخدام تقنية الاتصالات والمعلومات في تعليم العلوم للصفيّن الخامس والسادس. تشتمل الاستبانة على جزئين: الجزء الأول عبارة عن أسئلة عامة , الجزء الثاني سيركز على قياس اتجاهك و معرفتك بالتقنية.

(التقنية) اختصار تقنية الاتصالات و المعلومات ويقصد بها في العملية التعليمية ويقصد بها أجهزة الكمبيوتر, التابلت و الايباد, الأقراص المدمجة , البريد الإلكتروني, الانترنت, السبورة الذكية, الكاميرات الرقمية .....الخ

*يرجى الإجابة على الأسئة بمصداقية و أمانة و أشكرك مقدما للمشاركة في هذا الاستبيان.

## الجزء الأول : معلومات شخصية و معلومات عن المدرسة

**هل مدرستك ضمن برنامج تطوير؟** ☐ نعم ☐ لا

**المرحلة الدراسية**

☐الصف الخامس ☐الصف السادس

**نوع المدرسة**

☐حكومية ☐خاصة

**استخدم أدوات التقنية في :**

☐ البيت ☐ المدرسة ☐ كلاهما

**مستوى مهاراتك في استخدام التقنية:**

☐مبتدئ ☐متوسط ☐متقدم

**وسائل التقنية التي تستخدمينها في المدرسة :**

☐أجهزة الكمبيوتر ( المكتبية و المحمولة)
☐جهاز العرض\ البروجكتور
☐السبورات الذكيةSmart board
☐أجهزة التابليت و الايباد
☐الطابعات و الماسحات الضوئية (سكانر)
☐التلفاز و مشغلات الدي في دي (DVD)
☐الكاميرات الرقمية ( الديجتال)
☐أخرى.....

**تطبيقات و برامج التقنية التي تستخدمينها في تعلم العلوم:**

☐برنامج ورد لمعالجة النصوص Word
☐برنامج باور بوينت Power Point
☐البريد الإلكتروني Email
☐استخدام الإنترنت
☐موقع معلمة العلوم على الإنترنت
☐بوابة العلوم والرياضيات (العبيكان التعليمية)
☐موقع المدرسة على الإنترنت
☐برنامج متخصص في العلوم
☐لا شيء مما سبق
☐أخرى.....

ماهي تطبيقات وسائل التواصل الاجتماعي التي تستخدمينها:

☐ فيس بوكFace book ☐ تويترTwitter ☐ انستقرام Instagram ☐ LinkedIn
☐ سناب شاتSnap chat ☐ لاشئ مما سبق ☐ أخرى.....

## الجزء الثاني :اتجاه الطالبة و معرفتها بالتقنية

### 1- اهتمام الطالبة باستخدام التقنية

| | موافق بشدة | موافقة | محايدة | رافضة | رافض بشدة |
|---|---|---|---|---|---|
| 1- أرغب بمعرفة المزيد عن التقنية. | 5 | 4 | 3 | 2 | 1 |
| 2- أرغب بقراءة المجلات الخاصة بمجالات التقنية. | 5 | 4 | 3 | 2 | 1 |
| 3- أستمتع بالتعلم باستخدام التقنية. | 5 | 4 | 3 | 2 | 1 |
| 4- يجب أن يتم التركيز بصورة أكبر على التعليم بالتقنية. | 5 | 4 | 3 | 2 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 5- أستمتع بإصلاح الأغراض في منزلي الخاصه بالتقنية. | 5 | 4 | 3 | 2 | 1 |
| 6- يجب على جميع الطالبات استخدام التقنية في التعليم. | 5 | 4 | 3 | 2 | 1 |
| 7- العمل في مجال التقنية سيكون ممتعاً. | 5 | 4 | 3 | 2 | 1 |
| 8- مستقبل العمل في مجال التقنية واعد . | 5 | 4 | 3 | 2 | 1 |

## 2- موقف الطالبة تجاه التقنية

| | موافق بشدة | موافقة | محايدة | رافضة | رافض بشدة |
|---|---|---|---|---|---|
| 1- لتتمكني من التعلم باستخدام التقنية عليكي أن تكوني ذكية. | 5 | 4 | 3 | 2 | 1 |
| 2- لا يوجد شخص يرغب في الحصول على عمل في مجال التقنية. | 5 | 4 | 3 | 2 | 1 |
| 3- استخدام التقنية تجعل البلاد أكثر إزدهارا و نجاحاً. | 5 | 4 | 3 | 2 | 1 |
| 4- العمل في التقنية قد يكون مملاً. | 5 | 4 | 3 | 2 | 1 |
| 5- أغلب الوظائف في مجال التقنية مملة. | 5 | 4 | 3 | 2 | 1 |

## 3- المعرفة في مجال التقنية

| | موافق بشدة | موافقة | محايدة | رافضة | رافضة بشدة |
|---|---|---|---|---|---|
| 1- هناك علاقة بين العلوم و التقنية. | 5 | 4 | 3 | 2 | 1 |
| 2- تتميز التقنية بتأثير واسع على الناس. | 5 | 4 | 3 | 2 | 1 |
| 3- أعتقد أن التقنية تُستخدم غالباً في منهج العلوم. | 5 | 4 | 3 | 2 | 1 |
| 4- تتعدد استخدامات التقنية في الحياة اليومية. | 5 | 4 | 3 | 2 | 1 |
| 5- وزارة التعليم لها تأثيرٌ على دمج التقنية في تعليم العلوم. | 5 | 4 | 3 | 2 | 1 |
| 6- يمكنك استخدام العديد من الأدوات في مجال التقنية. | 5 | 4 | 3 | 2 | 1 |
| 7- الغرض من استخدام التقنية هو جعل حياتنا أكثر راحة. | 5 | 4 | 3 | 2 | 1 |
| 8- استخدام التقنية يساعد في تطوّر تعليم الطالبات. | 5 | 4 | 3 | 2 | 1 |
| 9-استخدام التقنية يحسّن المهارات التقنيّة للطالبات. | 5 | 4 | 3 | 2 | 1 |

## 4-التعلم باستخدام التقنية

| | موافق بشدة | موافقة | محايدة | رافضة | رافضة بشدة |
|---|---|---|---|---|---|
| 1- تعلم العلوم باستخدام التقنية أمر ممتع. | 5 | 4 | 3 | 2 | 1 |
| 2- أستطيع أن أتعلم بشكل أسرع باستخدام أدوات التقنية. | 5 | 4 | 3 | 2 | 1 |
| 3- ألاحظ أن استخدام التقنية يدعم حصة العلوم وتجعلها نشطة. | 5 | 4 | 3 | 2 | 1 |
| 4- أستطيع الحصول عل المزيد من المعلومات و زيادة النواحي المعرفية لديّ باستخدام التقنية . | 5 | 4 | 3 | 2 | 1 |
| 5- ألاحظ أن المؤثرات السمعية و البصرية في تعلم العلوم جذابة. | 5 | 4 | 3 | 2 | 1 |
| 6- تزيد دافعيتي و رغبتي لتعلم المزيد في منهج العلوم باستخدام التقنية. | 5 | 4 | 3 | 2 | 1 |
| 7- أستمتع بتعلم العلوم باستخدام التقنية . | 5 | 4 | 3 | 2 | 1 |
| 8- أستخدم التقنية في إنجاز الواجبات. | 5 | 4 | 3 | 2 | 1 |
| 9- توفر المدرسة أدوات التقنية في الفصول بصورة جيّدة . | 5 | 4 | 3 | 2 | 1 |
| 10- تحسّن التقنية من قدرتي على فهم العلوم . | 5 | 4 | 3 | 2 | 1 |

## 5- استخدامات التقنية في تعليم العلوم: استخدم التقنية مثل .....

| | دائما في الأغلب | غالبا | أحيانا | نادرا | لا استخدمها اطلاقا |
|---|---|---|---|---|---|
| 1- أداة لطباعة واجباتي المدرسية . | 5 | 4 | 3 | 2 | 1 |
| 2- إرسال الواجبات إلى المعلمة عن طريق البريد الإلكتروني . | 5 | 4 | 3 | 2 | 1 |
| 3- لسؤال المعلمة عن بعض الإستفسارات . | 5 | 4 | 3 | 2 | 1 |
| 4- لإيجاد معلومات عن المنهج الدراسي . | 5 | 4 | 3 | 2 | 1 |
| 5- لقراءة النقاط الرئيسية في الدرس التي قامت المعلمة بتحضيرها. | 5 | 4 | 3 | 2 | 1 |
| 6- للمشاركة مع الطالبات في مناقشة المواضيع التي تتعلق عن العلوم على الإنترنت. | 5 | 4 | 3 | 2 | 1 |
| 7- للحصول على معلومات إضافية من الإنترنت . | 5 | 4 | 3 | 2 | 1 |

شكراً لتعاونك

**تقييم فاعلية دمج تقنية الاتصالات و المعلومات في تعليم منهج العلوم للصفوف العليا من المرحلة الابتدائية في المملكة العربية السعودية**

اختيرت مدرستك للمشاركة في هذا البحث الذي يهدف لتقييم فعالية دمج تقنية الاتصالات والمعلومات في تعليم العلوم للصفيّن الخامس والسادس. تشتمل الاستبانة على ثلاثة أجزاء: الجزء الأول عبارة عن أسئلة عامة , الجزء الثاني سيركز على قياس اتجاهك و معرفتك بالتقنية , الجزء الثالث يُركز على قدرتك الذاتية على دمج التقنية بفاعلية في تعليم العلوم و أثرها على مخرجات التعليم المتوقعة.
( التقنية) اختصار تقنية الاتصالات والمعلومات ويقصد بها في العملية التعليمية ويقصد بها أجهزة الكمبيوتر, التابلت و الايباد, الأقراص المدمجة , البريد الإلكتروني, الانترنت, السبورة الذكية, الكاميرات الرقمية .....الخ
* أقدّر وقتك الثمين ولكن خبرتك ومعلوماتك في هذا المجال تفيد البحث العلمي كثيراً، آمل منك التعاون في تعبئة هذه الاستبانة لتحقيق أهداف البحث المرجوة لاستكمال المتطلبات لنيل درجة الدكتوراة. علماً بأن المعلومات ستُحفظ بسرية ولن تستخدم إلا لأغراض البحث العلمي فقط.

## الجزء الأول : معلومات شخصية و معلومات عن المدرسة

**هل مدرستك ضمن برنامج تطوير؟** ☐ نعم ☐ لا ☐ كلاهما

**الفئة العمرية**

☐25- 29 ☐30-44 ☐45-59 ☐عالمية

**المستوى التعليمي**

☐ دبلوم ☐ بكالوريس ☐ ماجستير ☐دكتوراه

**استخدم أدوات التقنية في :**

☐ البيت ☐ المدرسة ☐ كلاهما

**وسائل التقنية التي تستخدمينها في مدرستك :**

**العلوم:**

☐أجهزة الكمبيوتر ( المكتبية و المحمولة)
☐جهاز العرض\ البروجكتور
☐السبورات الذكيةSmart board
☐أجهزة التابليت و الايباد
☐الطابعات و الماسحات الضوئية (سكانر)
☐التلفاز و مشغلات الدي في دي (DVD)
☐الكاميرات الرقمية ( الديجتال)
☐أخرى.....

**تطبيقات وسائل التواصل الاجتماعي التي تستخدمينها:**

☐ فيس بوكFace book ☐ تويترTwitter
☐ سناب شاتSnap chat ☐ لاشئ مما سبق

**استخدم تقنية الاتصالات و المعلومات في التدريس( اختاري كل ما ينطبق)**

☐كوسائل تكميلية للمنهج مثل الفيديو و الصور و الأصوات بتطبيقات عملية
☐ طريقة للتواصل المستمر بين المعلمة والطالبة
.....

**مرحلة التدريس** ☐ الصف الخامس ☐ الصف السادس

**نوع المدرسة**

☐حكومية ☐خاصة

**عدد سنوات الخبرة**

☐ 5-15 ☐ 16- 25 ☐

**مستوى مهاراتك في استخدام التقنية:**

☐مبتدئ ☐متوسط ☐متقدم

**تطبيقات و برامج التقنية التي تستخدمينها في تدريس**

☐برنامج ورد لمعالجة النصوص Word
☐برنامج باور بوينت Power Point
☐البريد الإلكتروني Email
☐استخدام الإنترنت
☐موقعي الشخصي على الإنترنت
☐ بوابة العلوم والرياضيات (العبيكان التعليمية)
☐موقع المدرسة على الإنترنت
☐برنامج متخصص في العلوم
☐لا شيء مما سبق
☐أخرى.....

☐ انستقرام Instagram ☐ LinkedIn
☐ أخرى.....

☐ وسيلة لتعزيز نقل معلومات المنهج بطرق متنوعة و
☐ أخرى

## الجزء الثاني : اتجاه المعلمة و معرفتها بالتقنية

### 1-اهتمام المعلمة باستخدام التقنية

| | موافقة بشدة | موافقة | محايدة | رافضة | رافضة بشدة |
|---|---|---|---|---|---|
| 1- أرغب بمعرفة المزيد عن التقنية. | 5 | 4 | 3 | 2 | 1 |
| 2- أرغب بقراءة المجلات الخاصة بمجالات التقنية. | 5 | 4 | 3 | 2 | 1 |
| 3- أستمتع بالعمل باستخدام التقنية. | 5 | 4 | 3 | 2 | 1 |
| 4- يجب أن يتم التركيز بصورة أكبر على التعليم بالتقنية. | 5 | 4 | 3 | 2 | 1 |
| 5- استمتع بإصلاح الأغراض في منزلي الخاصه بالتقنية. | 5 | 4 | 3 | 2 | 1 |
| 6- يجب على جميع المعلمات استخدام التقنية في عملية التدريس. | 5 | 4 | 3 | 2 | 1 |
| 7- العمل في مجال التقنية سيكون ممتعاً. | 5 | 4 | 3 | 2 | 1 |
| 8- مستقبل العمل في مجال التقنية واعد . | 5 | 4 | 3 | 2 | 1 |

### 2-موقف المعلمة تجاه التقنية

| | موافقة بشدة | موافقة | محايدة | رافضة | رافضة بشدة |
|---|---|---|---|---|---|
| 1- لتتمكني من التدريس باستخدام التقنية عليكي أن تكوني ذكية. | 5 | 4 | 3 | 2 | 1 |
| 2- لا يوجد شخص يرغب في الحصول على عمل في مجال التقنية. | 5 | 4 | 3 | 2 | 1 |
| 3- استخدام التقنية تجعل البلاد أكثر ازدهاراً و نجاحاً. | 5 | 4 | 3 | 2 | 1 |
| 4- العمل في التقنية قد يكون مملاً. | 5 | 4 | 3 | 2 | 1 |
| 5- أغلب الوظائف في مجال التقنية مملة. | 5 | 4 | 3 | 2 | 1 |

### 3-المعرفة في مجال التقنية

| | موافقة بشدة | موافقة | محايدة | رافضة | رافضة بشدة |
|---|---|---|---|---|---|
| 1- هناك علاقة بين العلوم والتقنية. | 5 | 4 | 3 | 2 | 1 |
| 2- تتميز التقنية بتأثير واسع على الناس. | 5 | 4 | 3 | 2 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 3- أعتقد أن التقنية تُستخدم غالباً في منهج العلوم. | 5 | 4 | 3 | 2 | 1 |
| 4- تتعدد استخدامات التقنية في الحياة اليومية. | 5 | 4 | 3 | 2 | 1 |
| 5- وزارة التعليم لها تأثيرٌ على دمج التقنية في تعليم العلوم. | 5 | 4 | 3 | 2 | 1 |
| 6- يمكنكِ استخدام العديد من الأدوات في مجال التقنية. | 5 | 4 | 3 | 2 | 1 |
| 7- الغرض من استخدام التقنية هو جعل حياتنا أكثر راحة. | 5 | 4 | 3 | 2 | 1 |
| 8- استخدام التقنية تساعد المعلمة على تطويرالتدريس. | 5 | 4 | 3 | 2 | 1 |
| 9-استخدام التقنية يحسّن المهارات التقنيّة للمعلمات. | 5 | 4 | 3 | 2 | 1 |

## 4- التدريس باستخدام التقنية

| | موافقة بشدة | موافقة | محايدة | رافضة | رافضة بشدة |
|---|---|---|---|---|---|
| 1- أرى أن تدريس العلوم باستخدام التقنية أمر ممتعٌ. | 5 | 4 | 3 | 2 | 1 |
| 2- أستطيع التدريس بشكل أسرع باستخدام أدوات التقنية. | 5 | 4 | 3 | 2 | 1 |
| 3- ألاحظ أن استخدام التقنية يدعم حصة العلوم وجعلها نشطة. | 5 | 4 | 3 | 2 | 1 |
| 4- أستطيع الحصول على المزيد من المعلومات و زيادة النواحي المعرفية لديّ باستخدام التقنية. | 5 | 4 | 3 | 2 | 1 |
| 5- ألاحظ أن المؤثرات السمعية و البصرية في تدريس العلوم جذابة. | 5 | 4 | 3 | 2 | 1 |
| 6- تزيد دافعيتي و رغبتي لتدريس منهج العلوم باستخدام التقنية. | 5 | 4 | 3 | 2 | 1 |
| 7- استمتع بتدريس العلوم باستخدام التقنية . | 5 | 4 | 3 | 2 | 1 |
| 8- الطالبات يستخدمن التقنية في إنجاز الواجبات. | 5 | 4 | 3 | 2 | 1 |
| 9- توفر المدرسة أدوات التقنية في الفصول بصورة جيدة . | 5 | 4 | 3 | 2 | 1 |
| 10- تحسّن التقنية من قدرتي أثناء تدريس العلوم . | 5 | 4 | 3 | 2 | 1 |

## 5-استخدامات التقنية في تدريس العلوم: استخدم التقنية فيما يلي:

| | دائماً في الأغلب | غالباً | أحياناً | نادراً | لا أستخدمها اطلاقاً |
|---|---|---|---|---|---|
| 1- أداة لتدريس العلوم. | 5 | 4 | 3 | 2 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 2- للتواصل مع الطالبات عن طريق البريد الإلكتروني . | 5 | 4 | 3 | 2 | 1 |
| 3- للإجابة عن أسئلة الطالبات . | 5 | 4 | 3 | 2 | 1 |
| 4- لإيجاد معلومات عن المنهج الدراسي . | 5 | 4 | 3 | 2 | 1 |
| 5- لتحضير المنهج العلوم . | 5 | 4 | 3 | 2 | 1 |
| 6- للمشاركة مع المعلمات في مناقشة المواضيع التي تتعلق عن العلوم على الإنترنت. | 5 | 4 | 3 | 2 | 1 |
| 7- للحصول على معلومات إضافية من الإنترنت . | 5 | 4 | 3 | 2 | 1 |

## الجزء الثالث : كفاءة معلمة العلوم الذاتية في دمج تقنية الاتصالات و المعلومات بفاعلية و أثرها على النتائج المتوقعة لمخرجات التعليم

| | موافقة بشدة | موافقة | محايدة | رافضة | رافضة بشدة |
|---|---|---|---|---|---|
| 1- عندما تحقق الطالبة تقدماً أكثر من المعتاد في مادة العلوم ، فإن ذلك يرجع إلى بذل المعلمة زيادة من المجهود بدمج التقنية في تدريس العلوم . | 5 | 4 | 3 | 2 | 1 |
| 2- دائماً أجد طرق أفضل لتدريس العلوم باستخدام التقنية. | 5 | 4 | 3 | 2 | 1 |
| 3- عندما تتحسن النتائج الدراسية للطالبات ، فإن ذلك يرجع في الأغلب إلى تطبيق معلمتهم لطرق تدريس أكثر فاعلية باستخدام التقنية. | 5 | 4 | 3 | 2 | 1 |
| 4- أدرك الخطوات المهمة لتدريس مفاهيم العلوم بشكل فعال بدمج التقنية في تدريس العلوم. | 5 | 4 | 3 | 2 | 1 |
| 5- أنا لا أتمتع بالكفاءة العالية في استخدام التقنية في مراقبة التجارب العلمية . | 5 | 4 | 3 | 2 | 1 |
| 6- إذا كانت نتائج الطالبات في العلوم غير مرضية ، فإن ذلك في الأغلب يرجع إلى عدم دمج التقنية بكفاءة في تدريس العلوم . | 5 | 4 | 3 | 2 | 1 |
| 7- بشكل عام أنا أدرّس العلوم باستخدام التقنية بصورة غير فعّالة . | 5 | 4 | 3 | 2 | 1 |
| 8- يمكن التغلب على ضعف الطالبات في العلوم بالتدريس الجيد. | 5 | 4 | 3 | 2 | 1 |
| 9- بشكل عام لا يمكن توجيه اللوم للمعلمات على انخفاض درجات بعض الطالبات في مادة العلوم . | 5 | 4 | 3 | 2 | 1 |
| 10- عندما يتحسن مستوى أحد الطالبات عن السابق في مادة العلوم ، فإن ذلك يرجع إلى الجهد الإضافي الذي قدمته لها المعلمة. | 5 | 4 | 3 | 2 | 1 |
| 11- أنا ملمّة بمفاهيم العلوم بصور كافية مما يؤهلني لتعليم العلوم للمرحلة الابتدائية باستخدام التقنية . | 5 | 4 | 3 | 2 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 12- زيادة المجهود في دمج التقنية في تعليم العلوم يأتي بنتائج قليلة في تحصيل بعض الطالبات لمادة العلوم . | 5 | 4 | 3 | 2 | 1 |
| 13- المعلمة مسئولة بشكل عام عن تقدم درجة تحصيل طالباتها في مادة العلوم . | 5 | 4 | 3 | 2 | 1 |
| 14- ترتبط درجة تقدم الطالبات في مادة العلوم بصورة مباشرة بقدرة المعلمة على دمج التقنية في تعليم العلوم بكفاءة و فاعلية . | 5 | 4 | 3 | 2 | 1 |
| 15- إذا لاحظ أولياء الأمور أن أطفالهم يبدون اهتماماً زائداً باستخدام التقنية في دراسة العلوم في المدرسة ، فمن المحتمل أن ذلك يرجع إلى أداء معلمة الفصل | 5 | 4 | 3 | 2 | 1 |
| 16- أجد صعوبة أثناء شرح التجارب العلمية للطالبات . | 5 | 4 | 3 | 2 | 1 |
| 17- أنا قادرة على إجابة أسئلة الطالبات في مادة العلوم بشكل نموذجي. | 5 | 4 | 3 | 2 | 1 |
| 18- أنا أتساءل إن كانت لدي المهارات المهمة لتدريس العلوم باستخدام التقنية. | 5 | 4 | 3 | 2 | 1 |
| 19- فاعلية دمج التقنية في تدريس العلوم له تأثير قليل على إنجاز الطالبات الأقل حماساً للتعلم . | 5 | 4 | 3 | 2 | 1 |
| 20- إذا أتيحت لي الفرصة لن أدعو مديرة المدرسة لتقييم أدائي في دمج التقنية في عملية تدريس العلوم . | 5 | 4 | 3 | 2 | 1 |
| 21- عندما أجد تلميذة تعاني من صعوبات في إدراك مفاهيم العلوم غالباً أشعر بالحيرة حول كيفية مساعدة هذه الطالبة على الفهم بطريقة أفضل باستخدام التقنية . | 5 | 4 | 3 | 2 | 1 |
| 22- عندما استخدم التقنية في تدريس العلوم فإني أرحب بأسئلة الطالبات. | 5 | 4 | 3 | 2 | 1 |
| 23- لا أعلم ما علىّ فعله لتحفيز الطالبات و تشجيعهن على دراسة العلوم. | 5 | 4 | 3 | 2 | 1 |
| 24- يصعب حتى على المعلمات من ذوي مهارات التدريس الجيدة لتدريس العلوم مساعدة بعض الأطفال على تعلم العلوم . | 5 | 4 | 3 | 2 | 1 |

شكراً لتعاونك

للتواصل
alaahr2@gmail.com

## Appendix E
## Students Interview Questions

Q1 Are you interested and enjoying integrating technology in learning? Why?

Q2 Do you use educational sites that explains Science lessons like Obeikan?

Q3 How can make the integration of technology in Sciences interesting or enjoyable?

Q4 What are the benefits of the integration of technology in learning sciences? Mention them.

Q5 How can the integration of technology in sciences enhance your understanding of the subject? Give examples.

Q6 Explain how do you use the technology to achieve tasks and homework?

Q7 What are the advantages and disadvantages of integrating ICT in learning science?

Q8 How can you enhance your educational level through using technology in learning Science?

Q9 Does your teacher encourage you to use technology, how?

Q10 What is your suggestion on developing integrating technology in teaching Science?

## Appendix F

## Teachers Interview Questions

Q1 Are you interested and enjoying integrating ICT into teaching? Why?

Q2 Do you use the online educational sites to explain science lessons easily? Give an example

Q3 Explain the most effective devices in teaching Sciences for upper primary level students and give an example.

Q4 To which level using ICT in teaching Science improve the students to understand better?

Q5 Explain how the use of ICT in teaching leads to improve students' learning outcomes.

Q6 Do you use ICT with your student in the classroom or you use it only?

Q7 What are the devices you usually use in teaching Sciences for sixth or fifth grade?

Q8 How the school administration does encourage the teachers to integrate ICT with teaching?

Q9 From your experience, what are the advantages and disadvantages of it?

Q10 How could using ICT in science classroom improve teacher's teaching, and teacher technical skills?

Q11 Is your students do their work by using ICT? How?

Q12 Is there a relation between the improvement of students' educational level and the teaching with ICT?

Q13 Is the integrating of the ICT in the teaching process has little influence on achievement of students with low motivation?

Q14 What's your suggestions to improve this process in Saudi Arabia?

**أسئلة مقابلة الطالبات**

1) هل أنتي مهتمة ومستمتعة خلال دمج التقنية في التعلم؟ لماذا؟

2) هل تستخدمي مواقع تعليمية تشرح مادة العلوم مثل العبيكان التعليمية؟

3) كيف يمكن جعل دمج التقنية ممتعاً في مادة العلوم ؟

4) ما هي فوائد دمج التقنية في تعليم العلوم ؟ حددي

5) أعطي بعض الأمثلة على تأثير دمج التقنية في تحسين فهمك لمادة العلوم ؟

6) اشرحي كيف تستخدمي التقنية لإنجاز المهام و الواجبات المدرسية ؟

7) ما هي مميزات و عيوب دمج التقنية في تعلم مادة العلوم؟

8) كيف يمكن تحسين مستواك العلمي و تحسين مهاراتك عن طريق استخدام التقنية في تعلم العلوم؟

9) هل مدرستك تحفزك لاستخدام التقنية لتعلم العلوم. كيف؟

10) ماهي اقتراحاتك لتطوير دمج التقنية في تعليم العلوم؟

**أسئلة مقابلة المعلمات**

1) هل أنتي مهتمة ومستمتعة خلال دمج التقنية في عملية التدريس؟ لماذا؟

2) هل تستخدمي المواقع التعليمية على شبكة الإنترنت لتوضيح و تبسيط شرح دروس مادة العلوم ( على سبيل المثال موقع بوابة العلوم والرياضيات بموقع وزارة التعليم) ؟ مع إعطاء مثال .

3) أشرحي أي من أدوات التقنية أكثر فاعلية في عملية تدريس العلوم لمرحلة الصفوف العليا مع إعطاء مثال.

4) إلى أي مدى يؤثر استخدام التقنية في تدريس مادة العلوم على تحسين فهم الطالبة لهذه المادة ؟

5) أشرحي كيف يؤدي استخدام التقنية في تدريس مادة العلوم إلى تحسين النتائج الدراسية لطالبات الصف الخامس و السادس ؟

6) ما هو دورك في الفصل عند استخدام التقنية ؟ و هل تقومي باستخدامها وحدك أم بمشاركة الطالبات؟

7) أي من وسائل التقنية تستخدمينها عند تدريس مادة العلوم للصف الخامس أو السادس ؟

8) كيف تشجع إدارة المدرسة المعلمات على دمج استخدام التقنية في تدريس مادة العلوم ؟ مع إعطاء مثال.

9) من خلال خبرتك في هذا المجال ، ما هي مميزات و عيوب دمج التقنية في تدريس مادة العلوم؟

10) كيف يمكن تحسين مستواك العلمي و تحسين مهاراتك عن طريق استخدام التقنية في تدريس العلوم؟

11) هل يقمن الطالبات بإنجاز الواجبات باستخدام التقنية؟ كيف؟

12) هل يوجد علاقة مشتركة بين تحسّن درجات الطالبة و التدريس الفعال بواسطة التقنية؟ كيف؟

13) هل دمج التقنية في تدريس العلوم له تأثير على إنجاز الطالبات الأقل حماساً للتعليم؟

14) وما هي اقتراحاتك لتطوير استراتيجيات التعليم في المستقبل ؟

# Appendix G

**MEMORANDUM**

Curtin University

| | |
|---|---|
| To: | Prof David F. Treagust<br>Science and Mathematics Education Centre |
| CC: | Mrs Alaa Abdulaziz Alharthi |
| From: | Dr Catherine Gangell, Manager Research Integrity |
| Subject | Ethics approval<br>Approval number: RDSE-56-15 |
| Date: | 12-Oct-15 |

Office of Research and Development
Human Research Ethics Office

TELEPHONE 9266 2784
FACSIMILE 9266 3793
EMAIL hrec@curtin.edu.au

Thank you for your application submitted to the Human Research Ethics Office for the project: 5459

Evaluation of the effectiveness of information and communication technology integration in teaching and learning science at the upper primary school level in Saudi Arabia.

Your application has been approved through the low risk ethics approvals process at Curtin University.

Please note the following conditions of approval:

1. Approval is granted for a period of four years from **05-Oct-15** to **05-Oct-19**
2. Research must be conducted as stated in the approved protocol.
3. Any amendments to the approved protocol must be approved by the Ethics Office.
4. An annual progress report must be submitted to the Ethics Office annually, on the anniversary of approval.
5. All adverse events must be reported to the Ethics Office.
6. A completion report must be submitted to the Ethics Office on completion of the project.
7. Data must be stored in accordance with WAUSDA and Curtin University policy.
8. The Ethics Office may conduct a randomly identified audit of a proportion of research projects approved by the HREC.

Should you have any queries about the consideration of your project please contact the Ethics Support Officer for your faculty, or the Ethics Office at hrec@curtin.edu.au or on 9266 2784. All human research ethics forms and guidelines are available on the ethics website.

Yours sincerely,

Dr Catherine Gangell
Manager, Research Integrity

Curtin University
Science and Mathematics Education Centre

GPO Box U1987
Perth Western Australia 6845

**Telephone** +61 8 9266 7924
**Facsimile** +61 8 9266 2503
**Email** D.Treagust@curtin.edu.au
**Web** http://www.curtin.edu.au

## Appendix H

# Curtin University
## Science & Mathematics Education Centre- Faculty of Education
## Student Participant Information Sheet

My name is Alaa Abdulaziz Alharthi. I am currently conducting a research study for my Doctor of Philosophy degree in Science Education at Curtin University.

**Purpose of Research**
I am investigating of how effectively computer and Internet (ICT) are used in teaching and learning at the upper primary school level in Saudi Arabia.

**Your Role**
I am interested in finding out the extent of ICT integration in science classes from your perspectives by answering the questionnaire.
I will ask you about to explore more about your understanding of effectiveness of using ICT in science classroom.
The interview process will take approximately 30 minutes.

**Consent to Participate**
Your involvement in the research is entirely voluntary. You have the right to withdraw at any stage without it affecting your rights or my responsibilities. When you have signed the consent form I will assume that you have agreed to participate and allow me to use your data in this research.

**Confidentiality**
The information you provide will be kept separate from your personal details, and only my supervisor and I will have access to this information. The interview transcript will not have your name or any other identifying information on it and in adherence to Curtin University policy, the interview tapes and transcribed information will be kept in a locked cabinet for at least seven years, before a decision is made as to whether or not they should be destroyed.

**Further Information**
This research has been reviewed and given approval by Curtin University Human Research Ethics Committee (Approval Number RDSE/5615). If you would like further information about the study, please feel free to contact me on PHONE +966503850400 or by email alharthialaa@gmail.com. Alternatively, you can contact my supervisor Professor David Treagust on +618 9266 7924 or d.treagust@curtin.edu.au.

**Thank you very much for your involvement in this research.**
**Your participation is greatly appreciated.**

**CONSENT FORM**

---

• I understand the purpose and procedures of the study.

• I have been provided with the participation information sheet.

• I understand that the procedure itself may not benefit me.

• I understand that my involvement is voluntary and I can withdraw at any time without problem.

• I understand that no personal identifying information like my name and address will be used in any published materials.

• I understand that all information will be securely stored for at least 5 years before a decision is made as to whether it should be destroyed.

• I have been given the opportunity to ask questions about this research.

• I agree to participate in the study outlined to me.

---

Name: _____

Signature: _____

Date: _____

Curtin University

Science and Mathematics Education Centre

GPO Box U1987

Perth Western Australia 6845

**Telephone** +61 8 9266 7924

**Facsimile** +61 8 9266 2503

**Appendix I**

**Curtin University**

**Science and Mathematics Education Centre- Faculty of Education**

# PARENT Information Sheet

My name is Alaa Abdulaziz Alharthi. I am currently conducting a research study at Curtin University for my doctoral degree in science education.

**Purpose of Research**

I am investigating of how effectively computer and Internet are used in teaching and learning at the upper primary school level in Saudi Arabia.

**Your Role**

I will conduct research by asking for your child to take part in answering a short questionnaire and interview. Your child's teachers and the school principal have already been contacted and have agreed in principle to the project.
The questionnaires will not in any way affect the students reported grades.
This participation will be voluntary and of short duration (20-30 mins)

**Consent to Participate**

Your child's involvement in the research is entirely voluntary. You have the right to withdraw him or her at any stage without it affecting his or her rights or my responsibilities. When you have signed the consent form I will assume that you have agreed for your child to participate and allow me to use his or her data in this research.

**Confidentiality**

The information your child provides will be kept separate from his or her personal details, and only my supervisor and I will only have access to this information. The interview transcript will not have your child's name or any other identifying information on it and in adherence to university policy, the interview tapes and transcribed information will be kept in a locked cabinet for at least seven years, before a decision is made as to whether they should be destroyed.

**Further Information**

This research has been reviewed and given approval by Curtin University Human Research Ethics Committee (Approval Number RDSE/5615). If you would like further information about the study, please feel free to contact me on +966503850400 - or by email alharthialaa@gmail.com

**Thank you very much for your involvement in this research.**

**Your participation is greatly appreciated**

**PARENT CONSENT FORM**

---

• I understand the purpose and procedures of the study.

• I have been provided with the participation information sheet.

• I understand that the procedure itself may not benefit my child.

• I understand that my and my child's involvement is voluntary and I can withdraw at any time without problem.

• I understand that no personal identifying information like my name and address will be used in any published materials.

• I understand that all information will be securely stored for at least 5 years before a decision is made as to whether it should be destroyed.

• I have been given the opportunity to ask questions about this research.

• I agree to allow my child to participate in the study outlined to me.

---

Name: _____

Student Name:_____

Signature: _____

Date: _____

Science and Mathematics
Education Centre

GPO Box U1987

Perth Western Australia 6845

**Telephone** +61 8 9266 7924

**Facsimile** +61 8 9266 2503

**Appendix J**

## Curtin University

### Science and Mathematics Education Centre- Faculty of Education

# Teacher Participant Information Sheet

Dear science teacher,
My name is Alaa Abdulaziz Alharthi I am currently conducting a research study for my Doctor of Philosophy degree in Science Education at Curtin University in Perth.

**Purpose of Research**
I am investigating of how effectively of information and communication technology integration in teaching and learning at the upper primary school level in Saudi Arabia.

**Your Role**
I am interested in finding out the extent of ICT integration in science classes from your perspectives by answering the questionnaire.
I will ask you about to explore more about your perceptions of effectiveness of ICT integration in science classroom.
The interview process will take approximately 30 minutes.

**Consent to Participate**
Your involvement in the research is entirely voluntary. They have the right to withdraw at any stage without it affecting their rights or my responsibilities. When you have signed the consent form I will assume that you have agreed that your students can participate in the research and allow me to use the students' data in this research.

**Confidentiality**
The information you provide will be kept separate from your personal details, and only my supervisor and I will have access to this information. The interview transcripts will not have student names or any other identifying information on them and in adherence to university policy, the interview tapes and transcribed information will be kept in a locked cabinet for at least seven years, before a decision is made as to whether they should be destroyed.

**Further Information**
This research has been reviewed and given approval by Curtin University Human Research Ethics Committee (Approval Number RDSE/5615). If you would like further information about the study, please feel free to contact me on

+966503850400 or by email alharthialaa@gmail.com. Alternatively, you can contact my supervisor Professor David Treagust on +618 9266 7924 or email d.treagust@curtin.edu.au.

**Thank you very much for your involvement in this research.**
**Your participation is greatly appreciated.**

**TEACHER'S CONSENT FORM**

---

• I understand the purpose and procedures of the study.

• I have been provided with the participation information sheet.

• I understand that the procedure itself may not benefit me.

• I understand that my schools involvement is voluntary and I can withdraw at any time without problem.

• I understand that no personal identifying information will be used in any published materials.

• I understand that all information will be securely stored for at least 5 years before a decision is made as to whether it should be destroyed.

• I have been given the opportunity to ask questions about this research.

• I agree to allow students form my school to participate in the study outlined to me.

---

Name: _____

Signature: _____

Date: _____

Curtin University

Science and Mathematics Education Centre

GPO Box U1987

Perth Western Australia 6845

**Telephone** +61 8 9266 7924

**Appendix K**

**Curtin University**

**Science and Mathematics Education Centre- Faculty of Education**

# School Principal Information Sheet

Dear School Principal,

My name is Alaa Abdulaziz Alharthi I am currently conducting a research study for my Doctor of Philosophy degree in Science Education at Curtin University in Perth.

**Purpose of Research**

I am investigating of how effectively of information and communication technology integration in teaching and learning at the upper primary school level in Saudi Arabia.

**Your Role**

I am seeking your permission to conduct research by asking for science teachers and students (grade 5 and 6) to take part in short questionnaire on science that will complement their learning.

I may also ask for the participation in a short interview (individual) about their attitudes and opinions about ICT integration on science classroom. Again this participation will be voluntary and of short duration (20-30 mins)

**Consent to Participate**

The students and teachers in your school's involvement in the research are entirely voluntary. They have the right to withdraw at any stage without it affecting their rights or my responsibilities. When you have signed the consent form I will assume that you have agreed that your students can participate in the research and allow me to use the students' data in this research.

**Confidentiality**

The information provided will be kept separate from the students' personal details, and only my supervisor and I will have access to this information. The interview transcripts will not have student names or any other identifying information on them and in adherence to university policy, the interview tapes and transcribed information will be kept in a locked cabinet for at least seven years, before a decision is made as to whether they should be destroyed.

**Further Information**

Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number RDSE/5615). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential

complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au.

**Thank you very much for your involvement in this research.**
**Your participation is greatly appreciated.**

**PRINCIPAL'S CONSENT FORM**

---

• I understand the purpose and procedures of the study.

• I have been provided with the participation information sheet.

• I understand that the procedure itself may not benefit me.

• I understand that my schools involvement is voluntary and I can withdraw at any time without problem.

• I understand that no personal identifying information will be used in any published materials.

• I understand that all information will be securely stored for at least 5 years before a decision is made as to whether it should be destroyed.

• I have been given the opportunity to ask questions about this research.

• I agree to allow students form my school to participate in the study outlined to me.

---

Name: _____

Signature: _____

Date: _____

## Appendix L

**Based on the results of SATK, are there any differences between each scale based on Grade level**

*a) Students' interest in ICT in science learning*

To answer the second research question, analysis of the students' interest scale was done by comparing means for students from the different grade levels—fifth grade and sixth grade. Six out of eight items show that students in fifth grade had slightly more interest in ICT in science learning than did students in sixth grade. However, item 1.6 reveals that sixth grade students had more interest in ICT, in that they agreed that all students should use ICT in learning processes. "Working in ICT would be interesting," item 1.7, yielded equal results for both groups.

The total mean of the students' interest scale shows that fifth grade students had more interest than the sixth grade students in ICT in science learning (Table 1). Grade level differences in SATK were further confirmed by computing the effect sizes for the student interest scale, which composed a range from -0.03 for the item "enjoy repairing things" to 0.21 for the item "reading technological magazines," demonstrating medium to small differences in the two grade levels in student interest.

There was a small effect size of 0.21 related to item 2, which could be because fifth grade students need to read and know more about ICT; on the other hand, sixth grade students would already have read some of this type of magazine, and they were not interested in reading more. According to these measures, the results show that fifth grade had little general interest in technology.

Table 1: Student Participants: Mean, SD, & Effect size for student interest scale based on grade level

| 1.Student interest | | All students | 5th N =679 | 6th N =722 | Effect Size |
|---|---|---|---|---|---|
| 1. Know more | Mean | 4.68 | 4.70 | 4.65 | 0.08 |
| | SD | 0.59 | 0.59 | 0.58 | |
| 2. Read technological magazines | Mean | 4.16 | 4.26 | 4.06 | 0.21 |
| | SD | 0.95 | 0.86 | 1.02 | |
| 3. Enjoy learning | Mean | 4.73 | 4.71 | 4.74 | 0.05- |
| | SD | 0.61 | 0.64 | 0.57 | |
| 4. More education about technology | Mean | 4.63 | 4.65 | 4.61 | 0.06 |
| | SD | 0.70 | 0.68 | 0.72 | |
| 5. Enjoy repairing things | Mean | 4.19 | 4.26 | 4.12 | 0.13 |
| | SD | 1.04 | 1.02 | 1.05 | |
| 6. Students' use | Mean | 4.60 | 4.59 | 4.61 | -0.03 |

| | | | | | |
|---|---|---|---|---|---|
| | SD | 0.74 | 0.78 | 0.71 | |
| 7. Interesting | Mean | 4.73 | 4.73 | 4.73 | 0 |
| | SD | 0.58 | 0.60 | 0.56 | |
| 8. Job your future | Mean | 4.60 | 4.65 | 4.55 | 0.14 |
| | SD | 0.71 | 0.67 | 0.73 | |
| | Mean | 4.54 | 4.57 | 4.51 | 0.13 |

*b) Students' attitudes towards ICT*

The results of the analyses are revealed in Table 2. In the data analysis, mean scores for the fifth and sixth grade were computed. Table 2 shows the scale item means for students' attitudes. The purpose of this analysis was to establish whether there are significant differences in the perceptions of students according to their grade levels. As can be seen in the table, the differences in students' responses on this scale show that fifth grade students had a more positive attitude towards ICT in learning science than did sixth grade students. These results confirm that there is a difference in student attitudes associated with grade level. Looking at the effect size for attitude towards ICT scale, there was one item that had a higher difference, which was d = 0.31, in the first item, "you have to be smart to learn with ICT."

Table 2: Students Participants: Mean, SD, the Effect size for attitude towards ICT scale based on grade level

| 2.Attitude towards ICT | | All students | 5th N = 679 | 6th N = 722 | Effect Size |
|---|---|---|---|---|---|
| 1. Have to be smart | Mean | 4.58 | 4.71 | 4.45 | 0.31 |
| | SD | 0.83 | 0.66 | 0.95 | |
| 2. No one wants a job | Mean | 4.46 | 4.56 | 4.36 | 0.20 |
| | SD | 1.01 | 0.93 | 1.07 | |
| 3. Country prosperous | Mean | 4.81 | 4.83 | 4.80 | 0.05 |
| | SD | 0.55 | 0.54 | 0.55 | |
| 4. Working boring | Mean | 4.67 | 4.72 | 4.62 | 0.13 |
| | SD | 0.75 | 0.70 | 0.80 | |
| 5. Jobs are boring | Mean | 4.53 | 4.62 | 4.45 | 0.20 |
| | SD | 0.84 | 0.75 | 0.913 | |
| | Mean | 4.61 | 4.69 | 4.53 | 0.31 |

*c) Students' knowledge of ICT*

Table 4.11 shows scale means for each item relating to students' knowledge of ICT. A student in fifth grade tended to be more knowledgeable in ICT than students in sixth grade. The largest difference in means was for the third item on the scale, "I think ICT is often used in science." This could be due to the slightly more frequent use of ICT in fifth grade lessons than at the sixth grade level. As a result, the

difference between fifth and sixth grade students was computed to find the significant difference. Effect sizes in item three show that the difference between the two groups is 0.32. This could be because fifth grade uses ICT in science more than sixth grade does.

Table 3: Student Participants: Mean, SD, the Effect size for knowledge of ICT scale based on grade level

| *3. Knowledge of ICT* | | All students | 5th N = 679 | 6th N = 722 | Effect Size |
|---|---|---|---|---|---|
| *1.Science and ICT related* | Mean | 4.64 | 4.73 | 4.55 | 0.28 |
| | SD | 0.64 | 0.55 | 0.72 | |
| *2. Large influence* | Mean | 4.75 | 4.81 | 4.69 | 0.21 |
| | SD | 0.58 | 0.46 | 0.67 | |
| *3. Often used* | Mean | 4.29 | 4.44 | 4.14 | 0.32 |
| | SD | 0.93 | 0.82 | 1.02 | |
| *4. Lot to do* | Mean | 4.72 | 4.75 | 4.69 | 0.10 |
| | SD | 0.59 | 0.57 | 0.61 | |
| *5. Ministry of Education* | Mean | 4.69 | 4.77 | 4.62 | 0.22 |
| | SD | 0.67 | 0.59 | 0.73 | |
| *6. Use tools* | Mean | 4.73 | 4.75 | 4.72 | 0.05 |
| | SD | 0.59 | 0.55 | 0.58 | |
| *7. Life comfortable* | Mean | 4.72 | 4.77 | 4.68 | 0.15 |
| | SD | 0.61 | 0.58 | 0.63 | |
| *8. Improve learning* | Mean | 4.81 | 4.85 | 4.78 | 0.13 |
| | SD | 0.54 | 0.49 | 0.58 | |
| *9. Improves skills* | Mean | 4.79 | 4.82 | 4.76 | 0.17 |
| | SD | 0.54 | 0.47 | 0.61 | |
| | Mean | 4.68 | 4.74 | 4.62 | 0.32 |

*d) Students' learning with ICT in science*

The highest reliable scale in the SATK survey was students learning with ICT in science table (4.12). The results revealed in Table 4 clearly show the similarity in means for both groups. However, there was a considerable difference between means for item 9, "our school is doing a good job of putting ICT tools in to the classroom." That could be because it is a different kind of question; all other items relate to the individual student or the teacher's students, but item 4.9 is about the school. Moreover, the effect size shows the difference between the two groups. The highest result of learning with ICT was 0.39, also related to item 9.

Table 4: Student Participants: Mean, SD, the Effect size for learning with ICT scale based on grade level

| *4. Learning with ICT* | | All students | 5th N = 679 | 6th N = 722 | Effect Size |
|---|---|---|---|---|---|
| *1. Interesting* | Mean | 4.76 | 4.78 | 4.74 | 0.07 |
| | SD | 0.58 | 0.55 | 0.60 | |
| *2. Learn faster* | Mean | 4.79 | 4.81 | 4.77 | 0.08 |
| | SD | 0.52 | 0.47 | 0.56 | |
| *3. Active* | Mean | 4.77 | 4.83 | 4.72 | 0.20 |
| | SD | 0.56 | 0.44 | 0.64 | |
| *4. Update my knowledge* | Mean | 4.76 | 4.81 | 4.71 | 0.18 |
| | SD | 0.54 | 0.48 | 0.59 | |
| *5. Audio and visual* | Mean | 4.68 | 4.75 | 4.60 | 0.22 |
| | SD | 0.68 | 0.57 | 0.76 | |
| *6. Motivated to learn* | Mean | 4.72 | 4.75 | 4.69 | 0.10 |
| | SD | 0.63 | 0.58 | 0.66 | |
| *7. Enjoy* | Mean | 4.75 | 4.78 | 4.73 | 0.09 |
| | SD | 0.58 | 0.54 | 0.61 | |
| *8. Do my tasks* | Mean | 4.59 | 4.61 | 4.56 | 0.07 |
| | SD | 0.72 | 0.71 | 0.75 | |
| *9. School doing a good job* | Mean | 3.66 | 3.95 | 3.39 | 0.39 |
| | SD | 1.44 | 1.35 | 1.48 | |
| *10. Improves my learning* | Mean | 4.68 | 4.71 | 4.65 | 0.10 |
| | SD | 0.62 | 0.59 | 0.65 | |
| | Mean | 4.62 | 4.68 | 4.56 | 0.21 |

*a) students' usage of ICT in science learning*

Student usage of ICT in science learning differs between students and school initiatives. Table 4.13 shows there were mean differences in favour of fifth grade level students. The most dissimilar item means were in item 5, "to read lesson notes prepared by the teacher." This could be due to not all teachers offering the lesson's materials to their students to read. Regarding the effect size results for the student usage scale, there was little difference in the items, except for the fifth item; the result was 0.29. This significant difference could be due to the difference in the teachers' ways of teaching science.

Table 5: Student Participants: Mean, SD, the Effect size for student usage scale base on grade level

| *5. ICT Usage* | | All students | 5th N = 679 | 6th N = 722 | Effect Size |
|---|---|---|---|---|---|
| *1. Type my assignments* | Mean | 3.47 | 3.48 | 3.45 | 0.02 |
| | SD | 1.16 | 1.17 | 1.15 | |
| *2. Email* | Mean | 1.83 | 1.89 | 1.77 | 0.09 |
| | SD | 1.39 | 1.48 | 1.33 | |
| *3. Ask the teacher questions* | Mean | 2.77 | 2.75 | 2.78 | 0.02- |
| | SD | 1.61 | 1.61 | 1.60 | |
| *4. Information for course* | Mean | 4.07 | 4.11 | 4.03 | 0.07 |
| | SD | 1.14 | 1.10 | 1.17 | |
| *5. Read lesson notes* | Mean | 3.75 | 3.96 | 3.55 | 0.29 |
| | SD | 1.42 | 1.31 | 1.49 | |
| *6. Discussions* | Mean | 3.81 | 3.92 | 3.71 | 0.14 |
| | SD | 1.46 | 1.44 | 1.48 | |
| *7. Obtain information* | Mean | 4.34 | 4.37 | 4.31 | 0.06 |
| | SD | 0.99 | 0.96 | 1.01 | |
| | Mean | 3.43 | 3.49 | 3.37 | 0.15 |

## Appendix M

Students' interview responses

| No | Name | Grade | 1. Are you interested and enjoying integrating technology in learning? Why? | 2. Do you use educational sites that explains Science lessons like Obeikan? | 3. How can make the integration of technology in Sciences interesting or enjoyable? | 7. What are the benefits of the integration of technology in learning sciences? Mention them. | 5. How can the integration of technology in sciences enhance your understanding of the subject? Give examples. | 6. Explain how do you use the technology to achieve tasks and homework? | 7. What are the advantages and disadvantages of integrating technology in learning science? | 8. How can you u enhance your educational level through using technology in learning Science? | 9. Does your school encourage you to use technology, how? | 10. What is your suggestion on developing integrating technology in teaching Science? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PA1 | 5th | Yes, it gives me more information and I benefit more. | No, videos and pictures via Classera. | We always make a portfolio about the lesson and write down all what we have learned through using The Publisher program in the computer. The portfolio I made was about The Classifying the animals according to the kingdoms lesson. | We can learn more information about the lesson. | There are no examples. | If the teacher requires me to do a portfolio, I do it in the computer to make it clear. | Advantages: it makes the information clear. Disadvantages: None. | I study from the book, then I go to my PC to get more details, then I revise. I do get full mark. | Yes, like in computer lab, microscope, and projector. | To study using computers. Design Science program in computer to help students understand more. |
| 2 | PA2 | 5th | Very much, I need to understand something I google it, I don't play, I told my other I need iPad, it helps me to learn and understand. It | Google, I see videos my teacher sent. I must see Classera daily. Explain Classera? There is a plan, and many things. E.g. videos, | The projector is very good, if we don't understand the lesson such as, How animal eat, how the system of environmental, how volcanoes explode and | The projector is very important even if it's not working we borrow one from other teachers. If the sound is not clear we bring speakers, but it's very important to use it. I watch | Earthquakes and volcanoes. | I sign in Classera and I watch all the videos, If I don't understand something I text my teacher to explain it for me. | Advantages: The projector helps in Math, Science and English, how the animals eat, How plants make their own food, What are the tasks of stem | I go to APP store and download Math and Science Application, to prepare myself for the exam. I wish if have my iPad with me, | So much, | I wish we have laptop at school that is specified to study, not for games. I ask my teacher to explain even if my grades are low. I go to the teacher to correct my |

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| | | | is important for me, I want to be an excellent and be a doctor when get old. | H.W, plan. If you miss a worksheet, you can find it and print it via Classera. | how earthquakes disintegrate lessons, the teacher immediately views some related videos to help us understand better. I go over my iPad whenever I'm at my house to watch videos about earthquakes. I like the earthquakes but they are scary sometimes. | videos on my Ipads and my mom helps me, but if she's busy my dad does because he is a professor. | | | and leaves and in English if the teacher is absent she just present the lesson with all the correct answers. Disadvantages: None. | so I can show you, I have a lot. | | answer and learn from my mistake. I learned why animals get killed as human use them for production. |
| 3 | PA3 | 5th | Yes, because we know more. | Teacher asked us to download math multiplication for exams. For Science, we watch videos. | She presents things help us to understand better, like videos and pictures. | Videos and pictures make the understanding easier. | Elements. How? There's something smaller than the elements called atom. I like it. How does the teacher explain it? Through videos and pictures. | I did PowerPoint and videos and I gave them to the teacher. What was the lesson you made the PowerPoint for? About the elements and saved it on flash. | Advantages: she uses the projector. Disadvantages: None. | I have application for all subjects, the one for Science, I love it so much. I downloaded how earthquake do to stones and how explodes. I ask a lot about science. I like it when My father teach me, I go to hospital to learn about lots of things, whether scientific or not. My father | Teaching us via projector, go to computer lab where we make brochures there, I made one about food chain, environmental system, and we are doing a lot. | I don't have, I might do flash. |

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| | | | | | | | | | | is a surgeon, I love him so much. My mother teaches me Math because she is a Math lecturer at the university. My big brothers teach me too. I have a sister in 2nd secondary school, she taught me everything. She teach me biochemistry, chemistry, physics, she teaches me a lot. | | |
| 4 | PA4 | 6th | Yes, it may be useful for example if you like to add educational programs such Classrea and school e-Mail | Classera | She presents things help us to understand better, like videos, games and pictures. | If she uses games and videos the class becomes enjoyable because books are boring. | World's sites in the maps. | Like words I write my homework then I print it. | Advantages: make the students understand better. Disadvantages: when the teacher turns the light off, some student feel sleepy. | Classera, sometimes we go to lab. | Yes, the teacher says use technology to be better, she asked us to make PPT show for her. | Provide computers and laptops instead of books. Book get lost. Is there is any disadvantage if students use technology? Yes, we can't write by our hands easily. |
| 5 | PA5 | 5th | Yes, I enjoy it | rarely | Through Classera I can ask the teacher about the homework and anything I don't understand. | I understand better. | | Classera to solve my homework sometimes. | Advantages: allow me to communicate with my teacher more and it makes the lesson easy. | I always practice, by using technology I understand more, reach information fast. I can remember | Yes, like thru Classera, they always send homework and PPT | Studying via iPads and laptops. And use Classera |

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| | | | | | | | | | Disadvantages: None. | better. I don't remember information presented by teacher. | | |
| 6 | PA6 | 5th | Yes, because I learn more and I understand what the teachers are saying. | YouTube, Classera. | Through videos and pictures. | | Thunder and lightning. How did the teacher explain it? Lightning appears on the form of radiation and thunder as sounds. The teacher presented some videos to make it easier to understand. | | Advantages: it helps the girls on my age or younger or even older to understand better. Disadvantages: it hurts the eyes a little bit. | My grades become better, I understand Science better while using technology. | Yes, it provides us with Classera. | I would like to design Science programs. |
| 7 | PA7 | 6th | Yes, we understand more. I is easier for teachers. | Explain? When teacher send us H.W or videos or worksheets. | Understand better | Achieve more | See the roots and leaves of the plants and cells. | Solving homework in classera easier than books. | Advantages: it makes the information clear and easy. Disadvantages: None. | I enter programs and go to the learning zone. There is sections about Science, Art, and other things. I use Classera, send messages to teachers asking for extra videos. Moreover, I tell her when I don't understand a point. | Yes, and that is what makes my level better at Science. What did the teacher say? If you follow my directions and see what I am doing, exam will be easier, your level will be better, and you will be an ideal student. | The most important thing is to use iPad, because we can download books and answer. If the provide iPad, is there is any disadvantage? Yes, it is could harm eyes, but the advantages is it helps us studying. |
| 8 | PA8 | 5th | Yes, because sometimes it is more interesting like | Safari for search | | It gives us more information and we can use Google to search. | The water cycle in nature lesson by displaying it in | I go to Classera and print the worksheet or | Advantages: it provides more information from the book | By Programs, activities, and videos teachers send. | Yes, thru Classera program. | I suggest not bringing the mobile to school unless |

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| | | | when I do Science Brochures and school work. | | | | the projectors to make the lesson clear. | if there's short tests, and then I answer all the questions. | and reminds the teacher of information she might forget. Disadvantages: some students go over other games application during the class. | I can understand better. Before, we take homework and we don't understand and we tell teacher that we forget. | | there is an emergency to call my mother. Not to play with. The teacher gives more lessons than usual. |
| 9 | PA9 | 6th | Yes, it makes study more interesting. Why? Technology help understanding even at home. Where you teacher use it? In Classera | | It makes the learning easier. | Students understand better and it makes learning enjoyable. | Soil, mountains and rocks by presenting a PowerPoint. | | Advantages: not hard and the students understand better. Disadvantages: it makes us confused sometimes. | Do our homework through Classera. Sometimes, if we do homework and see a video and answer what is required in to earn extra point, there is a sense of challenge, who will get more points. therefore, my grades become higher, because I do read what is required and do my homework in Classera | Yes | Make more than one program for each school, communicate with them, and make a program for them. |
| 10 | PA10 | 5th | Yes, it is a fast and easy way to learn science. | No | She opens the PowerPoint and displays videos and pictures. | Easy and fast learning | Metals and non-metals. The teacher explained the lesson and she | I sign in Classera program and solve everything the | Advantages: it makes the information clear and we understand | Study of Science exam through Classera technology. | | Yes, provide more sites for science and encourage students to learn |

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| | | | | | | | used the projector. She explained the metals and said that they are malleable, shiny and reach heat. The non-metals are non-malleable, non-conductive and not shiny. | teacher upload it in it. | better. Disadvantages: it hurts the eyes a little bit. | | | more technology. |
| 11 | PA11 | 5th | Yes, because it is entertain people, in Science. You can study what is suitable to your age. | | The teacher presents a presentation about Volcano and Earthquake. It helps us to understand better thanks God. | If you get sick in the future you will know because you will be able to search about it before you go to the hospital. | Volcano and Earthquake and Earthquake come from the sea and etc…. | I sign in Classera program and solve everything the teacher upload it in it. | Advantages: it makes the information clear and we understand better like Volcano and Earthquake lessons. Disadvantages: None | I open and read and practice. If I forget my book I open it and study. | | I would like to tell Ministry of Education to allow schools to use technology to be able to understand. If it is prohibited to bring laptops we cannot bring it and break the roles. |
| 12 | PA12 | 5th | Yes, you can learn by internet | PowerPoint | | | Atoms | Through Classera. Explain it: it is a program clarify the learning plan, homework, the date of the exams, the Moms Council and I use it in the entire subjects. | Advantages: it helps you to become a teacher or a doctor in the future. Disadvantages: it hurts the eyes a little bit. | Thank God, it is good. | Yes, homework at Classera. For example, I have social exam tomorrow ISA. She will give me a work sheet at Classera and we will answer it. If you got full mark, it means you understand everything. | |

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| 13 | PA13 | 6th | Yes, I understand more, and I enjoy studying with technology. | | Experiment and she presents PowerPoint and videos. | | Planets through videos and photos. | If I don't know the answer I search for it. | Advantages: it makes the information clear and we understand better. Disadvantages: if I use it more than an hour my eyes and head will hurt me. | I enter Classera and revise lessons | Yes, computer, projector, and laptop. | Design sites for science. |
| 14 | PA14 | 6th | Yes, because when you use technology and education. It is boring to study with books only. | | We can provide devices and play the programs we are using and write down the information. | It benefits us and learning becomes easy and fast. | Energy and power, there are many videos help us to learn how to use energy and electricity devices. | Sometimes from classera and other times from the book. | Advantages: it makes the class interesting. Disadvantages: None. | | Yes, the teacher says take care and concentrate in order to not face difficulties while studying for your exam. | It is less boring and better when we use technology. We feel fun while we are studying. |
| 15 | PA15 | 6th | Yes, interesting to study with it. | Google and YouTube | Through projectors or we use a microscope to see the yeast and expired bread. | It makes the learning process easy and enjoyable at the same time. | The teacher summarizes the videos but I go to Classera to see the full version of the video, it's easier than the book because the book has too much definitions. | The teacher sends the homework, exams and worksheets in Classera and we answer them. I print them at my house and answer them at the exam time. | Advantages: It makes the learning process easy and enjoyable at the same time. Disadvantages: None. | May be when teacher download videos in Classera, we see and learn more. | Not too much | Design a web like Classera at school. Were we put all books. This website should be connected to teachers' devices. You can answer if you forget you book. The answers can be reached by teachers, corrected, get grades. You can design PPT Excel and Word. |
| 16 | PB1 | 6th | Yes, it helps education by using videos. It becomes | | | Easier to explain. | | | Advantages: explanation becomes easier. | I mean if there is a school program like Classera, I go | Yes, with Classera, projector, and computer. | Use technology at school and provides applications |

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| | | | easier and clearer than teacher explanation. | | | | | | Disadvantages: Sometimes the sounds or videos are not clear. | and open it and search for things that help me. If I still don't understand I open teacher's PowerPoint. She download exams, worksheets, and videos. | | such Curriculum application (Manahej). We can use it for Science. |
| 17 | PB2 | 5th | Yes, because it the best and most interesting way to study. | | Present video, pictures and sounds. | It makes the learning process easy and enjoyable at the same time. | Bacteria lesson and we have seen in the microscope | | Advantages: it gives more information Disadvantages: if the device damaged we will lose the information, so in case you have to save the information on a CD. | It enhance my skills to do my homework via PC | Sometimes the teacher ask us to do research on a certain topic, but sometimes I do it, but if I am busy I cannot. | Provide more microscopes, because two are not enough. In addition, we need more computer devices. |
| 18 | PB2 | 5th | Yes, more interesting and have benefit and facilitate learning. | | Present videos. | Learn and benefit from the videos and photos. | Cells, we went down to the lab and saw the rabbit cells in a microscope. | I search in the internet, but I paraphrase it in my own words. | Advantages: it helps us to memorize the information and don't forget them. Disadvantages: None. | I interact in class with teacher, because she uses projector, it is very motivating in class, I understand more, I get better results in exam. | Sometime she ask for research assignment or pictures or do presentation. | Provide iPad to get rid of the heavy school bags, and be a tool to simplify learning. |
| 19 | PB3 | 5th | Yes, more interesting and have benefit and facilitate learning. | | | Clearer information. | Seas | I don't use it too much for my homework but if I don't know an answer for some question. | Advantages: Science is my favorite subject, so I like to search for information, the speed and | I search about specific lesson, get information, read it then get answers for my homework. | Yes, teacher ask us to do research , make a lesson and do presentation using PPT. explain it and there is an | Help lighten my bag. Faster in writing. Use IPad at school. Why? Help lighten my bag. Faster in writing. |

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| | | | | | | | | When I come back from the school I summarize the lesson through PowerPoint, and review the lesson in vacation, I benefit from the presentation in two subject the Science and computer. | fun. Disadvantages: if the internet connection is slow. | | interaction between the students (little teacher project) | |
| 20 | PB4 | 5th | Yes, I enjoy using technology and study at the same time. | No | Presenting PowerPoint is very exciting. | It makes the information available, if I memorize slow I just print them or I write them down in a PowerPoint, and then I will memorize them. | Adaption and survival lesson. The teacher mentioned five examples, the lesson was very great. What were the examples? She gave us an example about the camel structural adaption that Allah created him with a sole under his feet that helps him to walk in the deserts. The second one is the behavioral adaption like how I change my clothes depend on the weather. | | Advantages: it makes the searching very easy not like before it was taking too much time. Disadvantages: when I don't understand the lesson I keep using the device and that's dangerous. | First, you must have an experience in technology before using it for Science. | Yes, sometimes the teacher ask us to bring some topics from news. However, I use the internet for search. | Each school must have technical devices. Moreover, I would like to invent when become older. Create a device and call it Book, all curriculum will be there from grade 1 to 12. Any update will be reflected. It will be used at all schools. It includes e-Pen. One device that will be used by the student from the first year he entered the school until he graduate from secondary school. I suggest also |

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| | | | | | | | | | | | | that exams should be online using EDMODO. Like in secondary school. My sister in grade 11 is using it. They locate the date and time and the correction is automatically after the exam. |
| 21 | PB4 | 5th | Yes, It is more understandable and unforgettable when I use technology. | | Sometimes the teacher presents pictures and explains them to the student, after that she choose one of the student to act like a teacher and explain the lesson again to her colleagues. | | In the last semester, the sexual and asexual production and budding. For the production the teacher presented many images such as bacteria and I will never forget them. | If I forget my book in the school I answer I do my homework in the iPad in front of my mom and then the teacher doesn't punish me. | Advantages: I love science and using technology has become better and easier, and I learned more, for example, when I was in first grade the teacher was explaining in the traditional board and it wasn't enjoyable to me, but using smart blackboard I became understand more and don't forget the information. | | Our science teacher asks us for research or look for specific information and reward us for that with points to get excellence certificate. | noting |
| 22 | PB5 | 5th | Yes, it is wonderful when I use computer and search. | I did not use Al Obeikan site, but I have a site for Math. Up to | Images and videos help me to understand better. | | | | Disadvantages: None | I study at home on my iPad, my results get better and I | Our science teacher encourage the students to use it. E.g. I did a | To use iPad do the bag is not going to be heavy. |

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| | | | | this moment, I am looking for something similar, but I did not find. Math Educational, How do you get benefit of? It explains math via video. Those Point I don't understand. Also it contains worksheets and course syllabus for teachers. | | | | | | remember information. | search on the sexual reproduction and the asexual. The teacher said who wants to search she can go and this is a site, she helped us. | |
| 23 | PB6 | 6th | Yes, It helps, it is easy to write and clearer. | | The teacher displays videos and photo and they are easier than the book. She also prepares the lesson and presents it via PowerPoint in the class. | Easier. | The water cycle in nature lesson. | | Advantages: I feel happy when I search in the internet and find extra information. Disadvantages: None | | | To use iPad do the bag is not going to be heavy. Information will be clear fast. |
| 24 | PB7 | 5th | Yes, I enjoy studying with technology. | | In every lesson we go to the lab to do experiments that are related to the lesson. | It helps me to understand better, so when I go back home I remember the explanation while I'm studying. | Tsunami lesson. | I search and study using Obeikan program, it's very helpful and I told my friend Dima about it. | Advantages: it's easier and delivers the information quickly and I understand more and I remember the teacher's explanation in the test. | It clarifies information and make information more memorable. | Yes, teacher ask us to do research , make a lesson and do presentation using PPT. ( little teacher project) | I wish when I get older that I become an inventor. I wished that I participated in Mawhiba (gifted and creative program) program. I wish i create a device |

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| | | | | | | | | | | | | that include all subjects and lessons. It includes videos, activities. They can ask teachers and have answers from students in an honest way. Whether they understand or not. |
| 25 | PB8 | 6th | Yes, it is more attractive and we get benefit more. | I study from them when I don't have the books with me. | Provides programs to make learning enjoyable. | Images and videos help me to understand better. | | | Disadvantages: Sometimes the teacher will rush in teaching and that will put me under pressure, so I can't understand very well. Sometimes the device might not working. | | | Put a place for chemical and develop the lab. I am very excited to take science lessons in the lab. |
| 26 | PB9 | 6th | Yes, using projector makes learning easy and interesting. | Nour and Curriculum application (Manahej) application. | When viewing videos, images and sound that attracts us to the lesson and concentrate with the teacher more. | It helps to deliver the information more correctly and clearly. The misunderstandings might happens or some of the girls do not understand the explanation when the teacher uses the board, but if she uses the videos and images ,then the lesson will be more clear to us. What if one of the | | | Advantages: the teacher views more than one video and pictures. Like, the stages of human growth through a video of the human existence in the mother's abdomen until they die and in the last semester we | My old school does not use technology, Science was very difficult, and I don't like it. But here, the use smart boards. I like English and Science. I feel that technology adds to my. | Yes, teacher asks us to do search, go home, summarize it, and then print it. | Apply an activity after each lesson, is done now. However, I would like it increase the amount of activities. To ensure the full understanding of lesson. |

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| | | | | | | students didn't understand? The teacher presents more videos and images and she explains more for her until she understands. | | | saw the rabbit's onion cells in the microscope. | | | |
| 27 | PB10 | 6th | Yes, we are the generation of development. | Nour, there are four main subjects; Math, Science, Arabic, and religion. | Every student bring her own IPad and from my opinion this is a big reason to make them active and participate in the class and Become polite, quiet and interact with the lesson and answer the questions. | Facilitate lesson, faster and clearer when viewing the lesson, without the technology there is no reaction from the students because if the teacher is only using the book, the lesson becomes harder and the ideas become difficult to understand, the use of the technology will be easier for the teacher to write a lesson, she writes it once and saves it, then uses it several times. | Photosynthesis and volcanoes processes. | I search in the internet, and then I paraphrase it in my own words. If it an experiment I apply it to the question in the book. | Advantages: the lesson becomes more clear and enjoyable because if she only uses the board the lesson going to be boring. Disadvantages: some videos are not clear. | Sure, my level is higher. Information now is in my memory until exam time. | Yes, with some topics, teacher asks us to do search, using the net searching for the lesson and summarize its information. | Teachers should motivate students to participate and those have the best answers should present them in front of their colleagues. |
| 28 | PB11 | 6th | Yes, it is good. Because I understanding and comprehend faster. Teacher present a video and we understand. | Curriculum application (Manahej), all subjects are there, they update them continuously. | Videos and smart blackboard make the lesson enjoyable. | I understand quickly. | Sun and moon, rain and cell. | | Advantages: the interaction of the students in the class is one of the positive effects and the student becomes excited to go to school and study. | I can prepare the lesson, I can answer more questions and practice. This improved my grades. | Yes, she encourages us to make a lesson and do presentation ( little teacher project) | Increase the class time for science. To have time to understand and get more topics. |

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| 29 | PD1 | 5th | Yes, it is more interesting and easy to use. I use it for PPT and research. | In Science, if my book is with my teacher, I can use them and answer exercises. | Through presentations, videos and competitions motivation. | | Lunar eclipse and Solar eclipse | I print my homework and I do presentation and save it on a CD. | Disadvantages: the student might take a photo of something and then the teacher might thinks that they are taking picture of her. | Not necessary for teacher to play videos, I go myself and search for it to learn more and enhance my skills. This has a positive effect on my grades. | Yes, by present a lesson in front of students. | Study by using iPad because some students throw books on floor. Add more educational scientific programs. |
| 30 | PD2 | 5th | Yes, in getting information. It is interesting. | | Present videos to explain the lesson. | For more benefit and entertainment. | Atom. The teacher explained it through a schedule had all the atoms components and The Physical and chemical experiments lesson, such and the ball and ring lesson. The metallic ball interference in the ring easily but if we put the ball close to the heat, then the molecules diverge and then the ball doesn't enter the ring. | | Advantages: quick understanding. Disadvantages: None. | I search for lessons that I don't understand via KidsJoy and iEN site. | Sometimes, she asks us to do research. | Use iPads as it is more enjoyable. |
| 31 | GB1 | 5th | Very much | | The teacher present pictures and videos using projector. | | When the teacher uses the projector, it helps me to remember the lesson. | For example the teacher asks us to search about a subject, I search in the | It makes the communication with the teacher easier and it helps us to do our | Using educational programs and search for more information | Yes, she asks us to look for new enrichment information to get benefit of. | Provide us with iPads. For example, teacher ask us to read a story. When there is |

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| | | | | | | | | internet, and then I paraphrase it in my own style. | homework easier as well. Disadvantages: some people waste their time on the technology. | | | time in class we can read about a topic and makes a competition. |
| 32 | GB2 | 5th | Yes, to understand more | Curriculum application (Manahej) at my iPad, sometimes I prepare the lesson earlier. Also, if I am absent I can study the lesson at home. Sometimes, I feel it is better than books, because I set in quiet place and my understanding is better. | Using presentations and videos. | We understand better and fast. | Extinct animals and non-extinct, the teacher presents pictures in the projector. | I search for extra information about the subject. | Advantages: more information and entertainment. Disadvantages: None. | | Yes, for example, the teacher asks to do research. Some students like computers and they interact with her. However, lazy students does not like to learn. | Provide iPads in class to help us in research. |
| 33 | GB3 | 5th | Yes, it helps me to understand the lesson, lessons become more interesting and easier. | Curriculum application (Manahej) at my iPad. There is a lot of videos that help me to understand | The teacher present pictures and videos using projector. | Quickly understanding. | The teacher presented images about extinct animals. | I search in the internet, and then I paraphrase it in my own words. | Advantages: it helps us to memorize the information and don't forget them and it gives me knowledge about the life. Disadvantages: None. | I concentrate on the lesson and understand more. | Yes, by asking to research for certain topics. | |
| 34 | GB4 | 6th | | | The teacher explains through images and videos. | Make the explanation easier for the teacher and the student | Lunar eclipse and Solar eclipse , the teacher explained it | | Advantages: I love the subject and I understand it. | I use iEN site to help me in understanding | | Provide us with technology like iPads, because it is easier than books. |

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| | | | | | | understand the lesson. | through pictures in the projector (fifth grade) | | Disadvantages: None. | | | |
| 35 | GB5 | 6th | Yes, it provides new information | iEN Site, revise lessons. | Provide activities and students do the presentation. | Increase the understanding. | | I search in the internet, and then I paraphrase it in my own style. | Advantages: We understand more and more enthusiasm. Disadvantages: None. | I use sites and educate myself, because it has a simplified explanation and videos that make lessons easy. | Yes, by asking to research the net. | Provide smart boards in all classes (we only have smart board in math and lab rooms), also, provide iPads as our bags are heavy and cause back pain. And it motivates students to learn and decrease the number of low level students. |
| 36 | GB6 | 6th | Yes, lessons become easier and more active. Students become more interactive in class. | Manhej, you can download all books, but there is no videos. | The teacher explains through projectors. | It makes the class more active and gives the student the chance to ask and answer more, because without the technology the students might feel shy to answer wrong. | | | | By searching and activities and presentations in front of students. | Yes, she encourages us to use sites that explains Science. | Provide iPads. However, is difficult to control students. Therefore, projectors and smart boards would be better. |
| 37 | GB7 | 6th | Yes, it provides activities, it encourages students to participate and ask if they don't understand. | | For example the teacher presents documentary about math and science and they listen to each other's opinion and if one of the student doesn't understand a part of the | Science through technology becomes easier, such as using a microscope shows us the cells and the projector makes the explanation easier for the teacher. | Cell lesson | I download the Curriculum on my IPad and I choose which subject and lesson exactly to study. | Disadvantages: None. | Technology enhance my scientific level, for example, if a student don't understand a question she search for it on the net. | Yes, if I don't find an answer for a question, I look for it, but I don't copy it. I write what I understand. | Yes, for example, in English, my grades was very low. After using technology and training via videos, my grades improved. |

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| | | | | | lesson she asks the teacher to explain it again. The lesson was about the natural life and how to maintain the trees and we have benefited from it. | | | | | | | |
| 38 | GB8 | 6th | Yes, lessons become easier and interesting. | | She presents too many videos and PowerPoint presentation to attract the students' attention. | The lesson becomes easier to understand. | The water cycle in nature, Eclipse. | I search in the internet, and then I paraphrase it in my own style. | Advantages: if one of the students doesn't understand the lesson, the teacher uses the technology or some programs to help the student understand better for the test. Disadvantages: Instagram and Snapchat waste the students' time. | | Yes, she encourages us to go visit some sites on the net. | Use internet, and let two teacher assistance to supervise and control students' access and use. |
| 39 | GB9 | 6th | Yes, tech. make students love the subject more. | | Encourage the students to do presentations and explain the lesson via the PowerPoint. Did you do it? Yes but not in this school in the last school | It makes the hard subject easier such as Math and Science. | The Evaporation lesson. I was absent at that time but I searched about it in the YouTube and I understand it, of course the ways in | | Disadvantages: None. | By searching and understanding difficult lessons and print it, because reading lessons is betters from screens. | Yes, she encourages us sometimes to go visit some sites on the net and search for topics. | I am neutral in regard using technology, because some students are using it in a negative way. Unless if there is a way that teacher can control student's |

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| | | | | | I worked in. I did a typical lesson on the Earth course with a group of students and we explained the lesson via the PowerPoint and the students Interacted with me and the director attended the lesson. | | the YouTube are different from my teacher but I got the main ideas. Also. The volcano lesson, it was difficult to me but I tried to understand it better, So I watched videos in the YouTube. | | | | | access, so they cannot access non-academic sites. |
| 40 | GB10 | 6th | Yes, it develop mental skills. | | Technology helps to learn, for example if I don't understand a question I Google it. | It's normal thing to use the technology in Sciences subjects because we need the microscope. | Cell lesson and Occurrence of the four seasons through the YouTube, there's another teacher explained the Science lessons and downloaded it the site | If there's a difficult question I search about the answer but I never copy paste, because it's plagiarism and doesn't benefit me or the students. | Advantages: educate people and about Science and improve their English language. | I use it in searching and brochures. Originally I have high grades. | Yes, asking for the (little teacher project) for topics of science, Math. And English. We prepare the lesson, explain it, and the teacher observes us. It is a wonderful experience. | Use technology for other subjects like Art, some girls does not know how to draw a circle. |
| 41 | GB11 | 6th | Yes, it attracts students to study and helps them in understanding. | iEN channel, it explains lessons | Through videos and images. | Attract the students to learn more and the teacher might doesn't have enough ability to deliver the information because of that the videos help us to understand everything. | The volcano lesson through videos and images and the cell lesson through the microscope. | | Disadvantages: some information is not correct. | | Yes, for example, if students does not understand a lesson she says go to this beneficial site. | Provide computer devices. E.g. 10 devices in each class. Because if I don't understand something, I can do something. Now, we only have one device in our class and |

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| 42 | GC1 | 6th | Yes, because sometimes we get more information like animal lesson, we get more information. | Google | | | Vertebrate and Invertebrate animals lesson. | | Advantages: We understand more and more enthusiasm. Disadvantages: hurts the eyes. | If teachers ask to do brochures and I don't understand the lesson in class. I can use educational channels in the net. Then I understand. | Yes, asking for the little teacher project, this experience is hard but beautiful. | Provide a lab so I can design scientific research and PPT. I ask the help of my sisters. But some students does not have knowledge. This lab will make us more dependent. |
| 43 | GC2 | 6th | Yes, I understand the lesson in much better way. And more memorable. | Twitter, Facebook, Instagram, and PowerPoint | Using the presentation in the class | | The yeast and cell lesson through the projector and I will never forget that lesson. | Sometimes. | | If the lesson is difficult, I search on the net, I find a summary, I read it and I understand better. | | |
| 44 | GF1 | 6th | Yes, I understand the lesson in much better way | Search on the Net | Using technology and present presentations more. | | | | Disadvantage: Harmful to health, damage the eyes and bring laziness. | Because technology helps me better understanding. We have a teacher that presents to us some pictures and it became posted in my mind. | Yes, the teacher say if you want extra information, go search the net, info is more understandable. I read it and summarized it then it will stick on my head. | Replace books with iPads. Bags are heavy. |
| 45 | GF2 | 6th | Yes, because studying without technology is boring. | iEN Channel, I use it mostly for Math and Science, it is a site that explains in a very ideal way | Provide pictures for the students in the first grade, so they can understand better. | | | | Advantages: it eases the subject for those who have difficulty in learning and they will understand better because | I enter sites and I understand better. E.g. I enter a site and take more information. In exam I become fully | | Provide a class at school that is divided for each subject. Each subject has a robot that explains for students and repeat for those |

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| | | | | | | | | | of the pictures and videos or special programs for them. Disadvantages: Instagram and Snapchat waste the students' time, but the students must learn the Science for better future. | understand the curriculum. | | did not understand. |
| 46 | GF3 | 6th | Yes, we enjoy and understand more. | | | Quickly understand and entertainment. | Planets by PowerPoint and videos. | I Google the information and understand it, then I paraphrase it in my own understanding. | Disadvantage: the sound and images might not be so clear, so we can't understand very well. | | | Provide iPads, because learning is boring without technology. |
| 47 | GH1 | 6th | Yes, it facilitates teaching and develop it. | Apply Curriculum application (Manahej) to design brochures | The students divided as group in the class and every group has a box inside it a mouse and the fastest group use the mouse to answer faster | Summarize the science subject to make the difficult lesson easy. | The water cycle in nature. | | Advantages: provide more information Disadvantages: hurts the eyes. | | | Use devices instead of books and bags. Because it is heavy. Not to use it for entertainment but to make learning easy. We are in the time of development. |
| 48 | GH2 | 6th | Yes, because it is an easy way to comprehend and understand information. | A Program in iPad where there are picture and videos and extra information than those in the book. | Provides computers and IPads. | | Life cycle in nature | | Advantages: I use it as a way to help me understand the lesson. Disadvantages: if I use it continuously it will bring me headache. | e.g. I remember teachers' explanation in class and I answer definitions and questions | Yes, the teacher says instead of summarizing and writing down ideas. It might be incorrect. Search in the internet, take | Provide us with devices and educational programs to give us more knowledge. |

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| 49 | GH3 | 6th | Yes, lesson becomes easy | | | Make the learning easier for the students and the teachers and it also make the learning process enjoyable. | | | Advantages: the students understand and listen better. Disadvantages: hurts the eyes and ears if the sound is high. | | No | Provide iPads. We can use sites more than books. |
| 50 | GH4 | 6th | Yes, it is interesting and facilitate comprehension | Obeikan, there are activities for lessons. I use to train myself. | The teacher plays videos or divides us into group and we use the mouse and the fastest group will be the winner. | | The plants. | I use the computer to print or search about something specific subject. | Advantages: it makes the information clear and we understand better. Disadvantages: it hurts the eyes a little bit. | | Yes, teacher ask to do research for a topic and get extra points. | |
| 51 | GD1 | 6th | Yes, it is beneficial | Obeikan, I choose the lessons I don't understand and I study it. | | Understanding and comprehension and learn more. | | | | | Yes, if we don't know an answer, the teacher says google it. | |
| 52 | GD2 | 6th | Yes, I can understand and remember information at the exam. | Obeikan contains questions and activities for Science | | Facilitating or simplifying the lesson to the students to understand and perceive it, they understand it in this way more than the traditional way. | | | Advantages: there are activities in the class and entertainment. Disadvantages: None. | | Yes, teacher gives us sites, and we use it. | |
| 53 | GD3 | 6th | Yes, because we comprehend and get benefit | iEN and Curriculum application (Manahej), | | Increase the understanding and the students enjoy the pictures. | If I don't understand from the teacher's | | Make learning fun. | | | Provide iPads and internet at schools. |

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| | | | more than traditional teaching | but I use Curriculum application (Manahej) more, because it is like books but on my iPad. | | | explanation I search about the lesson to understand better. | | | | | |
| 54 | GH4 | 6th | Yes, because I have more interesting when use in Science subjects. | No | The teacher presents the lesson and images via PowerPoint and she gives us homework and also draws the lesson on the blackboard. | It helps us to understand. | Planets and galaxies | | Disadvantages: None. | If there is a lesson I don't understand, I go to the net and understand. | Yes, she encourage us, if we do understand, we go to internet and search to understand. | Provide us with computers and iPads, when they ask for research, we can search and get answers very quickly. |

## Appendix N

Teachers' interview responses

| N | Name | Years of | Qualification | 1. Are you interested and enjoying integrating technology in teaching? | 2. Do you use the online educational sites to explain science lessons easily? Give an example | 3. Explain the most effective devices in teaching Sciences for advanced students and give an example. | 4. To which level using technology in teaching Science improve the students to understand better? | 5. Explain how the use of technology in teaching leads to improve students' learning outcomes. | 6. Do you use technology with your student in the classroom or you use it only? | 7. What are the devices you usually use in teaching Sciences for sixth or fifth grade? |
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| 1 | PA1 | 22 years | Bachelor of Educational Biology | Yes, because it helps the teacher to explain easily and the students to understand faster. In one hand, it's hard to explain the digestive lesson orally or display panel. In another hand, explanation while using Data show particular video or through certain arranging by the student help them to memories the lesson. | Manarat AlOloum & Alriyadyat is very helpful. www.mathandsci.org | Flashes, students can find the experiment's steps in a particular flash. Also, I use question and answers. | High level. | When the student see it they understand better. | Sometimes I use it with my students like flashes I must use it with them. | Projectors. I used IPad and Interactive whiteboard before, but from my opinion smart board is very helpful especially for elementary students because I attract their attention by viewing games. |

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| 2 | PA2 | 3 years | Bachelor of Biochemistry | Yes, I'm so happy using technology while teaching because it helps the student to understand in a better way. | Classera. | PowerPoint, Videos, pictures and Song. | It effects in a positive way and increases their information. | I use Calassera to contact with my students outside school. I send PowerPoint, Videos and pictures, it improves the students' level but some parents do not allow their daughters to use the internet during the week what aims to deactivate the program. | I use it only because the devices are sensitive and hard to fix them. | |
| 3 | PB1 | | Bachelor of Chemistry | Yes, the class becomes exciting and the students participate more. Also, students get the ideas with lesser effort through videos or games. | | Elementary stage depends on games because of that every lesson includes PowerPoint presentation, comparative games and different pictures. | Excellent and very influential | Improve the students' understanding, attract their attention and because of that it effects their results in a positive way and the class becomes excited to them. | Sometimes they use it with me. Like, when we use the smart board. | |

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| 4 | PB2 | 5 years | Bachelor of Chemistry | Of course, it helps to deliver the information easily, through videos and games. | Manarat AlOloum & Alriyadyat and AlObeikan sites. Did you tell the student about the websites? Yes, I encourage them to search at the beginning of every class, I tell them new strange things like, there's a planets that eat Insects, and then I tell them to do research about specific video in YouTube. | Learning experiments are important for some lessons, such as cells lesson. The students understand better when they see the cell under the microscope and even more when they try the experiment by themselves, such as an experiment about an onion slice, they zoom in and zoom out the microscope and of course that benefits them a lot. | Improves a lot, especially for students who learn by listening or others by seeing things. | | Sometimes with my student. When we use the smart board, play videos or when a student explains the video in front of the students. | |
| 5 | PB3 | 3 months | Bachelor of Physics and Diploma of Education. | Yes, because it makes it easier for students and teachers rather than talking all the time. Simplify the information. | | The students understand the lessons better through PowerPoint presentations, videos and pictures. Like, Erosion, Sedimentation and Weathering lessons or some strange phrases. | To very high level. | Some student doesn't understand through explanation the lesson to them only, but they need to see things. There are small group of students who don't need to see but not all of them. | Sometimes | |
| 6 | PD1 | 3 years | Bachelor of Chemistry | Yes, it is more excited, but I don't rely on technology 100% because I might forget my laptop or the projector breakdown. It's a way help explain lessons. | I search in Google because I don't use specific website. | Some students get bored during the class, but whenever I play video they get excited. | | | I tell the students to turn on the projector to make the class activate | Laptops, Projectors to play videos, documentary, and sometimes experiments that are hard to do it in the lab. I use IPads to practice some strategies, I found it useful but it's hard to use IPad because not all the students have it. |

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| 7 | PC1 | 7 years | Bachelor of Biology | Depend in the lesson, some lessons need and some don't. | Experiments in YouTube, I use Obeikan in home to search for information and I use Classera to solve homework, send daily or weekly homework, videos and finally discussion rooms that some students interact in. | | | It is could have a little effect, actually it depends on the student if they are studying or no, 40% is on the teachers and 60% is on the students. | Sometimes we divide tasks on the students, such as every week between two students. They help me turn on devices and follow PowerPoint steps accordingly and sometimes the student gets the chance to choose a subject to present it to the class (acting teacher). | Projectors, smart board and PowerPoint. |
| 8 | PE1 | 7 years | Bachelor of Pharmacy, Cairo University. | Yes, it serves student's development process and keeps up with progress. | Yes, I use explore learning site to make sciences subject easier where students conduct experiments on their private IPads (Interactive learning). | Computers and IPads. | The student can do the interactive experiments on their IPads or researches that help then concernedly understand. | It makes their results better because the technology helps them to understand better. | Sometimes with the students because my role is to guide them and ease the students' responsibilities. | Internet through using IPads and laptops. |
| 9 | PE2 | 5 years | Bachelor of Chemistry. | Yes, it makes the lesson easier to understand and enjoyable | Yes like Education City and Gizmos. | Virtual labs like the knowledge of the lights effect on the plant growth. | To very high level. | It improves the students' results. | Sometimes I use it with them. | Videos, electronic sites, IPads and electronic games. |
| 10 | PE3 | 4 years | | Yes to keep up with the time | Yes like Education City site. | IPad applications. | Increases the understanding of the students. | Increase the efficiency of the students and achieve the highest results. | With the students. | IPads and videos. |

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| 11 | PE4 | 7 years | Biochemistry | Yes, it makes the lesson easier and enjoyable. | Yes. | They put the questions and the ability of answer them in the Gizmos program. | Make the students depend on themselves. | | My role is to guide and help them. | Practical experiments, data and painting. |
| 12 | PE5 | 7 years | Bachelor | Yes. | I usually search more in English sites. | Computers and IPads. | | Help the students to understand through searching. | I use it with the students but my role is to guide them | Internet and IPad. |
| 13 | GL1 | 21 years | Bachelor of Science and Education in the revival of Zoology. | Yes, I developed myself and my students to get their attention. How did you develop yourself? I attended many courses, my Colleagues introduce me to new programs and supervisor always keep me updated if there are new courses or programs. Moreover, there are courses every semester and sometimes courses for teachers or lessons in science or technology like, using Interactive whiteboards and blogs. | I use AlObeikan to verify my information. Did you tell the student to visit the site? Yes, Obeikan has written in the book "go back to Obeikan's site". According to the new Aen channel not all the students have background about it. | The scientific movies. The scientific experiments such as reproduction and cells division. The students had an exercise at their books about cells division, it wasn't clear to them. But they only understood when they saw a movie about cells division and embryo development. Their knowledge about cells division grew when they saw the movie | | Of course it improves them, because they search by themselves. | With the students. | Projectors and laptops. |

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| 14 | GK1 | 13 years | Bachelor of Science and Education. | Yes, it makes teaching easier, shorten the time, memories information, expand students' perception and benefit them. | I use Fahem site. | Projectors like using the electronic microscope while the students doing an experiment on a slice, or watching an animation videos on YouTube for the digestive system or blood cells that helps her to memorize the experiment, laptops and microscope. | | Increases the understanding of the students | The student might present in front of the class or as group and my role is to guide them. | Projectors and laptops. |
| 15 | GK2 | 19 years | | Yes, to do the work easily and shorten the time. | School doesn't provide Internet. | Projectors and computers | Make able to understand. | Yes | I use it alone. | View on projectors. |
| 16 | GD1 | 17 years | Diploma in Science and Mathematics | Of course, it makes teaching easier to me, benefits the students more, let the students want to ask more question and keep the class active. | I don't find enough information in AlObeikan site because of that I search in Google to find information fit the age of the students and the curriculum. | Yes it helps the students | | Increase the efficiency of the students and achieve the highest results. The students search for videos and save them on CD's. | I use it with them I let them play the video and replay it in case that some students don't understand. | |

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| 17 | GC1 | 20 years | Intermediate Diploma. | Yes because I love teaching my student and I enjoy integrating technology with teaching, it makes teaching easier and it's save time, rather than wasting time opening the book on certain page I open it using my projector. This way helps us to follow up together and helps to get their attention. | | I bring my IPad with me sometimes but it takes time because every student want to use the iPad but time is not enough but projectors give all the students the chance to use it because of that teachers prefer it . I present pictures that the book doesn't have it like Mother Bear to attract them. | It helps me a lot to present the experiment that I can do in the class like sulfur and the division process in cells experiments. Sulfur experiment is toxic and I explain the experiment to them by viewing pictures. | Of course. | With the student. The students prepare PowerPoint that saved on a CD, sometimes they prepare more than one, so I must present the first one and we give comments on it and thank the student, then the second one and atc…. Also, we have (a little teacher project) the students acting as teachers and explain the lesson. | |
| 18 | GC2 | 18 years | Bachelor | I agree to use it. I don't have a good experience about it because of that I don't use it. Did you think to attend courses and improve from yourself? Yes but the courses here are in the educational field more than technology field. | Yes like Manarat AlOloum & Alriyadyat is very helpful. http://www.mathandsci.org/vb/forum98.html | Projectors and computers. | Of course but our use of the technology is still limited. | | With the students. | |
| 19 | GF1 | 7 years | Bachelor of Chemistry. | Of course, it helps to clarify some things like planets. | YouTube. | Projectors and I suppose to use the smart board, but I don't know how to use it, like the universe and space lessons. | To high level. | Good improvement ( depends on the lesson ) | With the students. | Projectors and laptops. |
| 20 | GB1 | 26 years | Bachelor of Science and | Yes to improve myself. | Shabakat AlOloum & Alriyadyat (Science and Math net) http://ksa-science.com/vb | Projectors. | To high level. | | I use it with the students but my role is to guide them | Projectors, laptops and Digital microscope. |

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| 21 | GB2 | + 30 years | Intermediate Diploma General Science. | Yes very much it supports me to explain using technology rather than using the traditional way. Every class is different than the other one, some classes help me to teach using technology, but other classes waste the time. I played a video during teaching the good classes but I couldn't play it in the bad ones because of the large number of students in the class and they wasted the time too. | No, I only take the distribution of curriculum. | | There are too many ways make the students like the Science subject. Using the technology eases learning on the students and if I don an electronic test it will benefit the entire students, the low and high level of the students. (Self-assessment ) | There's improvement in their levels. | I use it with the students because they are active and like to use it. | Electronic microscope, electronic clips and experiments from DELL we present a movie from the internet like plant growth |

| N | 8. How the school administration does encourage the teachers to integrate technology with teaching? | 9. From your experience, What are the advantages and disadvantages of it? | 10. How could using ICT in science classroom improve teacher's teaching, and teacher technical skills? | 11. Is your students do their work by using technology? How? | 12. Is there a relation between the improvement of students' educational level and the teaching with technology? | 13. Is the integrating of the technology in the teaching process has little influence on achievement of students with low motivation? | 14. What's your suggestions to improve this process in Saudi Arabia? |
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| 1 | The administration always encourages us and they created Classera program and they always check if the teachers are using it or no. | I want to use it in the right way but the negativity of it that some students are using it 24/7. | When I worked in private school before I didn't know how to use computer but I learned myself, I faced some difficulty in preparing lessons and sometimes I cried from the pressure but I improved myself by asking my colleagues, after that I attended courses in school. | Yes, but it has advantages and disadvantages like sometimes the iPad deleted all the work in a minute and student can't write. | Yes because it makes the information clear and helps the students to remember very fast. | Yes it makes them excited. | From my experience there's a huge improvements in the school. |

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| 2 | | The Advantages are: raise the students' level, attract their attention, it helps the students to understand better and it also helps the teacher to know the students' weaknesses and to be sure that the students are reading correctly. The disadvantages are:(Technical maintenance) damage the devices and they need time to fix them, the lighting is weak which make the students sleepy and also the writing skills of the students become weak. | | | Yes. The technology helps to raise their marks or in other word improver their educational level. | | All the classrooms should have computers and projectors. |
| 3 | Provide the tools in school. | The advantages are: attract the students' attention and reduce the effort of the teachers during the class. The disadvantages are: damage the devices sometimes. | I improved myself by searching and attended courses in school learned me how to use smart boards | Yes sometimes through searching. | Yes. | Yes it effects in a positive way and attracts the students. | My suggestion is to provide smart boards, projectors and prepare the lab with all the important tools. |

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| 4 | Encourage a lot by providing devices and fix them and provides the tools that are the teachers need. | The advantages are: make the information easy and simple and deliver it clearly.<br>Disadvantages: the devices might breakdown. | Through searching or reading information the simplify them to say it in easy way especially for students in elementary school. | Yes, in doing researches and brochures. | | Yes depends on the student and how much she likes to use technology more than researches. | Activate the technology in private and public schools and make courses. Did you attend courses before? Yes in school was talking about how to use smart board. The teachers can learn themselves in their house as well. How do you improve yourself? In house or from a teacher who teaches secondary students, but if there's courses outside the school it will be better. |
| 5 | Encourage them by providing devices in every classroom such as smart boards and tools. | Advantages: make the information clear and teaching easy.<br><br>Disadvantages: sometimes they broken. | Through researches, information, learning sites and skills come in practicing. | Sometimes they searched for video or idea. | Yes it is improving my teaching. | Yes, attract students, help them and enjoy with it. | |

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| 6 | I notice my improving every month because of the practical lessons in the schools and they give the teachers the chance to make typical or ideal lessons then practical lessons. What's the difference between the two lessons? The typical lessons view in my school only but the practical lessons view in all the north sector schools. In the beginning of my teaching here they asked me to do typical lessons and now they are asking me to do another one and another practical lesson. | Advantages: faithful or honest teaching, the enthusiasm, the excitement , the teachers don't forget any information and practical videos explain the experiments because there's some experiment that are dangerous for elementary school students.<br>Disadvantage: some teachers depend and rely on technology 100%. | By different ideas. | | | | |
| 7 | It encourages them at the end of the semesters. | The advantages are more than the disadvantages, but the disadvantages in the house are depending on the house rules. | | Yes, if it's on Calassera most of the students using technology, but if it's in the book all of them answer. | | | I wish they provide classrooms especially for Sciences subject that the students come to it rather than the teacher go to their classrooms. |
| 8 | The most important things to improve the school are to encourage and improve the teachers to use technology during classrooms through workshops and the plan of the teachers that includes evidence of their implementation. | Advantages: make the teaching process easy.<br><br>Disadvantages: it needs strong internet connections and extra time. | Through search about everything is new that serves the educational process and attend workshops. | Yes, our school is using a website and via it the teacher give the students their homework and the students should answer in the site. | Yes | Yes | 1- Provide a strong connection. 2- Training teachers on the latest applications that can be used. 3- Register for some application. |

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| 9 | Through courses and buy some websites like education city. | Advantages: deliver the information in easy, fast and simple way.<br><br>Disadvantages: it needs a continuous control and good budget. | Sure. | Yes, My learning. | Yes the students' marks reflect how much she's able to understand the subject. | Of course | Make continuous training courses to improve the teachers' ability. |
| 10 | Provide workshops. | Advantages: make learning easy. Disadvantages: the connection is slow. | Through workshops. | Yes via My learning website. | Yes | Yes | Provide workshops. |
| 11 | Through using programs on the tablet device. | It makes the subjects exciting but we should use the traditional way as well. | Through keeping up with learning sites and learning to use them in class. | Yes through opening homework on their tablets and using internet to solve homework. | Yes | | Open and register educational websites. |
| 12 | Through continuous training courses | Connection is slow or sometimes the students forget their iPad. | Through training courses. | Yes through school's site. | Yes | Yes | The teachers join courses and buy programs for the school. |
| 13 | School principal and supervisors require the teachers to teach using new ways and tools, and then they evaluate them. | It has many advantages, but the disadvantages that the connection is disconnect sometimes and some teachers don’t know how to use it. | Of course the more you have knowledge the more you are going to use technology in the right way. | Yes, we have activities calls science and writing, science and society, we ask student to search in the internet and solve a problem. Also, the book ask them to go back to AlObeikan site. | | | Provide the right learning resources and tools, the teachers attend courses. |

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| 14 | Yes it encourages them and attends the teachers' classes. | Advantages: provide right information from Reliable sites and the Ministry of education provides websites for the schools and every student has an account such as Classera site for private schools. Disadvantages: the student might search and find wrong information. Some schools hard for parents see the teachers face to face because the contacting with teacher via E-mails. | Keeping up with everything is new and renewing your information. | | | | Provides labs that have all the tools like computers and internet to encourage the student to search specially in their free time. |
| 15 | Yes it encourages them. | Disadvantages: sometimes there's no internet and the devices breakdown. | Courses and training. | Optional only. | Yes. | Yes. | Provides everything that learning needs. |
| 16 | Provide projectors and tools in every classroom and maintain the devices. | The advantages are more than the disadvantages. Disadvantages: sometimes the technology needs time and the time of the class might not be enough. | Through continues search. | | | | My suggestion is that they should focus on the teachers and decrease the number of classes from their teaching tables. |

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| 17 | The principal imposes us to combine technology in teaching. One time the principal attended my class and I wanted to use the projector at the end of the class but I couldn't turn it on and then the class finished but right before the principal left the class the projector turned on, she said " you don't need the projector you already explained enough, the I said " there was extra information to add". | Advantages: it provides information and pictures. Disadvantages: sometimes it needs more time. | Yes of course, I improved myself by myself, I didn't attend any course in the school. I like to increase my information to answer all my students' question specially those who are excellent and want to ask many question, sometimes I know the answer but I want to know more about it, so I request the student who asked to search more in the internet and then explain the answer to her colleagues. | Not all of them, There are excellent groups and other groups don't even study. | | | Provides projectors and computers in all the classrooms. |
| 18 | Integrate technology in education affect in yearly teaching functional performance and it will encourage teachers motivate them to use technology in their teaching. | Advantages: it Shorten the teachers' efforts and time, provides information. Disadvantages: sometimes it needs more time. | I have a limited experience because of that I only use projectors. | A few numbers of the students use the internet to search for extra information and I think the parents haven't encourage them to use technology. | | Yes it might enhance their skills, because there are students who learn by listening and others by seeing. | Reduce the curriculum, provide many options and give the teachers the chance to choose what technology they want to use and do not limited the courses in the educational field only. |
| 19 | Yes | Depends on the teachers. Some teacher use it in effective way. In other hand, other teachers use it in the negative way. | Continue searching for information and know how to simplify the information. | Yes, researches and working papers but I don't force them. | Of course it makes the subjects easy to understand and some students bring pictures related to the lesson. | To some points. | Depends on the lesson. |
| 20 | Provides tools. | Advantages: improve the science and raise the level of the students. | Through attending courses and providing devices and tools. | No because the parents don't accept it. | Yes their level has increased | Yes. | Provide devices and tools and examine the teachers' experience about the technology. |

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| 21 | The school principal encourages us. | It has too many advantages.<br><br>Disadvantages: the huge number of the students in the classroom doesn't give all the students the chances to use the technology. | I look over sites to learn new information. | | Some of the students the technology benefits them whether in the school or the house, but there are some students don't focus because of the large number of the student in the class. | Yes it makes the students depend on other things than the teacher because some students feel that the teachers are boring and put them under pressure. | They should provide advertising screens in the walkways of the school to remind the student of the technology and to warn them if there's dust wave to wear masks. My suggestion for Science felt merely science but I would not accumulate science curriculum and also repetition, studying the subject in the science curriculum, I find my colleague are teaching in the curriculum of Social Sciences. |