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ABSTRACT

Economic, social, technological and educational factors have led to an increase in the use of ICT (Information and Communication Technology) in education at all levels. Most research concerning this has focused on the way in which e-learning can be used to improve teaching and learning across the curriculum and has neglected the teaching of ICT as a subject (Hammond, 2004). In a 1999 Ofsted inspection, ICT was found to be the least well taught subject in primary schools. The present research considers how the teaching of ICT could be better supported in the UK and Saudi Arabia.

In the first stage, an investigation was made of the teaching of ICT in UK primary schools to understand why its teaching had been rated unfavourably. It was discovered that teaching focused on technical aspects (i.e. how to use specific applications) whilst ignoring the communication and information parts. Although it has been argued widely that e-learning improves teaching and learning across the curriculum, observations showed that e-learning was not, in itself, used to support teaching of the ICT curriculum. Hence, this research explored the ways in which the teaching of the ICT curriculum (to 9-11 year olds) could be made more effective, particularly through the incorporation of e-learning material.

It was hypothesized that the experience of teaching and learning could be enhanced if e-learning material was designed which specifically addressed the needs of the teachers and young learners. Evidence collected in the course of the research suggested that little material existed to support the ICT curriculum, and that e-learning material produced to support other subjects does not always suit the teachers’ needs. Therefore in the second stage of the research, a design approach that engaged end users (teachers and young students) was proposed which was tested and refined during the design of e-learning material to support the teaching of the Multimedia Unit of the ICT National Curriculum.

The resulting e-learning material was evaluated in UK schools to determine the extent to which it satisfied user needs and its effectiveness in teaching the intended learning outcomes. The results in both cases were positive implying that such a method could lead to the production of useful supportive material.
As a former Saudi Arabian computer teacher, one of my personal goals was to provide opportunities to improve the experience of teachers and children in my own country. As such I have been interested in how I can transfer my understanding of the UK educational system to my home country. Following the successful evaluation of the e-learning material in the UK, a demonstration of how a child centred design approach can be used to design effective educational material. Unfortunately although such a process might produce more effective learning outcomes and pleasurable material, I also found that such an approach is considered incompatible with commercial design environments.

In the last stage of the thesis strategies are discussed which could be used (particularly in Saudi Arabia) to encourage the producers of educational materials to engage in the design of more effective teaching and learning experiences, especially in relation to the primary ICT curriculum. One such strategy would be to train undergraduates in applying a more user centred design approach as an integral part of their practice. The resultant design approach has now been approved by the Director of the Graphic Design Department in Dar Al Hekma Collage (Jeddah – Saudi Arabia) to be taught as a design approach for designing e-learning material for children on the Information Design Course. Additionally, a set of recommendations was developed for the Saudi Ministry of Education addressing the sort of revisions needed to improve the ICT curriculum in Saudi Arabia.
USING E-LEARNING TO IMPROVE THE EFFECTIVENESS OF TEACHING PRIMARY SCHOOL ICT

RUBA ABOU HASSANA

A thesis submitted in partial fulfillment of the requirements of Coventry University for the Degree of Doctor of Philosophy 2008
CHAPTER 1: INTRODUCTION TO THE THESIS

This chapter provides an introduction to the overall research described in this thesis. The following sections describe the aims, objectives, and the rationale of the research; this is followed by a description of the research process, the structure of the thesis and the proposed contributions to knowledge.

1.1 Introduction

The use of Information and Communication Technology (ICT) in education is increasing. As defined in the UK QCA (Qualification and Curriculum Authority) schemes of work, the use of ICT in education refers to the electronic communications, facilities and features that variously support teaching, learning and a range of activities in education such as, keyboards, effects and sequencers in music teaching, internet-based research to support geographic enquiry, communications technology to exchange administrative and assessment data.

As a Saudi graduate from the Department of Computer Applications and Education, and afterwards, working as a computer teacher in Saudi Arabia, I witnessed an increase in the use of e-learning (i.e. the application of computer educational software as a tool in the learning process; as used by the learner rather than the teacher). However, e-learning was often applied with no evidence of its effectiveness on the learning outcomes. Also the teaching of ICT as a subject in its own right was neglected when compared to other subjects. This encouraged me to explore ways to improve the teaching of the ICT curriculum and especially to consider how e-learning might be used to improve the teaching of it in Saudi Arabia. Given that the use of ICT in education and the teaching of ICT in schools in the UK is more developed than in Saudi Arabia, it was hoped that lessons could be learnt from the UK experience and applied to Saudi Arabia.

ICT is found as a subject in its own right in the National Curriculum (DfEE, 1999) for England and Wales, and is also a tool which can be used by teachers and pupils to support teaching and learning in other subjects. ICT is compulsory throughout primary and secondary schools (ages 5 to 16). The National Curriculum for ICT is designed to provide experiences which will equip young people with the ability to use technological
tools to find, explore, analyse, exchange, and present information responsibly and with discrimination (DfEE 1999:96).

In 1998 the QCA (Qualification and Curriculum Authority) produced schemes of work which illustrated how the National Curriculum programme of study for Information and Communication Technology (ICT) for Key Stages 1 and 2 could be translated into a practical plan\(^1\). It showed how ICT might be taught to groups of children to attain levels appropriate to their age. This optional exemplar was designed to help teachers deliver ICT programmes of study. There are four aspects of study at Key Stages 1 (ages 5-7) and 2 (ages 8-11), which are extended into Key Stages 3 (12-14) and 4 (15-16) to provide coherence. They are: 1) finding things out; 2) developing ideas and making things happen; 3) exchanging and sharing information; and 4) reviewing, modifying and evaluating work as it progresses.

Children develop these skills as they work with a range of information, explore a variety of ICT tools, investigate and compare different uses of ICT. During Key Stage 1, children explore ICT and learn to use it confidently and with purpose to achieve specific outcomes. They start to use ICT to develop their ideas and record their creative work. They become more familiar with hardware and software. During Key Stage 2, children use a wider range of ICT tools and information sources to support their work in other subjects. They develop their research skills and decide what information is appropriate for their work. They begin to question the plausibility and quality of information. They learn how to amend their work and how to present it in such a way that it suits its audience.

However, most research has neglected the teaching of ICT as a subject and concentrated instead on its use in the teaching and learning of other subjects (Hammond, 2004). Ofsted inspections (1999) have shown that ICT is one of the least well taught subjects for all age groups in primary schools. Hence, there is a need to research ICT curriculum teaching practices in order to gain an understanding of how effectively it is taught, where problems arise and how these can be alleviated. This is particularly important in primary schools, as ICT capability is now a life skill which

\(^1\) Details about the programme of study and attainment targets for Information and Communication Technology as specified by the National Curriculum can be found in Tables 3-1 and 3-2 in Chapter 3.
supports teaching and learning across the curriculum, hence it should be taught from early stages. So that all children may be fluent in the skills they need.

It is generally accepted by the British Educational Communication and Technology Agency (BECTA) (2005a) that e-learning can enhance education. However, e-learning has not been applied to enhance the understanding of young learners in ICT classes. Hence, there is also a need to research the ways in which e-learning can be designed to support the teaching of the ICT curriculum itself. Figure 1-1 shows the emergence of the research question.

![Figure 1-1: Preliminary Research Problem](image)

Design methodologies have already been developed that can be applied to the design of e-learning material (Heinich et al., 2002). However, there is still a lack of research addressing how young learners’ needs may be captured, fed into the design process, and met in e-learning material. User centred design (UCD) has been used by researchers in mathematics, HCI, product design, instructional design, and information design (Kuyper, 1998; Dick and Carey, 1996; Lowe, 1996). As indicated by Niederhelman (2001) and Gulliksen (2000) UCD is seen as a successful design approach because it provides designers with an opportunity to understand more about the task, user, tool, and environment. It will be argued that user centred design may be an appropriate design method for designing e-learning material for children.

The research showed that although the situation in the UK is not ideal with respect to the use of e-learning or the teaching of ICT, it compares favourably to Saudi Arabia, where there is no policy or framework for designing or implementing e-learning in schools, and designers produce e-learning materials with little user involvement in the
design process. It is argued that a child centred participatory approach may lead to the development of more effective material.

As a part of this research a user centred design method was developed and used to produce e-learning material (multimedia game) for primary school children. This material was evaluated by UK primary school children and teachers to assess the extent to which it supported the teaching of the ICT curriculum, fulfilled the learning outcomes and was pleasurable to use.

Given that the material was well received, the next stage of the work addressed whether such an approach could be adopted by Saudi designers. To this end, designers were interviewed to determine the feasibility of the approach and the changes that might be needed for its adoption in a commercial environment. In the final stage the knowledge acquired about the teaching of ICT in the UK, and the need to produce more effective e-learning material, was used to develop a set of recommendations for the Ministry of Education in Saudi Arabia.

1.2 Aims and objectives

The main aim of the research was to explore the effectiveness of e-learning in supporting the teaching of the ICT curriculum in primary schools, with special reference to the UK and Saudi Arabia.

To achieve the above aim the following objectives were specified:

1. To investigate current teaching methods, practices, and e-learning with respect to the ICT curriculum in primary schools in the UK and Saudi Arabia.

2. To develop an e-learning design process that supports the teaching and learning of ICT in primary schools based on the requirements of the age group, teachers and curriculum in a British primary school context.

2 Details about the current design process followed by designers in UK can be found in Chapter 4 and for Saudi Arabia can be found in Chapter 7.
3. To create and evaluate e-learning material that teaches part of the UK ICT curriculum to key stage 2 children which exemplifies the design process developed in objective 2.

4. To assess the practicability of the design process used to develop e-learning material with e-learning designers in Saudi Arabia.

5. To produce a set of recommendations for the IT Department in the Saudi Ministry of Education with regard to the teaching of ICT in primary schools.

1.3 Rationale

The use of ICT in education is steadily increasing. This is because ICT is perceived as contributing richer learning environments, improving learning and teaching (Heemskerk et al., 2005; BECTA, 2005b; Schiller and Tillett, 2004) across the curriculum. Although the increased use of ICT across the curriculum and the difficulties experienced in using it has been documented and understood (Cuban, 1986; Cuban et al, 2001, Somekh, 2000; Ofsted, 2001a; Watson, 2001), several countries are facing difficulties in defining the nature and scope of ICT as a subject (in Saudi Arabia Almoneea, 2001; in UK Munro et al, 2002). The efficiency of teaching the ICT curriculum itself is neglected compared to the concern given to the integration of ICT tools across curricula (Hammond, 2004; Robertson, 2002). For example, ICT was assessed the 'least well taught' subject in English schools (Ofsted, 1999). Standards are reported as improving (Ofsted, 2001b) but concerns remain due to wide variation in the provision and the quality of teaching. Therefore, there was a need to investigate the current teaching practices associated with the ICT curriculum to understand why it was assessed as such.

ICT is taught using a very pragmatic approach (Hammond and Mumtaz, 2001). Although teachers apply a blend of teaching pedagogies which involve both teacher directed learning and pupil exploration (Abu Hassana and Woodcock, 2006a) the emphasis is on how to use technology and not why, where or when to use it.  

3 For details see Chapter 2
4 For details see Chapter 3
concentrating on how to use technology (i.e. how to use specific applications) young learners may not reach the learning objectives specified by the QCA.

As ICT is used to enhance teaching and learning in other subjects it might be asked whether it is possible to use ICT tools, particularly e-learning to support the teaching of the ICT curriculum itself. Thus, this research explores the potential of e-learning to support the teaching of the ICT curriculum to young learners.

Despite the increasing availability of technology, particularly e-learning, and the attention given to its potential to improve learning outcomes, teachers face difficulties in using available e-learning material in lessons because it does not suit their needs. Hence, there was a need to understand why e-learning material is being produced that does not satisfy end users. This may be attributed to the lack of clear rules and directions for the design of e-learning material, the focus on the content of the material rather than teaching strategy, or the lack of sufficient analysis of the context and user needs (Triantafyllidis and Mitropoulou, 2005).

Mellar et al. (2000) concluded that most of the early attempts of e-learning material developers did not take into consideration the basic needs existing in schools or in classroom. To examine if this is still the case, this research investigated the current design practices of the e-learning materials in both UK⁵ and Saudi Arabia⁶.

A participatory design approach might be useful in this context (Puphaiboon, 2005) and might lead to more effective e-learning material. Such an approach allows designers to understand the needs of teachers, pupils, the context, and the factors that might influence teaching and learning. In this research, Puphaiboon’s user centred design method was adopted to develop e-learning material that supports the teaching of the Multimedia Presentation Unit from Key Stage 2, of the UK National ICT curriculum. The material was developed in collaboration with students and teachers in UK primary schools⁷ as no definitive ICT curriculum has been approved in public Saudi schools, and e-learning is more advanced in UK.

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⁵ For details see Chapter 4
⁶ For details see Chapter 7
⁷ For details see Chapter 5
The resultant e-learning material was evaluated in UK schools to determine its effectiveness in teaching the ICT curriculum and the extent to which it satisfied the user needs.

Although a user centred design approach has been shown to produce more effective material, it could be considered resource intensive and inappropriate for commercial environments (Kelly et al., 2006). Thus, there was a need to evaluate the practicability of the design method with practicing designers to assess its commercial reliability. This assessment was undertaken in Saudi Arabia, where it is hoped this work will have an impact on the use of e-learning and the ICT curriculum teaching.

Additionally, in order to provide the IT Department in the Ministry of Education in Saudi Arabia with a set of recommendations regarding the teaching of ICT, a comparison was undertaken between UK and Saudi Arabia in order to identify which aspects of the teaching and learning of ICT in UK primary schools could be transferred and adopted to the Saudi Arabian education.

1.4 Outline of research stages

The present research involved five main stages: (1) understand; (2) propose; (3) realize; (4) Evaluation; (5) knowledge transfer. Figure 1-2 shows the research stages.

Throughout the research, emphasis was placed on understanding the needs of the students and teachers in schools. Hence, qualitative research methods were selected as being more appropriate for collecting in depth data from a small sample.

Considering the flow of the research, as outlined in Figure 1-2, in the first stage, a problem was identified, i.e. problems in the ICT curriculum teaching practices and problems with the design of current e-learning. The scope of this was established in both the UK and Saudi Arabia through: (1) literature review; (2) classroom observations; (3) interviews with teachers; (4) interviews with designers about current

8 For details see Chapter 6
9 For details see Chapter 7
10 This research consists of several studies, methodologies used are described in association with each study.
practice. This understanding stage fulfils the first research objective which is to investigate current teaching methods, practices, and e-learning with respect to the ICT curriculum in primary schools in the UK and Saudi Arabia. The findings were used in the second stage to form a hypothesis that problems associated with the teaching of ICT could be addressed by developing a set of design principles that would lead to the development of e-learning material more sensitive to the usage context (schools) and end user needs (teachers and children). During the third stage these design principles were informed by literature on user centred design, and in the realization phase of the research iteratively refined through the development of a prototype e-learning game.

The proposed design method involves six steps:

1. A detailed design specification for the e-learning material, determined through interviews with children and teachers. This included consideration of children’s ICT interactions, ICT teaching practices, and the learning context.
2. The development of a prototype based on the requirement specification and wider information gathered from stage 1.
3. Iterative design in which children were asked to comment on the usability and enjoyment of the prototype, and the teachers were asked to comment on the extent to which the prototype would facilitate achievement of learning outcomes. This revealed any problems and provided guidance on prototype development.
4. The development of a full working prototype taking into account the information derived from previous stages.
5. Assessment of the usability of the prototype.
6. Evaluation with teachers and pupils in primary schools to determine the effectiveness of the material.

In the fourth stage; a critique of the use of e-learning in teaching the ICT curriculum was undertaken to assess whether the use of more effective user centred designed e-learning material might help to overcome the problems identified in the current teaching practice of the ICT curriculum. Finally, the last stage of the work entailed transfer of knowledge to Saudi Arabia. This involved conducting a study with Saudi designers to determine whether the proposed method would be acceptable to them, and by reflecting on the entire research developing a set of recommendations for the IT Ministry of Education relating to the teaching of ICT.
1.5 Organization of the thesis

Figure 1-3 shows the structure of the thesis. This chapter provides an overview of the research.

Chapter 2 provides the background of the research. It contains a review of the literature associated with the use of ICT in primary schools, the design of e-learning and child-centred design. It will be argued that an understanding of these domains is crucial for the aim of the present research.

Chapter 3 presents the field study conducted to gain understanding of the way in which ICT is taught as a subject in UK primary schools.

Chapter 4 presents the criteria considered by primary school teachers in the selection and evaluation of e-learning material available in the UK market targeted to year 5 and 6. It also provides an account of the current design practice undertaken in UK e-learning publishing companies.
Chapter 5 describes how the e-learning material was produced using a child centred design approach aimed at producing more effective e-learning material for young learners. It also presents the results of the laboratory based usability test.

Chapter 6 describes the evaluation material’s effectiveness in achieving the intended learning outcomes and the extent to which it satisfies the end user requirements.

Chapter 7 provides details of Saudi Arabia ICT curriculum teaching practices, the e-learning design practices and describes the study conducted with Saudi designers to evaluate the proposed method in terms of its usefulness.

Chapter 8 presents the set of recommendations made to the Ministry of Education in Saudi Arabia on the ways in which the teaching of ICT in primary schools could be improved.

Chapter 9 draws final conclusions from the research, details the contributions to knowledge, the implications for designers and issues for further research.

![Figure 1-3 : Thesis Structure](chart.png)
1.6 Contributions to knowledge

It will be argued that the following contributions to knowledge have been made:

1. Evidence is provided that e-learning can support the teaching of the ICT curriculum in UK primary schools. This has been derived from the interviews with teachers, literature review, and observations in schools.
2. Formalization of a child centred design approach for the creation of e-learning material for primary schools.
3. Demonstration of the economic and practical impediments to adopting a user centred design approach for the development of e-learning material outside academia. This has been indicated through interviews with practicing designers in e-learning manufacturing companies in Saudi Arabia.

1.7 Conclusion

This chapter started with an introduction to the scope of the thesis, indicating the personal and academic motivations behind the research. Aims and objectives have been presented followed by a description of the underlying principles of each objective in the rationale section. The thesis format, chapter organization and the proposed contribution to knowledge have also been presented.

The rationale for the research, supported by related studies, will be shown in the following chapter which presents more detailed grounds for the research through a literature review on the current use of ICT in teaching and learning, and introduces user centred design approaches in the context of e-learning.
CHAPTER 2: LITERATURE REVIEW

A literature review was conducted in three areas, considered necessary to underpin the research. Firstly, the use of ICT in schools was considered. This concentrates on the rationale for integrating ICT in teaching and learning and the issues this raises at the teacher, learner and institutional level. Secondly, the characteristics of young people (aged 9-11 years) are considered both as end users of the material and design partners. Lastly, research on both user and child centred design was reviewed to determine the most appropriate methods that could be employed in the research.

2.1 Introduction

The aim of the literature review was to explore current research and thinking about the use of ICT in education, elements of effective e-learning game design, and child-centred design. It will be argued that an understanding of these domains is crucial for the fulfillment of the aims of this research, i.e. the exploration of the effectiveness of e-learning in supporting the teaching of the ICT curriculum in primary schools, with special reference to the UK and Saudi Arabia (Section 1.2). As an e-learning game was developed in collaboration with teachers and children (aged 9-11 years old) issues related to child centred design are also presented in this chapter. See Chapter 5 for more details about the development process of the game.

The review begins by considering the rationale of using ICT in education either as a subject or as a support tool. This is followed by a consideration of the issues that have emerged with the introduction of ICT in education, such as the divergence between the students' ICT experience inside and outside school. The review is augmented by research reported in the following chapter from field studies undertaken to consider how the ICT curriculum is taught, particularly in relation to issues that were raised in the literature but not fully addressed.

Globally, governments have set national goals and polices that identify a significant role for ICT in improving educational systems and reforming curricula (Kozma and Anderson, 2002). In England targets were established for school leavers to be accredited in ICT, and all schools were required to be connected to the Internet by 2002 (DFEE, 1997).
British educational policies for schools require that pupils should be given opportunities, where appropriate, to develop and apply Information Technology (IT) across the curriculum. This is a strong, regulated requirement. Within the UK, all publicly funded schools must adhere to the National Curriculum which specifies both the content of the curriculum and the expected levels of attainment at different ages. The National Curriculum is organized by 'Key stages', which roughly correspond to school stages. This research focuses on children in Key stage 2 (ages 9-11).

E-learning can offer a greater opportunity to engage children in learning environments, through interactive games, whilst also satisfying their needs and preferences. In order to develop suitable e-learning material, BECTA (2005b) suggested that teachers should be involved in the design of such material. The children's role in the design of e-learning materials and child centred design approaches were reviewed which have enabled a design method to be developed for the creation of e-learning material to support the ICT curriculum which takes into account children's needs.

Figure 2-1 shows the relation between the literature reviewed in the present chapter and the research objectives presented in Section 1-2.
2.2 The use of ICT in education

Improving and facilitating education has been a long and perplexing puzzle for educators. Many people have shared the assumption that there is something unique, valuable and powerful about enlisting technology in education (Kerr, 2005).

The type of technology incorporated in education has changed, and new forms have emerged to complement former ones according to changes in society and occupational needs. In the 19th century, organized state controlled schooling appeared as a central social institution in many parts of the developed world. At that time the key demand of schools was basically to produce a literate worker, someone who could follow instructions, and operate unfamiliar types of machinery, make simple adjustment to that equipment and function well as a solitary cog in the industrial machine (Kerr, 2005). In the 20th century different forms of technology (such as films, TV programs, and radio) were introduced into education (Cuban, 1986; Kerr, 2005).

Since 1970s computer technology has been developed for educational use (Heemskerk et al; 2005). Computers have several features that distinguish them from other media, tools or resources such as capacity, range, speed (Bolstad, 2004) and interactivity (Calvert, Strong and Gallagher, 2005).

Leinonen (2005) states the phases of using computer technology in education (see Figure 2-2) as follows:

1. Late 1970’s - early 1980’s: programming, drill and practice;
2. Late 1980’s - early 1990’s: computer based training (CBT) with multimedia;
3. Early 1990’s - Internet-based training (IBT);
4. Late 1990’s - early 2000: e-Learning;
5. Late 2000 - social software + free and open content.

![Figure 2-2: The use of computer technology in education](image-url)
The deployment and use of technology is now central to educational change (BECTA, 2005a). Technology has redefined learning and teaching and is well on the way to changing the future principles, practices, policies, and underlying epistemological issues that define the value, worth, meaning and delivery of educational service (Kompf, 2005). Thus, the debate is why the use of technology in education is attractive to so many people.

Hawkridge (1990) discerned different reasons for integrating ICT in education:

1. An economic rationale: the development of ICT skills is necessary to meet the need for a skilled work force. Learning is related to economic prosperity and growth. Watson (2001) added that David Blunkett, UK Minister for Education and Employment (2001) said that the use of technology for improving the delivery of education has enormous potential to raise standards and increase employability.

2. A social rationale: this builds on the belief that all pupils should know about and be familiar with computers in order to become responsible and well-informed citizens. Tondeur et al., (2007) added that all students must be digitally literate in order to be prepared to take their place in a knowledge based society. The National Education Center (2000) also stated that the use of e-learning increased pupils IT skills hence they must quickly have basic knowledge of IT to be able to use e-learning. Hence, the integration of ICT in education might improve pupils' IT skills.

3. An educational rationale: ICT is seen as a supportive tool to improve teaching and learning. This might be related to the assumption that the use of technology can improve student learning. Research has indicated that the use of technology can have the following positive impacts:
   a. Development of learner's understanding
      ICT as a tool can contribute to the development of understanding across the curriculum (Higgins, 2001). Dewey's definition 'to understand is to grasp meaning'; to grasp a meaning of a thing, an event or a situation is to see it as its relates to other things: to note how it operates or functions, what consequence follows from it, what causes it, what uses it can be put to (Dewey,1933:137). Higgins (2001) argued how ICT might contribute to learners' understanding; firstly, ICT is powerful in presenting information in
different ways. This might be through speech and text, or text and pictures, or numerals through tables and graphs; Secondly, ICT has potential to represent information dynamically so that the learner can make changes easily.

b. Learner's individualisation and differentiation
ICT is viewed as an important tool in facilitating new levels of learning support (BECTA, 2005a). ICT can facilitate differentiation and individualisation in education: it makes it possible to tailor the content, presentation and speed of introduction of new concepts to the individual's background, experience, needs and characteristics (Heemskerk et al., 2005). ICT has the potential to be a major force in educational reform for achieving a more learner-centered, constructivist approach to learning (Schiller and Tillett, 2004).

c. Self-esteem and pleasure
ICT has the potential to enhance learning, self-esteem and pleasure for pupils (Klaces, 2006). Also BECTA (2005a) reported on pupils spending longer on tasks, increasing their commitment to learning, achieving more through the use of ICT and of being enthusiastic about using ICT in their lessons.

d. Participation and attainment
The use of ICT as a tool has a positive effect on learner's participation, retention and attainment (Harris et al; 2003; Maurer and Davison, 1999).

e. Collaboration Learning
ICT usage fosters collaborative learning and flexible learning opportunities— independent of time and place (Tondeur et al., 2007).

2.2.1 Categories of ICT use in education

Broadly speaking, the use of ICT in education includes two important aspects (Tondeur et al., 2007):
1. ICT as a subject;
2. ICT as a tool;
2.2.1.1 ICT as a subject

ICT is a new subject in many schools in UK (Hammond, 2004) and Saudi Arabia (Almoneea, 2001 - See Section 7.2.

Capability in information technology (IT) was presented as a strand of ‘Technology’ when the first National Curriculum documents appeared in England and Wales (Department of Education and Science, 1990). IT became a subject in its own right in 1995 (Department for Education, 1995). The National Curriculum was further revised in 1999. IT was renamed Information and Communication Technology (ICT) in England, but the content was left largely unchanged (Hammond, 2004), emphasizing the tools associated with IT (Smith, 1999) such as the use of internet to search for information about particular subjects, or to use PowerPoint to present lessons to students. However, programmes of study in England were now grouped around four major themes of finding things out; developing ideas and making things happen; exchanging and sharing information; reviewing, modeling and evaluating work as it progresses (Department for Education and Skills (DFES), 1999). Details about the programme of study of Key stage 2 and the attainment targets for the ICT curriculum are presented in Tables 3-1-3.

ICT as a subject concerns the knowledge, skills and processes involved in understanding how to make appropriate, effective and productive use of new technology tools including computers, the hardware linked to computers, software applications and the Internet (Cook and Finlayson 1999; Smith, 1999).

Through studying ICT, the student is expected to become 'ICT literate'. This is potentially as important to the citizen of the 21st century as literacy and numeracy have been in earlier centuries (Dale et al., 2002). As indicated earlier, the need for all students to be digitally literate is one of the main rationales for integrating ICT in education. The need for people to become confident and competent in its use has increased the consideration given to ICT as a subject. It should be taught to all pupils in the same way as the core and foundation subjects of National Curriculum (Heinrich, 1997). However, inspection reports (Ofsted, 1999) show that ICT is the 'least well taught' of National Curriculum subjects and subject to 'substantial underachievement in about two fifths of primary schools' (Robertson, 2002).
2.2.1.2 ICT as a tool

Using ICT as a tool means using technology - software and hardware - to support learning, teaching and management across various subject areas e.g. measuring the variables in science experiments, using data-logging equipment, or searching the Internet for information about World War II in History (Heemskerk et al., 2005).

In the literature, e-learning definitions range from broad definitions which include any learning that uses information and communication technologies in any learning context (DFES, 2001), or using any electronic media, such as internet, intranets, extranets, satellite broadcast, audio-video tape, Interactive TV or CD-ROM (Urdan and Weggen, 2000), to narrower definitions which either restrict the medium to online web-based learning or limit the users to higher education students (Fitzgibbon and Jones, 2004). The term e-learning in this thesis is used to refer to the application of ICT (computer hardware and software) as a tool in the learning process, particularly, if used by the learner and not the teacher (Pollard and Hillage, 2001).

The most prevalent form of e-learning in schools is educational software. As reported by Crozier (1999) and Volman and Van Eck (2001) this can be thought of as falling into one of four loosely defined categories:
1. Drill and practice, which offers repetition or practice of a particular skill;
2. Problem solving, which presents a scenario where a child needs to provide a solution to solve a problem;
3. Simulation, which presents events in a number of virtual environments, and
4. Tutorial, which presents a lock – step approach in teaching a concept.

It must be noted that much of the software produced today is actually a combination of two or more of these categories; therefore, many of the features will overlap. Of course, some software is more successful in helping children achieve learning goals than others. With this in mind, the features that account for this difference in learning must be considered; the design of e-learning material is therefore discussed in section 2.3.

In summary, this section has shown that the use of technology in education is increasing due to the demand to satisfy societal needs through producing digitally literate students and improving their learning. However, most available literature has
focused on ICT as a tool and its impact on the learner and not on the teaching of ICT as a subject. Moreover, the literature has indicated that ICT as a subject is not well taught. Thus, in order to identify how ICT is being taught in schools, research needs to be undertaken regarding the quality of the ICT curriculum and its teaching practices. Such a study is discussed in Chapter 3.

Prior to an investigation of the current teaching practices of the ICT curriculum, the issues associated with the integration of ICT in schools should be reviewed. The following section presents the main issues which have emerged from the introduction of ICT in schools.

2.2.2 Issues that have emerged with the introduction of ICT in schools

Firstly, ICT seems to have increased inequality in education through the divergence between students who have access to ICT outside school, and those who only rely on school equipment. The following are some examples:

1. This has been noted previously by Dale et al. (2004) who have commented on the pupil-home-school relationship. The relationship between pupils' experience or instruction at school and the use they make of ICT at home is related (Facer et al., 2001, Hakkarainen et al., 2000, Papastergiou and Solomonidou, 2005 and Sinko and Lehtinen, 1999; McCormick and Moon, 2003; Valentine et al., 2005).

2. Children who use a computer at home are more enthusiastic and confident when using one in school (Leask and Pachler, 1999) and can bring formidable prior ICT knowledge with them to school (Klaces, 2006). However, the different levels of ICT ability acquired outside school may make it difficult for teachers to understand the level of ICT capability of their classes – and judge appropriate levels of material. The wide range of skills acquired outside school are not yet fully appreciated (QCA, 2004). The children may be more sophisticated and expert in the use of ICT than teachers. As indicated by DFES (2002), to ensure that pupils remain motivated to learn and prevent them from becoming frustrated and disaffected, the skills acquired outside school need to be recognised and developed in an appropriate program of study.

3. There may be a gap between the way computers are used at home (and the type of software that is used) and the seemingly restricted or boring use computers at school. Downes (1997) and Facer et al. (2001) proposed that home use is neither
a simple nor uniform phenomenon, but has the potential for a variety of appropriations, uses, and constructions that are not always reflected in school experiences. ICT school use is heavily teacher directed in order to achieve syllabus outcomes in key learning areas. So the pupils are told 'not to fiddle' with school computers and that if they face a problem they should ask for help and not try to fix it themselves. Also at school they do not have a lot of time for practicing the skills which are taught. While at home children learn to use ICT through a variety of meaningful tasks and having lots of time for playing, doing, exploring, experimenting, discovering and modeling, which is hugely beneficial. At school, there are restrictions of resources, time and rules about playing.

4. Abu Hassana, and Woodcock (2006a) supported that the schools are becoming increasingly irrelevant to the modern child as a result of their failure to embrace the digital media. They explains that outside school, children are engaged in a constant whirl of media and yet in many schools they are taught little more than the rudiments of information retrieval. Therefore, there is a need to bridge the gap between the home and the school use of ICT to ensure that pupils remain motivated to learn in schools. It may be hypothesized that there is an imbalance between the sophistication of the software used at home, and that used to deliver teaching and learning in schools. Children, experienced in the use of such software may be reluctant to engage with resources which do not match their level of sophistication as computer users; this in turn may affect their willingness to engage with the subject matter being presented. Therefore, it is important to understand and design for children's ICT expertise.

Secondly, although most western schools have computers and internet access, they differ in the way they use these. In the UK, inspectors found inconsistencies between schools (Ofsted, 2005). Significant differences can be observed in the way ICT is currently implemented between and within schools and the quality of the provision (eg, Goodison, 2002; Kirschner & Selinger, 2003; Loveless and Dore, 2002; Ofsted, 2005). In addition, there is a variation in the levels of using ICT in teaching between subjects, with highest levels of use found generally in core subjects (i.e. Mathematics, English, Literacy, and Science) (BECTA, 2005b).

Thirdly, teachers still lack ICT knowledge and use ICT in restricted ways. The acceptance of ICT in the primary classrooms may be dependent on teachers who are
the gatekeepers of the use of technology (Griffin and Bash, 1995; Davis et al., 1989; Zhao and Cziko, 2001). Many teachers have not incorporated ICT into their regular teaching (Schiller and Tillett, 2004) due to technical difficulties (Klacies, 2006), or their lack of expertise and confidence in using ICT (La velle et al., 2003).

Recently, BECTA (2006b) described the different approaches taken by teachers in their use of ICT:

1. Integrated, where the use of ICT is planned within the subject to enhance particular skills and concepts.
2. Enhanced, where an ICT resource is the focus, and is used to enhance some aspect of the lesson, or tasks.
3. Complementary whereby an ICT resource is used to empower students’ learning and reduce the mundane and repetitive aspects of tasks.

In summary, this section has identified issues raised with the introduction of the ICT in schools; inconsistencies between schools, and teachers’ ICT knowledge, confidence in integrating ICT in education and the divergence between the student ICT experience inside and outside school. The following Section discusses the characteristics of the target audience group associated with their use of ICT.

### 2.2.3 ICT and the Target Audience (children aged 9-11 years)

ICT is creating a revolution in education and other aspects of children's lives (Stacker and Pollock, 2005). Children like using ICT (Klacies, 2006) and regard their use of ICT as play (Cook and Finlayson, 1999). Many children spend a lot of their free time on computer games, especially children between 5 and 12 years of age (Dill and Dill, 1998; Carol et al., 1995).

The main use of ICT by 9-11 years old in teaching and learning is through the use of CD ROMs/DVD (Valentine et al., 2005). Mostly, they search and retrieve information using Internet browsers; create word processed documents; draw and manipulate still and video images using graphics packages; use spreadsheets for mathematics and representation of numbers in graphs; play games for entertainment; and use email communication (Stacker and Pollock, 2005).
There are several factors that influence the children's perception of ICT such as the child's individual characteristics (such as age, gender, motivation, interests), their peers, supervising adults, the technology itself, the task to be performed and the context within which it is performed (Stacker and Pollock, 2005).

Additionally, other studies have considered the influence of gender on attitudes towards ICT, eagerness, and purpose of use either in school or outside school (Valentine et al., 2005; Heemskerk et al. 2005; Schofield, 1997; Cook and Finlayson, 1999).

Supervising adults, such as parents and teachers, can have considerable influence over children's interaction with ICT. Within a school context, teachers can influence the ICT hardware and software, furniture and environment, but they have even more influence over the tasks that have to be performed and how those tasks are organised. Parents also influence the purchase of technologies and have varying levels of influence over what tasks are performed and when.

Moreover, Stacker and Pollock (2005) considered that ICT might influence the children’s development as follows:

1- Cognitive development: ICT can have a positive impact on outcomes important to cognitive development such as critical thinking, problem solving and motivation.

2- Social development: ICT use for today's children is often synonymous with the use of the internet and e-mail. These technologies emphasise communication and interaction and therefore offer children the potential to socialise in ways that have not been possible for earlier generations.

3- Life attitudes and skills development: ICT use in childhood provides an opportunity to develop a positive attitude to interacting with computers and technology in general. Children who are exposed to computers exhibit low levels of computer anxiety and show strong positive attitudes towards computers and technology.
2.2.4 Conclusion

The above studies indicate that pedagogic approaches to the incorporation of ICT should consider the following elements:

1. Learner: The impact of ICT on learner's motivation, attainment and individual needs.
2. Context: The way in which the learning and teaching takes place, and the obstacles for implementing ICT.
3. Teacher: The teacher's own knowledge, skills, competency base that inform his or her use of available resources, and the approaches taken by them in their use of ICT.

Most research has concerned the use of ICT in teaching and learning across the curriculum particularly in core subjects such as Mathematics, English, and Science (BECTA, 2006b; Ofsted, 2005) and its positive impact on the learner. However, the teaching of ICT as a subject (Hammond, 2004) is neglected and Ofsted inspections (1999) have raised concerns about poor teaching methods used in the delivery of the ICT curriculum in primary schools, and indicated that it is the least well taught subject. Accordingly, more research is needed on:

1. Strategies for linking learning inside and outside institutions.
2. Teaching practices and techniques related to the ICT curriculum.

It was hypothesized that the integration of gaming features into a school based ICT experience might bridge the gap between the entertaining ICT experience of students outside school and their restricted experience in school. Literature concerning this is discussed below and an investigation of the current teaching practices of the ICT curriculum is presented in Chapter 3.

In conclusion, the literature presented so far has indicated that children like using ICT. However, in order to keep children motivated in using ICT in schools, material should be designed that meets children’s needs and expectations. It will be argued in Section 2.3.3 that user involvement in the design of their ICT products is important in order to design an effective product that suits their needs.
2.3 E-learning Games

As games form the main use of ICT by children (Section 2.2.3) and several researchers (Mumtaz, 2001; Virvou et al., 2005) have confirmed that children like computer games, this section focuses on literature that addresses the impact of educational games on children and educational game design, in order to identify elements of game design that promote learning and satisfy the children needs.

Generally, games can make an important contribution to the educational process (Hayes and Whitebread, 2006) and make learning meaningful to students (Rosas et al., 2003).

Aguilera and Mendiz (2003) maintained that computer games are conducive to the development of specific skills: attention, spatial concentration, problem solving, decision making, collaborative work, creativity, and ICT skills. Many of these skills are earmarked as necessary to successfully participate in the global, knowledge based economy of 21st century. Therefore, schools should take advantage of the influence that computer games have on children, by providing a combination of activities and games with an overlay of educational content.

Computer games have a positive influence on students' motivation, reportedly more so than traditional teaching methods (Kulik, 1994; McFarlane et al., 2002; Randel et al., 1992; Denis and Jouvelot, 2005). An increase in motivation has been found to be directly related to children's attention and concentration (Mcfarlane et al., 2002).

In addition, computer games add fun to the classroom. Polonoli (2004) argued that a classroom without games and fun would be a very boring classroom. With this in mind, it is reasonable to assume that educational software which uses gaming strategies will foster more fervent pupil interaction. More intense involvement and longer contact period with the learning activity is something that good classroom instructors are constantly trying to accomplish. Gaming may be one way of achieving this goal.

Games can help children see what is relevant and irrelevant. As they can show examples of the same kinds of problems arising in different contexts, which is useful in helping children to learn to transfer ideas and processes. The attempt to connect
school based learning with real situations gives it an appropriate level of importance and motivates the child to learn (Hayes and Whitebread, 2006).

As the target age group (9-11 years olds) like computer games and these can form a large percentage of their ICT usage, and several researchers confirmed the positive influence that games can have on education, the e-learning material developed in the present research was produced as a game.

2.3.1 Design e-learning game for children

Unfortunately, most of the games that are particularly written for certain educational goals are of poor quality (Overmars, 2004). Kiili (2005) argued that most of the educational games resemble digital exercise books and do not utilize the power of games as an interactive context. The reason for this may be that the field of educational technology lacks research on how to design game environments that foster knowledge construction, deep understanding (Moreno and Mayer, 2005) and satisfy user needs. This research seeks to identify elements of effective e-learning game design. See Section 2.4.

2.3.1.1 Elements for effective e-learning game design

The following elements which should be considered in order to design an effective educational game have been found:

1. Learning style

The importance of individual learning preferences and styles is acknowledged by several researchers (Kolb, 1984). The three most common learning styles are:

1. Visual: Visual learners prefer information presented visually— in pictures, flow charts, time lines, films, and demonstrations —rather than in spoken or written words.
2. Auditory: Auditory learners are more effective in using verbal cues. To address auditory learners, discussion, lectures, dialogue, and music need to be included.
3. Kinesthetic: Kinesthetic learners prefer physical engagement in a “hands on” activity to understand ‘how?’ To address kinesthetic learners, computer simulations, demonstrations, individual reports, and working with interactive objects are required.
Several researchers (Felder and Henriques, 1995; Silverman and Felder, 1988; Kolb, 1984) have shown that students who receive mismatched teaching styles tend to be bored and inattentive in class, do poorly on tests, get discouraged about the course, and may conclude that they are no good at the subject and give up. Nevertheless, the DfES and educational researchers (Coffield et al., 2004) have argued that learners should not be attached to a particular learning style because they will have to experience or collaborate with others types of learners in their future career. Hence, the DfES teaching guidelines adopted the 4MAT teaching model based on McCarthy’s research (McCarthy, 1996) which aids all types of learners regardless of their natural preferences. The 4MAT teaching model focuses on asking students four questions (why, what, how and what if) so they can become deductive, reflective, and active learners. Questions recommended by Coffield et al. (2004) whose research was for the DfES included: 1) “Why are we learning this concept?” 2) “What are the key points of this concept?” 3) “How do I use this knowledge?” and 4) “What are the key implications of this concept in other contexts?” The aim being to teach all learners to be active, engage them in discussion and help them to learn from others in activities such as debates that incorporate graphics and movement around the room, use simulations in laboratories with objects and include a follow up discussion, make a documentary film, newsletters, or interactive poster display etc (Smith, 2004). Thus, the game should be designed using multimedia to accommodate these learning styles.

2. User needs

Benedyk, Woodcock and Harder (2008) propose that from an ergonomic perspective, learning (the transformation and extension of the learner’s knowledge or skills) is undertaken by a student (learner) while in a dynamic exchange of information with another participant (e.g. student or teacher) or with learning material objects (such as textbooks, coursework, technology, equipment). Although the use of e-learning material in education is increasing, rules and directions of general acceptance for the design of e-learning material have not been formulated and initial attempts at e-learning design have not taken into consideration the basic needs existing in schools or classrooms (Mellar et al. 2000). Hence, teachers have faced difficulties when they implement e-learning material in their classrooms (Mitropoulou and Triantafyllidis, 2005).
Focusing on users has been attributed to creating a successful design (Popovic, 2004; Wai and Siu, 2003). Mitropoulou and Triantafyllidis (2005) argued that in the design and development of e-learning material, designers should try to understand better the needs of the teachers and the students. Gradually, designers have come to appreciate that both teachers and students should participate actively in the design and development of e-learning material, that their needs should be taken into account, and their knowledge and experience used to inform design (Mitropoulou and Triantafyllidis, 2005).

Thus, adopting a user centred design (UCD) approach provides designers with an opportunity to understand more the ergonomics factors of the educational environment which is included in the concentric rings ergonomic model (Benedyk, Woodcock and Harder, 2008). UCD is an approach that puts the user at the centre of the design and development process.

However, researchers have identified problems with UCD for stakeholders in terms of an increases in cost, time and workload (Wai and Siu, 2003; Hughes and Hay, 2001). As a result, management is sometimes unwilling to adopt iterative UCD because of fear of losing control over the timescale (Gulliksen, 2000). If this approach was adopted in the present research it would require the early and continued involvement of teachers and students in the iterative design of teaching material. More details about the problems encountered when adopting a child centred design approach can be found in Chapter 7.

In this research it will be argued that a more extensive, iterative child centred design approach to e-learning will lead to the production of more effective e-learning material. The following section presents issues associated with child centred design method in more detail.

In summary, despite the increasing availability of e-learning materials and computer games, teachers are facing difficulties in using existing materials as design companies do not take into consideration the basic needs of the schools and games written for educational purposes are poorly designed. There are no clear rules and directions which can be generally applied to the design of e-learning games (Mitropoulou and Triantafyllidis, 2005). However, a consideration of the teachers teaching styles and the
pupils learning styles and characteristics needs to drive the design process, through a series of participatory activities.

**2.3.1.2 Child centred design in e-learning**

Child Centred Design is a young field which comes from the user-centred and participatory design methodologies, where users are the central point from which design activity takes place (Pardo, 2004).

No research has proposed a child centred design approach to the development of e-learning material to improve the teaching of ICT. Yet, it is common for developers of new technologies to ask parents and teachers what they think their children or students may need, rather than ask the children directly (Druin et al., 1999; Druin, 1996).

The target audience in the present research is children, aged 9 – 11 years. The majority of the participatory design work conducted with children has been undertaken with those aged between seven and ten (Alborzi et al., 2000; Druin and Solomon, 1996; Druin, 1999; Druin et al., 2001). There is little work on designing with older children (Isomurso et al., 2003; Theng et al., 2001). Kano and Read (2005) found involving children aged 11-12 years in the design process can be a worthwhile, although difficult process. They indicated that the children were keen and highly interested in participating in the design session. Thus, evidence supports that children can and should be an integral part of the design process in developing new technology, as equal stakeholders throughout the design process (Druin, 2002).

The rationale for involving children more directly is firstly based on the assumption that parents, teachers and designers are adults. Children are not miniature adults (Druin, 1996) and design principles formulated with adults in mind cannot simply be scaled down. Children’s motivations, desires, expectations (Read et al., 2002) culture, norms, and complexities (Berman, 1977) are different.

Early designers assumed that taking an interface that works for adults, adding a few animations and bright colours, automatically made it appropriate for children (Druin, 1999) and children were rarely involved in the development of products for kids. However, Puphaiboosoon (2005) found that students’ evaluation of mathematical diagram
animations developed in collaboration with teachers differed in important ways from the children's view of the material.

Secondly, it is now recognized that children have a voice that should be heard in the design of products and environments which they will use and there is a new demand for research that focuses on children as actors in their own right (Borgers et al., 2000).

A third reason for involving children is that involving them in the design and evaluation of their own artifacts is fun and rewarding for researchers, developers and, more importantly, for children (Read, 2005). Uden and Dix (2000) involved children aged 5-6 years old in the design of a visual and iconic interface for children. They adopted the design process recommended by Lodding (1983) consisting of three phases: 1) stating the message; 2) rendering the design and 3) testing the resulting icon. They concluded that children know what they want and like. They liked assisting in the design and expected the designers to understand their insights. Designers should never underestimate children’s abilities to say what they like.

However, the question which needs to be addressed is how can children be involved in this process. Some techniques used with adults have been extended and adapted for use with children and others have been proposed for this special purpose (Pardo, 2004). The most suitable approach to any project depends on different factors, starting with the purpose of user involvement, the capabilities of the user, the type of the product and practical considerations of logistics, funding etc (Facer and Williamson, 2004).

Table 2-1 presents the techniques used in involving children in the design process (Preece, et al., 2002; Hart, 1992; Read et. al., 2003; Read et al, 2001; Hanna et al., 1997; Hanna et al., 1999; Lloyd and Bekker, 2003).

Thus, a range of methods are available that look potentially useful at different stages of the design process. Details about the techniques used to involve children in the development of the e-learning game in this research can be found in Chapter 5.
<table>
<thead>
<tr>
<th>Technique</th>
<th>Purpose</th>
<th>State of the Design Cycle</th>
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<tbody>
<tr>
<td>Drawing and writing story</td>
<td>Used to obtain children’s ideas</td>
<td>Pre-concept stage</td>
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<tr>
<td>Video tours and 3D modeling</td>
<td>Capture children preferences in the interior design of their rooms in the hospitals</td>
<td>At the beginning</td>
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| Interview and questionnaires      | • Collecting data related to the needs and expectations of users; to elicit detail about the mental models that children have;  
                                       • To gather requirements for interfaces;  
                                       • Collecting qualitative data related to user satisfaction with the artifact;  
                                       • Evaluation of design alternatives, prototypes and the final artifact; | At the beginning or at the final stage |
| Focus groups                      | Include a wide range of stakeholders to discuss issues and requirements | Early in the design cycle               |
| Cultural probes                   | Provide access to children’s everyday lives which are not necessarily accessible through conventional methods. | Early in the design cycle               |
| On-site observation and think aloud protocol | Collecting information concerning the environment in which the artifact will be used and collect data related to likeability and user preferences; | Early in the design cycle               |
| Role playing, walkthroughs, and simulations | Evaluation of alternative designs and gaining additional information about user need and expectations; or prototype evaluation | Early and mid-point in the design cycle |
| Smarty o meter                    | Measure the children level of preference of opposed to simply asking them their preference. The children given five smarties (chocolate sweets) and asked to distribute them between the options. | Mid-point and final stage of the design cycle |
| Usability testing                 | Collecting quantitative data related to measurable usability criteria    | Final stage of the design cycle         |

Table 2-1: Ways to involve users in the design development of a product/artifact
2.4 Design principles of e-learning games for children

Research into design for children crosses over into several disciplines; human-computer interaction, education, and psychology researchers have all made significant contributions in the area. However, none of this has provided design principles relating to how to design e-learning games for children. This section provides a classification of design principles and insights which have been used as a starting point for the development of a more reliable set of principles that can be used in the design of e-learning games.

1. Interface
Children aged 9-11 may not fully understand text-based instructions. Conventional interfaces include menus and help functions that are text-based, making them inappropriate for young users. Interfaces that require textual input can also be problematic. Children can be very creative spellers, making it difficult for an interface to recognize text input (Druin et al., 2001).

Hanna et al. (1999) present several interface design guidelines for children’s technology based on their experience with developing children’s software. To deal with varying literacy levels, they suggest presenting instructions in an age-appropriate format and including the option of having text instructions read aloud, as most children are not accustomed to reading on a screen. They also suggest that instructions should be easy to remember and should avoid making use of concepts unfamiliar to children. Alternately, on-screen characters can speak instructions with corresponding animations. This method is especially useful because it directs attention and helps in understanding (Chiasson and Gutwin, 2005).

The visual communication used in e-learning material, as Gillani (2000) puts it, should attract different students. She argues that in African cultures the use of bright colours is often preferred. Fiore (1999) found that girls like a lot of detail and bright colours, whereas boys prefer darker colours. Also good quality pictures and videos are necessary to capture the interest and attention of young people (Agusto, 2001). In addition, visual communication should be clear and easy to understand.
The position of the menu and icons is a relevant issue when a language that must read vertically or from right to left is involved (Henderson, 1996; Reeves, 1997; Gillani 2000; Heemskerk et al., 2005).

As indicated by Druin et al. (2001) children (aged 5-10 years) have difficulty with abstract concepts, and may not have the in-depth content knowledge required to navigate complex interfaces. Their usual approach is trial-and-error: once they find a method that works, they are unlikely to look for a more efficient strategy or for advanced options.

Regarding the interactivity of the interface, children are accustomed to direct manipulation interfaces. Their actions should map directly to the actions on the screen. If other styles are used, most users will require training and some will be unable to grasp how the interaction works (Johnson et al., 1999; Plaisant et al., 2000). Moreover, Druin et al. (2001) added that mouse interactions should be as simple as possible. One-click interfaces are easier than dragging or double clicking. Hourcade et al. (2004) and Druin et al. (2001) said that all mouse buttons should have the same functionality.

2. Audio

Two issues concerning the audio aspects of e-learning materials are addressed. Firstly, the use of voice is taken into account. It is preferable that the accents used be familiar to the students (Royer et al., 1994). Secondly, it is suggested that the sound track should include a variety of sounds and music styles (Gillani, 2000).

3. Instructional structure of the e-learning material

The instructional structure of e-learning material refers to the extent to which different levels of students are taken into account. E-learning materials should offer instruction or tasks at various levels of difficulty in order to allow the student to seek help from peers or adults (Maurer and Davidson, 1999) and should accommodate students’ preferred learning strategies (Heemskerk et al., 2005). Hanna et al. (1999) add that activities should start out simple, and then increase in complexity and difficulty as the child masters the required skills. Hence, activities should allow for expanding
complexity, and should support children as they move from one level to the next in use of the product (Sedighian and Klawe, 1996; Hanna et al., 1999).

4. Feedback and Guidance

Children expect to see the results of their actions immediately (Rosas et al., 2003; Fisch, 2005). Said (2004) found that children (9-14 yrs) expect their actions to be immediately reflected on the screen and that feedback should be given in a timely fashion. If nothing happens after their input, children may repeat their action until something does occur (possibly causing a chain of unexpected and unwanted events) (Chiasson and Gutwin, 2005). Although constant auditory and visual feedback can be annoying for adult users, children often expect it.

Being able to use the e-learning game without instruction is also important for children. Children can not be expected to read a manual to learn how to use a game; the game must either be entirely intuitive or provide some form of guidance through tasks. Effective games weave objects and characters into a game environment that provide feedback for successful game play (Fisch, 2005).

Chiasson and Gutwin (2005) added that visual or audio feedback should be present when children move their mouse over clickable portions of the screen to indicate what is clickable and what is not.

5. Motivation

Several means of motivating children through computer games have been investigated. One concrete way researchers have found to motivate children is through the use of entertainment click-ons (or ‘hotspots’). These are active regions on the screen that reward users who click on them by displaying an animation, sound effect, or other multimedia response. Children spend a significant amount of time finding and revisiting click-ons, usually as a break from other tasks. Super et al. (1996) studied the success of entertainment click-ons in an educational mathematics game called “Counting on Frank”. They found that children (8-12yrs) used the click-ons most after periods of maths-focused activity and that click-ons offering multiple responses, humour, and
multimedia were most enjoyable and popular. They also determined that screen position and type of on-screen object affected the likelihood of finding the hotspot.

A second motivational tool for children’s e-learning game is having an on-screen animated character. Lester et al. (1997) investigated the use of animated pedagogical agents by including such an agent in an educational product teaching children about plants. Five versions of “Herman the Bug” were used, ranging from a muted agent to a fully expressive one. They found that simply having an animated character on the screen while children (12-14yrs) worked on an educational task positively affected children’s experiences and encouraged them to use the software more frequently.

Another key factor in children’s applications is the use of extrinsic rewards (Hanna et al., 1999). While designing tasks that offer intrinsic rewards is ideal, where solving a problem or learning a new skill is reward in itself, often this motivation is not enough to sustain children’s interest. In children’s technologies, extrinsic rewards often come in the form of multimedia messages, scoring systems, and bonus activities. These rewards should be consistent and available even if children repeats the same problem or activity levels, as they will often fail at more advanced levels and need to re-experience success to gain confidence for moving forward.

Pausch et al. (1992) also uncovered the importance of having extrinsic rewards such as a scoring system in children’s games. Their study examined the effectiveness of alternative input devices: children (6-17yrs) played a version of the well-known “Pong” game that originally did not display a score on the screen. They found that the children wanted a score displayed and in its absence kept score themselves by counting. The score display was later added to keep children focused on the task.

Enabling social interaction may motivate children to use the e-learning material. Kaplan et al. (2004) found that older children (10-14yrs) wanted the ability to communicate digitally with others while reading and working within a digital library, even when they were located in the same room. In the absence of such features, they resorted to alternating between two applications – the digital library and an instant messenger.

Furthermore, children naturally group around one computer to work together even when they have their own computers (Inkpen et al., 1995), they enjoy playing together
and like to share their experiences with friends and family (Druin, and Inkpen, 2001). They are often more successful as a result of this collaboration (Danesh et al., 2001).

2.5 Discussion and Conclusion

This chapter commenced with an overview of the rationale of integrating ICT in education as a tool or as a subject in order to explain why educators and researchers might be interested in addressing issues associated with such integration.

Literature indicated that most studies have focused on the use of ICT as a tool to support other subjects and its impact on the learning and teaching process. Also Ofsted (1999) inspection evidenced that the ICT curriculum was the least well taught compared to other subjects. Although the literature considered reasons behind challenges and obstacles of integrating ICT in education (as a tool and as a subject), none of the reviewed literature associate these challenges or obstacles with the low level of teaching ICT. Thus, in order to improve the teaching of the ICT curriculum, there is a need to identify how ICT is being taught in schools, and whether the reasons behind the obstacles of ICT integration indicated in the literature are responsible of the lower quality of ICT teaching. Chapter 3 investigates the current teaching practices associated with the ICT curriculum in UK and Chapter 7 reveals the result of a similar investigation conducted in Saudi Arabia1.

According to the literature, and before identifying current teaching practices, it was hypothesised that e-learning can be used to support teachers to improve the teaching of ICT curriculum, as it is being used effectively in other subjects. This will be discussed in more details in Section 3.5. The intention of the research was to explore whether e-learning could be used to improve the teaching of the ICT curriculum to young children.

As the target audience’s main use of ICT is computer games, and the evidence discussed in this chapter proved educational games to have a positive impact on children learning. The e-learning material developed in the present research is developed will be in the form of a game.

1 Saudi Arabia is considered as results conducted in UK will be transferred to Saudi Arabia
Literature associated with the design of e-learning material for children showed that there are few clear rules and directions for the design of e-learning material, the focus is placed on the content of the material rather than teaching strategy, in addition to the lack of sufficient analysis of the context and user needs (Triantafyllidis and Mitropoulou, 2005).

The literature also indicated that available materials are poorly designed. Therefore, there is a need to identify the current design practices in the e-learning producing companies in order to determine reasons that might lead to the production of poor quality material which does not satisfy the teacher’s requirements. Hence, teacher’s requirements for e-learning materials should also be considered. This is discussed in detail in Chapter 4.

In addition, this research seeks to identify elements of effective e-learning design. Two elements of effective e-learning game design have been identified: the need to accommodate different teaching styles and to satisfy user requirements.

Children's requirements might be ascertained through adopting a more child centred design approach to the creation of material. This might lead to a more effective, usable design which increases engagement and therefore learning. However, no research has been found that proposes a child centred design approach to the development of e-learning material especially in relation to the ICT curriculum. Thus, the aim is to enhance design practice by developing a method that will increase the teacher’s and children's satisfaction of teaching and learning ICT (Section 1.2).

Design principles identified from the literature will feed into the design process. The Child Centred Design process could confirm whether the design principles identified in the literature could be applied to designing an e-learning game for the target age group.
CHAPTER 3: AN INVESTIGATION OF THE CURRENT ICT TEACHING PRACTICES IN UK

This chapter presents two field studies conducted to gain an understanding of the current teaching practices and techniques used in teaching ICT as a subject in UK primary schools. A similar investigation was undertaken in Saudi Arabia and is presented in Section 7.2, with a comparison to the findings of the UK studies.

The following sections introduce the rationale for these studies, the methods used to achieve the specified objectives, the results, and a discussion of these in relation to the overall objectives of the research.

3.1 Introduction

Information Technology became a subject in its own right in 1995 (Department for Education, 1995) and was renamed Information and Communication Technology (ICT) in England, but its content was left largely unchanged. Later, IT capability was described in the Information Technology National Curriculum (DfEE, 1995) in terms of communicating and handling information; modeling; measuring and control.

In 1996, the Education Act defines a programme of study as the ‘matters, skills and processes’ that should be taught to pupils of different abilities and maturities during a specific key stage. Table 3-1 provides the programme of study which specifies what pupils should be taught in ICT at key stage 2 and the basis for planning schemes of work.

The attainment target for ICT in Table 3-2 sets out the ‘knowledge, skills and understanding that pupils of different abilities and maturities are expected to have by the end of each key stage as defined by Education Act in 1996.

Each level description describes the types and range of performance that pupils working at that level should characteristically demonstrate.

The level descriptions provide the basis for making judgements about pupils’ performance at the end of key stages 1, 2 and 3. At key stage 4, national qualifications
are the main means of assessing attainment in ICT. Table 3-3 shows the expected levels for each key stage.

<table>
<thead>
<tr>
<th>Knowledge, skills and understanding</th>
<th>1. Finding things out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils should be taught:</td>
<td></td>
</tr>
<tr>
<td>a. to talk about what information</td>
<td></td>
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<tr>
<td>they need and how they can find</td>
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<tr>
<td>and use it [for example, searching</td>
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<tr>
<td>the internet or a CD-ROM, using</td>
<td></td>
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<tr>
<td>printed material, asking people]</td>
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<tr>
<td>b. how to prepare information for</td>
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<tr>
<td>development using ICT, including</td>
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</tr>
<tr>
<td>selecting suitable sources, finding</td>
<td></td>
</tr>
<tr>
<td>information, classifying it and</td>
<td></td>
</tr>
<tr>
<td>checking it for accuracy [for</td>
<td></td>
</tr>
<tr>
<td>example, finding information from</td>
<td></td>
</tr>
<tr>
<td>books or newspapers, creating a</td>
<td></td>
</tr>
<tr>
<td>class database, classifying by</td>
<td></td>
</tr>
<tr>
<td>characteristics and purposes,</td>
<td></td>
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<tr>
<td>checking the spelling of names is</td>
<td></td>
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<tr>
<td>consistent] to interpret</td>
<td></td>
</tr>
<tr>
<td>information, to check it is</td>
<td></td>
</tr>
<tr>
<td>relevant and reasonable and to</td>
<td></td>
</tr>
<tr>
<td>think about what might happen if</td>
<td></td>
</tr>
<tr>
<td>there were any errors or omissions.</td>
<td></td>
</tr>
</tbody>
</table>

| 2. Developing ideas and making     |                      |
| things happen                      |                      |
| Pupils should be taught:           |                      |
| a. how to develop and refine ideas |                      |
| by bringing together, organising   |                      |
| and reorganising text, tables,     |                      |
| images and sound as appropriate    |                      |
| [for example, desktop publishing,   |                      |
| multimedia presentations]          |                      |
| b. how to create, test, improve    |                      |
| and refine sequences of instructions|                      |
| to make things happen and to        |                      |
| monitor events and respond to them |                      |
| [for example, monitoring changes in |                      |
| temperature, detecting light levels |                      |
| and turning on a light]            |                      |
| c. to use simulations and explore   |                      |
| models in order to answer ‘What if  |                      |
| ...?’ questions, to investigate     |                      |
| and evaluate the effect of         |                      |
| changing values and to identify    |                      |
| patterns and relationships [for     |                      |
| example, simulation software,       |                      |
| spreadsheet models].                |                      |

| 3. Exchanging and sharing          |                      |
| information                         |                      |
| Pupils should be taught:            |                      |
| a. how to share and exchange       |                      |
| information in a variety of forms,  |                      |
| including e-mail [for example,      |                      |
| displays, posters, animations,      |                      |
| musical compositions]               |                      |
| b. To be sensitive to the needs of |                      |
| the audience and think carefully    |                      |
| about the content and quality when  |                      |
| communicating information [for      |                      |
| example, work for                    |                      |
presentation to other pupils, writing for parents, publishing on the internet].

4. **Reviewing, modifying and evaluating work as it progresses**

Pupils should be taught to:

a. review what they and others have done to help them develop their ideas
b. describe and talk about the effectiveness of their work with ICT, comparing it with other methods and considering the effect it has on others [for example, the impact made by a desktop-published newsletter or poster]
c. Talk about how they could improve future work.

5. **Breadth of study**

During the key stage, pupils should be taught the knowledge, skills and understanding through:

a. working with a range of information to consider its characteristics and purposes [for example, collecting factual data from the internet and a class survey to compare the findings]
b. working with others to explore a variety of information sources and ICT tools [for example, searching the internet for information about a different part of the world, designing textile patterns using graphics software, using ICT tools to capture and change sounds]
c. Investigating and comparing the uses of ICT inside and outside school.

Table 3-1 : Programme of Study : Information and Communication Technology
(National Curriculum Online Version)

**Level 1**

Pupils explore information from various sources, showing they know that information exists in different forms. They use ICT to work with text, images and sound to help them share their ideas. They recognise that many everyday devices respond to signals and instructions. They make choices when using such devices to produce different outcomes. They talk about their use of ICT.

**Level 2**

Pupils use ICT to organise and classify information and to present their findings. They enter, save and retrieve work. They use ICT to help them generate, amend and record their work and share their ideas in different forms, including text, tables, images and sound. They plan and give instructions to make things happen and describe the effects. They use ICT to explore what happens in real and imaginary situations. They talk about their experiences of ICT both inside and outside school.
<table>
<thead>
<tr>
<th>Level 3</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Pupils use ICT to save information and to find and use appropriate stored information, following straightforward lines of enquiry. They use ICT to generate, develop, organise and present their work. They share and exchange their ideas with others. They use sequences of instructions to control devices and achieve specific outcomes. They make appropriate choices when using ICT-based models or simulations to help them find things out and solve problems. They describe their use of ICT and its use outside school.</td>
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<tr>
<th>Level 4</th>
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<tbody>
<tr>
<td>Pupils understand the need for care in framing questions when collecting, finding and interrogating information. They interpret their findings, question plausibility and recognise that poor-quality information leads to unreliable results. They add to, amend and combine different forms of information from a variety of sources. They use ICT to present information in different forms and show they are aware of the intended audience and the need for quality in their presentations. They exchange information and ideas with others in a variety of ways, including using e-mail. They use ICT systems to control events in a predetermined manner and to sense physical data. They use ICT-based models and simulations to explore patterns and relationships, and make predictions about the consequences of their decisions. They compare their use of ICT with other methods and with its use outside school.</td>
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<table>
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<tr>
<th>Level 5</th>
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<tbody>
<tr>
<td>Pupils select the information they need for different purposes, check its accuracy and organise it in a form suitable for processing. They use ICT to structure, refine and present information in different forms and styles for specific purposes and audiences. They exchange information and ideas with others in a variety of ways, including using e-mail. They create sequences of instructions to control events, and understand the need to be precise when framing and sequencing instructions. They understand how ICT devices with sensors can be used to monitor and measure external events. They explore the effects of changing the variables in an ICT-based model. They discuss their knowledge and experience of using ICT and their observations of its use outside school. They assess the use of ICT in their work and are able to reflect critically in order to make improvements in subsequent work.</td>
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<th>Level 6</th>
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<tbody>
<tr>
<td>Pupils develop and refine their work to enhance its quality, using information from a range of sources. Where necessary, they use complex lines of enquiry to test</td>
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</table>
hypotheses. They present their ideas in a variety of ways and show a clear sense of audience. They develop, try out and refine sequences of instructions to monitor, measure and control events, and show efficiency in framing these instructions. They use ICT-based models to make predictions and vary the rules within the models. They assess the validity of these models by comparing their behaviour with information from other sources. They discuss the impact of ICT on society.

**Level 7**

Pupils combine information from a variety of ICT-based and other sources for presentation to different audiences. They identify the advantages and limitations of different information-handling applications. They select and use information systems suited to their work in a variety of contexts, translating enquiries expressed in ordinary language into the form required by the system. They use ICT to measure, record and analyse physical variables and control events. They design ICT-based models and procedures with variables to meet particular needs. They consider the benefits and limitations of ICT tools and information sources and of the results they produce, and they use these results to inform future judgements about the quality of their work. They take part in informed discussions about the use of ICT and its impact on society.

**Level 8**

Pupils independently select appropriate information sources and ICT tools for specific tasks, taking into account ease of use and suitability. They design successful ways to collect and prepare information for processing. They design and implement systems for others to use. When developing systems that respond to events, they make appropriate use of feedback. They take part in informed discussions about the social, economic, ethical and moral issues raised by ICT.

**Exceptional performance**

Pupils evaluate software packages and ICT-based models, analysing the situations for which they were developed and assessing their efficiency, ease of use and appropriateness. They suggest refinements to existing systems and design, implement and document systems for others to use, predicting some of the consequences that could arise from the use of such systems. When discussing their own and others’ use of ICT, they use their knowledge and experience of information systems to inform their views on the social, economic, political, legal, ethical and moral issues raised by ICT.
The National Curriculum (1990) for England and Wales called for all subjects to use Information Technology. Accordingly most of the research has focused on how using ICT as a tool can contribute to the development of pupils understanding across the curriculum, rather than the development of pupils understanding of ICT as a subject within the curriculum.

Although pupils are required to apply their IT know-how in other lessons, little emphasis has been placed on how they are actually taught ICT. It was widely assumed that IT capability would be developed through a hybrid approach involving both discrete IT lessons and across-curriculum dimensions (Hammond, 2004). However, it is unclear how young pupils pick up the skills and techniques necessary to do this. Teachers, who have subject expertise for example in geography, may not have a sufficient level of competence (or time) to teach ICT in their lessons. Therefore, it must be assumed that children pick up basic skills in ICT lessons, and transfer this learning to other classes. Given that the teaching of ICT is not always of high standard (Hammond, 2004; Robertson, 2002), an investigation of how ICT is taught was needed in order to understand why ICT was rated as the least well taught subject by Ofsted in 1999. Such an investigation would reveal ways in which its teaching could be improved.

In order to find out about this, an observational study of children in ICT lessons, and semi formal interviews with Keystage 2 teachers were undertaken. The aim of these studies was to determine how the ICT curriculum is delivered in ICT lessons in primary schools.

This was broken down into the following objectives:

1. To explore current teaching practices of the ICT curriculum.
2. To determine what e-learning materials are used to support teaching in the ICT curriculum.
3. To identify the problems and difficulties of teaching the ICT curriculum.
The conclusions drawn from the studies will fulfill the first research objective mentioned in Section 1.2, which is to investigate current teaching methods, practices, and e-learning with respect to the ICT curriculum in primary schools in the UK and Saudi Arabia. A similar study of Saudi schools is described in Section 7.2. The conclusions will be used in the subsequent stages of the research to provide a case for the development of e-learning material for 9-11 year olds to support the teaching of ICT curriculum. More details about the development of this can be found in Section 5.3.

3.2 Methodology

Schools in the West Midlands were targeted as a convenience sample for the two studies. Using the Ofsted reports available on the Internet, 120 schools, varying in terms of socio-economic catchments areas, levels of IT experience, resourcing, and quality of educational provision were contacted either by post, fax, telephone or e-mail (See Appendix A.1 for a sample of the letter sent to schools). The correspondence explained the purpose of the research and asked whether the school would like to participate in it. Additional letters were sent until the required sample size of 15 primary schools was reached. The number of pupils in the sample schools ranged from 142 to 481; the pupils came from areas ranging from high to low levels of social deprivation; the teaching across the curriculum as indicated in the Ofsted reports was rated as satisfactory, although some schools fell below average in core subjects such as Mathematics or English. Pupils' achievement in ICT in the sample schools varied from good to below standard, and the use of ICT across curriculum was found to be either good or satisfactory in schools where this was specifically mentioned. See Appendix A. 2 for more details about the schools.

The schools were visited three times during the autumn term of 2005. The visits were broken down as follows:
Visit one: Observation of a total 18 ICT lessons in Years 5 and 6, to understand how ICT was taught.
Visit two and three: Follow up interviews with the teachers of the observed lessons in order confirm the results of the study and gain a wider view of the teachers beliefs on observed practices, to assess the extent to which the results could be generalized.
3.3 Study 1: Classroom observation

Classroom observation was chosen as a research method in order to discover what actually occurs in lessons. 18 ICT lessons (taught in the ICT suite) were observed in order to determine issues which might influence teaching and learning.

The objective of the observations was to understand the methods, techniques and technologies used in teaching ICT.

These allowed documentation of the teaching methods used. Observations were made from the back or middle of the classroom (when tables were arranged in a 'u' shape) in order to see all interactions clearly. Sometimes, with the agreement of the teacher, the researcher participated in the lesson by encouraging pupils to rethink, or to guide them to the correct answers. In addition, pupils were asked for more explanation if critical actions or comments were observed while they used the computers.

Immediately after the lesson a short, 50-120 words, descriptive synopsis of the lesson were made concentrating on key events, to enable contextualization of the discussion of events with teachers. These descriptive synopses were written from memory and field notes, using an observational record form as a guide (Appendix A.3). These were analyzed to draw out significant or critical moments or episodes with respect to the teaching and learning of ICT, teacher's practice, pupil's reactions and ICT skills.

3.3.1 Results

16 out of 18 of the observed lessons of year 5 or 6 students were related to the "Multimedia" Presentation Unit. Table 3-4 provide details of the Multimedia Presentation Unit as provided by the QCA (Qualification and Curriculum Authority) schemes of Work Website. The other 2 lessons were about adding images to Microsoft word documents. These lessons were the ones which occurred naturally at the schools in that term. The interviews with the teachers confirmed that the lessons observed were "typical" in terms of the approach of teaching, techniques used and the concentration

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1 Multimedia is the use of a combination of different media of communication; simultaneous presentation of several visual and/or sound entertainments.
on “how” skills and hence the results could be generalized to the teaching of ICT in Keystage 2.

ABOUT THE UNIT

In this unit children learn to create a multimedia presentation using text, images, and sounds. They will be taught to create links between pages and show sensitivity to the needs of their audience.

Children will apply what they have learnt in this unit when communicating and presenting information in music, art, history, geography, science, design and technology.

**Integrated task:** to use a multimedia authoring program to organise, refine and present information in different forms for a specific audience

WHERE THE UNIT FITS IN

Children may have created individual multimedia pages in earlier units.

This unit assumes that children are familiar with tree diagrams.

**TECHNICAL VOCABULARY**

- interactive
- hot spot/hyperlink
- attach
- hypertext

**Additional vocabulary:**

- action button
- link

**RESOURCES**

- Microphone
- CD-ROMs (Internet browser)
- printouts of sample pages

**Additional Resources:**

- PowerPoint
- Clicker5
- Textease
- Digital camera
- Movie camera

EXPECTATIONS at the end of this unit

**Most children will:**

- use a multimedia authoring program to organise, refine and present a set of linked multimedia pages, which incorporate images, sounds and text

**some children will not have made so much progress and will:**

- use a multimedia authoring package to assemble images, sound and text on a multimedia page

**some children will have progressed further and will:**

- use a multimedia package to organise, refine and present a set of linked multimedia pages, which incorporate images, sounds and text; create pages which offer users a variety of options; present information that matches the needs of the audience

<table>
<thead>
<tr>
<th>Learning Objectives</th>
<th>Possible Teaching Activities</th>
<th>Learning Outcomes</th>
<th>Points to Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting the sense</td>
<td><strong>Discuss with the class the difference between a CD-ROM, books and videos, and demonstrate that a CD-ROM includes a range of media and offers the user different options.</strong></td>
<td><strong>Understand that a presentation conveys meaning and is intended for a specific audience.</strong></td>
<td>Children should be encouraged to think about the advantages and disadvantages of multimedia and how it compares with other forms of communication such as telling a story.</td>
</tr>
<tr>
<td></td>
<td><strong>Discuss how these options address the needs of different audiences.</strong></td>
<td><strong>Understand the potential of Multimedia</strong></td>
<td></td>
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</tbody>
</table>

**Short focused tasks**
| Technique: to design multimedia pages | • Show the class a variety of multimedia page designs. Discuss how emphasis and location help the user understand the page, e.g. how buttons are placed consistently, how bright colours and sizes are used to indicate importance, how picture and text complement each other.  
• Ask the children to evaluate a CD-Rom or internet home page and list the features which they think work or do not work. | Recognise the features of good page design | Features of good design include buttons placed consistently, easy to understand icons, clarity, appropriate use of pictures and text, appropriate use of colour. |
| Technique: to sample sounds | • Demonstrate how to record sounds using a microphone and how to create a button which plays the sounds  
• Divide the class into groups and ask them to create a page which includes a menu of sounds. | Create a page of sounds which are activated by appropriately named positioned buttons | If a microphone is not available, appropriate sound could be dragged and dropped from a CD-Rom |
| Technique: to produce a diagram that shows the links between pages | • Demonstrate how buttons can create links between pages. Prepare a set of A4 sheets showing sample multimedia pages without links. The set should include a menu page and pages which lead to a number of following pages.  
• Ask the children to work in groups to identify the links between the pages, draw on any necessary buttons and write next to the buttons the page to which they link.  
• Ask each group to produce a flow chart showing the links between the pages. | Organise sample screens and identify appropriate choices and links. | Children who find connecting pages easy to understand could be introduced to the idea of branching structures and web-link structures |

**Integrated Task**

**To use Multimedia Authoring Program to organize, refine and present information in a different form for a specific audience**

Explain to the class that they will use what they have learnt to create a multimedia presentation, which includes images, sounds and text. Divide the class into small groups and ask each group to choose a subject for their presentation and to describe their audience. Ask each group to draw a diagram of their presentation, showing how the pages link. Children should then design their pages on screen and print out their results.

**Design pages and links which present the user with clear information**

Schools with internet links could use electronic mail to share sound, text and graphic attachments with other schools.

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**Table 3-4 : Multimedia Presentation Unit QCA Scheme of Work**
The lessons were observed to have two parts; a teacher centred and pupil centred part. During the teacher centred part, all the teachers applied traditional teaching methods (face to face teacher centred teaching, where the teacher conveys information in written and oral form directly to passive students) (Abu Hassana, and Woodcock, 2006a). Microsoft Office (Word and PowerPoint) was the only application used.

During this part of the lesson, the teacher demonstrated the commands needed to perform a specific task on the computer application (e.g. insert an image in a word document) using a projection screen. 16 out of 18 lessons took place in the ICT suite and 2 in a classroom, as the ICT suite was not equipped with a projection screen. In 17 of the lessons, teachers focused on the techniques required to perform the tasks (See Table 3-4 for examples of the techniques). These were illustrated directly on the computer application. Only one of the teachers used PowerPoint to set the scene (see Table 3-4 for details about the key ideas involved in the scene of the lesson) by presenting the lesson objectives, providing examples of finished work, and illustrating where and when the skills could be used. None of the teachers used additional supportive e-learning materials during the ICT lessons. So, the lesson was not about ICT in general but how to use a specific piece of software.

During the pupil centred part of the lesson, the students were required to perform the specified task. This was either an oral request or the pupils were given a work sheet. Pupils worked on their PCs to practice the required technical skills. However, no more than 4 children were seen working individually on computers, the rest of the class worked with a peer on a single computer, due to the lack of PCs in the ICT suite.

All the questions asked by children related to difficulties in performing the task such as, how can I insert a new slide, how I can move the text box. In 2 of the lessons, the teachers sat on their PC and answered the pupils' questions by demonstrating material on the projection screen, while the other teachers moved around the class, looking at work and answering questions by demonstrating on individual PCs.

In 16 of the lessons the teacher's feedback was limited to the technical aspects of the work. For example in developing a multimedia presentation, the feedback focused on technical skills such as how to insert images and how to format them and not the
appropriateness of the design, its fitness for purpose, or how the elements related to each other.

The following section describes the activities of the ICT lesson in more detail:

3.3.2 Teacher Centred Part of the Lesson

Example one; occurred in three of the observed lessons in Year 6. The lesson was the first one from the Multimedia Presentation Unit. This was particularly interesting as the game produced in this research would cover this topic. The lesson was about introducing the key idea that computer software can include a range of media and gives the user a range of options. For details about the possible activities and learning outcomes included in the lesson please refer to Table 3-4. In order to allow children to achieve the intended learning outcome of the lesson which is to understand the potential of multimedia the following objectives should be considered:

1. Understand the definition of multimedia, particularly the difference between multimedia and other forms of media (What is multimedia?).
2. Understand the advantages and disadvantages of multimedia (why use a multimedia presentation?)
3. Identify the purposes of Multimedia presentations (where multimedia presentations can be used?)
4. Understand that the multimedia presentation is designed for a specific audience (who is it for?)

In order to achieve the intended learning outcomes, a possible activity is to discuss with the class a range of materials to try to initiate comparisons between the way information is presented in books and CD-ROMs. This will lead to a consideration of:

- How much interactivity exists?
- When is it better to use a CD-ROM rather than a book?
- When is a book better than a CD-ROM?
- How the materials meet the needs of the users.
- Look specifically at occurrences of:
  - Sound
  - Text
  - Video
• Still images

However, teachers focused on technical skills such as how to start a new presentation file, how to insert text and images into a PowerPoint slide, by copying material from internet pages, using the projection screen to demonstrate how to do this to the whole class. Afterwards the students were asked to practice the demonstrated skills by creating PowerPoint slides about a given subject by copying and pasting from a specific website.

Example two; this occurred in 5 of the lessons in Year 6, the objective was to design multimedia pages. In order to allow children to achieve the intended learning outcome of the lesson which is to recognize the features of good page design, the following objectives should be considered:

1. The features of good design such as background colours, font size, format and the appropriateness of the design to the audience;
2. The compatibility of the multimedia presentation slide content (i.e. how pictures and text complement each other);
3. Show sensitivity to audience needs and requirements;

In order to achieve the intended learning outcome which is to recognize the feature of good page design, possible activities are to show the class a variety of multimedia page designs and assess their elements such as how emphasis and location help the user understand the page, how buttons are placed consistently, how bright colours and sizes are used to indicate the importance and the suitability of the slide content to the purpose and the needs of the audience.

However, teachers demonstrated the skills of copying and pasting contents from a pre-existing Word document to a PowerPoint slide. Again, after the teacher demonstrated what to do the children were asked to create their own multimedia presentation in a similar way. The focus in this case was on how to open an existing file, copy and paste text from a Microsoft application to another one, changing text format and saving files. Teachers did not consider issues of content complementation, content placement or layout decisions.
Example three, in 2 year 6 lessons the objective was to create buttons to link pages. In order to allow children to achieve the intended learning outcome of the lesson which is to organize sample screens and identify appropriate choices and links, the following objectives should be considered:

1. Demonstrate how buttons can create links between pages.
2. Children should be able to identify the links between the pages;
3. Plan and produce a flow chart showing the links between the pages;

Possible activities include:

1. Presenting linear and non linear presentations and discussing the differences.
2. Prepare a set of A4 sheets showing sample multimedia pages and organize them according to their links.

However, what actually happens in the lessons is that the teacher demonstrated the technique of how to insert a hyperlink to a website in a multimedia presentation slide. She started by defining what a hyperlink is, and then demonstrated how to copy a URL and paste it as text in to the slides. The teacher asked the pupils to practice this on pre-created multimedia presentations. However, the teacher did not explain why hyperlinks should be added to multimedia presentations or the difficulties this might cause in running the presentation.

In none of these lessons, regardless of the objectives, did the teacher explain what multimedia was: how it is different from other presentation media, why it was appropriate, who it was for, how elements were selected, why specific elements were needed, or the relationship between the text and images in the final presentation or say that each element in the presentation should convey a specific meaning. Most pupils considered that graphical and pictorial information was suitable only for the young or for 'space filling' when insufficient text had been retrieved. It might be argued that students who were successful in these lessons had learnt a technique but this was not underpinned by the knowledge needed to use the technique appropriately.

3.3.3 Pupil Centred Part of the Lesson

The second part of the lesson was based on discovery learning. These parts were more practical, with pupils spending time interacting with the computer. The observations have been grouped under four categories as below:
1. Pupils’ questions

Pupils’ questions related to how to perform the required task (such as, "How can I log in?", "It does not allow me to log in", "How can I paste the image?", "How can I add an image?", "How can I open this page?" etc). None of the questions concerned why, when, or where such skills should be applied.

2. Assessment and feedback

The teacher did not overtly assess the ICT skills of the pupils or their understanding of why, where and when to use what they had learnt in any of the observed lessons. Teachers assessed pupils’ work only by moving around the PCs and giving them verbal feedback with comments such as; "Good", "Well done" on their technical ability of performing the task and not on the quality of content of the work produced. However, when ICT is used in any lesson across the curriculum if any further feedback was given it would be about the slide content and not the use of ICT. For example, if the presentation was about geography, the teacher’s feedback would be about the geographical information included on the slide and not the layout, design or the appropriateness of the images, text format or better ways of using ICT to reach the target audience or to deliver the message purpose. Rarely was the actual information or communication skills assessed in association with the content or the technical skills.

If pupils faced a technical problem while they are practicing on the computers, all teachers demonstrated the procedure again either to the whole class on the projection screen if more than 4 pupils faced the problem otherwise they demonstrated it just on the machine of the pupil who had the problem.

3. Purpose

Pupils perform the required task. Their objective was to achieve the technical skills demonstrated by the teacher by accomplishing the task, regardless of why or where these skills can be used. This was identified through talking with pupils while they are working on their presentations.
4. Audience and presentation of work

Pupils' time was spent on trying to complete the activity, rather than on considering who they were creating the presentation for.

During the formulation and analysis stage of their task, the majority of pupils seemed totally unaware of the concept of an “audience”. They saw what they were doing as just part of the lesson for their teacher, or perhaps themselves.

In none of the lessons did the pupils present their work, or work towards presenting it. Although pupils saved their work, the teacher indicated that it was not usual for them to present it and that this would only occur if the class had finished their work early.

3.3.4 Conclusions

As observed, ICT is being taught in schools using a blend of the following teaching approaches:

1. Face to face instruction
2. Practice based learning

During the face to face instruction, the focus is on the teaching of technical skills (know how) and demonstrations of how to do a specific task rather than why, where or when such skills might be used. This limits the practical part of the lesson to the practice of the required skills on particular software. Moreover, no additional supportive e-learning material was used by the pupils in any of the observed lessons and ICT itself was used only to present and download material from the internet.

The observational study led to the achievement of the intended objectives which was to explore current teaching practices in ICT lessons, determine whether e-learning materials were used and identify any problems or difficulties in the current teaching practices of ICT. However, there was a need to understand whether the finding held true across the ICT curriculum or whether they just related to the observed lessons. This investigation was made through interviews with teachers. These are discussed in the following section.
3.4 Study 2: Interviews with teachers in primary schools

The aims of this part of the study were to gain a wider perspective of the approach to teaching ICT in order to be able to generalize the results from the observational study and to clarify issues arising from the classroom observations, such as the content of the ICT curriculum, teachers’ problems and difficulties in teaching ICT.

15 teachers were interviewed individually for about half an hour. The researcher guided the discussion around a predetermined schedule, asking direct questions when further clarification was required. See Appendix A.4 for more details about the interview questions. All comments were gathered through open-ended questions and audio-recorded for later transcription. The interviews were transcribed, organized and categorized in relation to the research questions (Miles and Huberman, 1984).

3.4.1 Results

3.4.1.1 ICT curriculum content

All the teachers based their lessons on the National Curriculum attainment targets and level descriptions as shown in Table 3-1 and 3-2. However, two thirds indicated that they ignored those concepts they believed were beyond the understanding of the pupils such as the appropriateness of the presentation to the audience and the compatibility between the text and the images used in the presentation. Others mentioned that they used the National Curriculum as guidance to develop their own lesson plans, regardless of the units. As one of the teachers said “I create my own curriculum according to what I feel is needed to be used in other curricula”, and another one said "I feel that the ICT National Curriculum is above the ability of my students".

An investigation of what teachers feel is the ability of the students and what they think should be taught in the ICT curriculum should be further addressed.

3.4.1.2 ICT curriculum teaching approach

All teachers believed that material learnt in the ICT lessons could be applied across the curriculum.
Teachers used the following lesson plan:

1. Informed students about the objectives of the lesson i.e. what they would be able to do when they had successfully completed the lesson.
2. Made a link to previously produced work.
3. Told the students what tasks had to be completed through a written prompt sheet or verbal description.

All teachers confirmed that they divided the ICT lesson into these parts; during the first part they demonstrated the steps needed to perform the task and in the second part asked pupils' to practice what they had seen.

When discussing the objectives of the lesson, they confirmed that they focused on teaching practical skills. They believed that ICT should be limited to the practical use of technology. However, children should not just be taught how to use ICT but that they should understand why, where, when and who it’s used for.

### 3.4.1.3 Use of E-learning

When asked about the use of e-learning materials to teach the ICT curriculum, the teachers indicated that they had not seen or received any demonstrations of materials that could support this, although 13 out of 15 had seen material that could support the teaching of mathematics and literacy and 8 had used these. 4 indicated that they were aware of e-learning materials that helped pupils improve keyboard skills or their understanding of input and output devices, but they had not used it.

In addition, during one of the classroom observations, one of the students mentioned that a BBC animated tutorial covered the same material as the lesson. This comment was ignored by the teacher, who later commented,

"I don't like such tutorials and I do not think that it is motivating to this age group to just sit down and watch recorded steps of a tutorial!"

Another teacher when asked about the use of e-learning games, online teaching or learning material, argued that these materials were not specific enough to what he wanted to do and contained additional material that he did not want to cover.
Another said,

"I feel that it is not easy for pupils in primary school to understand an animated, recorded tutorial. I prefer to model the tutorial to them rather than using any e-learning material"

When asked about e-learning products associated with the ICT curriculum in particular, they all pointed to the applications such as Microsoft Office.

This confirmed the observer notes regarding the lack of e-learning tools to assist the teaching of ICT.

3.4.1.4 Problems and difficulties of teaching ICT

1. Home use of ICT

All teachers pointed to the inequality of opportunities in accessing ICT outside the school as a major obstacle to teach ICT (Abu Hassana and Woodcock, 2006a). Comments indicated "students who have computers at home are progressing very quickly", "students who have computers at home did not ask for help and usually help their peers" and "It is very difficult for me to plan the lesson in a way that considers the students who have computers and those who do not ".

This confirmed the research presented in the literature review in Section 2.2.2 (McCormick and Moon, 2003; Valentine et al, 2005; Leask and Pachler, 1999; Downes, 1997; Facer et al., 2001).

2. Assessment of ICT skills

All teachers indicated that ICT assessment was limited to the content of the work produced in the ICT lesson and assessment limited to verbal feedback given during the second part of the lesson. However, the teachers also indicated that they did not have a set of criteria to follow for each lesson, so assessment depended on the pupils' demonstration of practical skills.
3. Teacher's ICT training

Regarding their own levels of ICT literacy, 4 indicated that they had not received any ICT training. 11 indicated that their ICT training was limited to practical skills. 2 claimed to have had training with other teachers in the school on how to integrate ICT across curriculum. None had received specific training on how to teach ICT skills. One of the teachers said: "I am trained just on how to use Microsoft Office applications in my school work".

3.4.2 Conclusions

The results confirmed firstly that teachers use a blend of teaching methods that merge face to face demonstration with practice based learning; Secondly, that teachers focus only on one of the aspects of the ICT curriculum stated in the National Curriculum i.e. the technical skills (such as, opening a word document, copying and pasting text and images from word document to PowerPoint presentation) and not the purposes or the context of using these skills. Thirdly, e-learning material was not used in delivering communication and information skills. Fourthly, several problems were identified with teaching the ICT curriculum such as the different levels of pupils' ability, lack of teacher training, and lack of ICT skills assessment.

Although several researchers have pointed to the gap between home and schools use of ICT, and lack of teachers ICT training they did not relate these problems to the low ratings indicated by Ofsted inspections in 1999. This research assumes that these problems might be the reason behind that inspection.

The problem of different levels of pupils’ ability due to their use of ICT outside school is partly being solved by government initiatives to provide pupils with laptops, and the availability of affordable PCs.

The lack of teachers ICT knowledge and skills in teaching the ICT curriculum might have led to a focus on technical skills. To overcome this, training could be provided.

In addition, supportive e-learning material could be provided that would address those required components of the ICT National Curriculum which are not currently covered in
lessons such as knowledge and understanding relating to when, why, and where to use the acquired technical skills. Refer to Table 3-1 for details about the ICT National Curriculum programme of study.

The results conducted from the interviews clarified the content of the ICT curriculum, the delivery approach with special regards to the use of e-learning materials and identified problems associated with teaching ICT in primary schools. This complements the results of the observational studies in relation to the first objective of the research (i.e. to investigate current teaching methods, practices, and e-learning with respect to the ICT curriculum in primary schools in the UK).

3.5 General discussion

The two studies described in this chapter investigated the current teaching methods, and practices with respect to the ICT curriculum in UK primary schools. Such an investigation was needed to identify areas in which the quality of the teaching of ICT as a subject could be improved. It is believed that some of the problems noted might have led to the poor rating of ICT by Ofsted. This could help in finding solutions to improve the teaching of ICT curriculum in primary schools.

The findings revealed that teachers provide a mix of whole class teaching and hands on activity; teacher directed and pupil directed learning. The approach currently used would seem to be sympathetic to recent government guidelines on teaching ICT as a subject in England and Wales through the publication of advisory schemes of work (Qualification and Curriculum Authority, 2001). However, the approach is not tailored to the needs of the teacher or the age group of the pupils as several problems have been identified in the teaching of ICT curriculum primary schools.

Firstly, teaching is focused on the technical skills and not the task that needs to be done. QCA defined the ICT curriculum to include a blend of technical know how with conceptual understanding of information gathering, modeling, control and communicating in order to solve real world or simulated problems (Department for Education and Skills, 2002). The expected level of achievement for the majority of pupils at the end of key stage 2 at age 11 is level 4 (refer to Table 3-2 and 3-3) which includes being able to use ICT to present information to show they are aware of the
intended audience and the need for quality in their presentations. However, teachers focused on a narrow set of skills. They focused on the development of techniques (such as cut, copy and paste), but did not underpin this with information about how to apply these appropriately to the tasks in hand. For example, teachers demonstrated how to copy material off the web using cut and paste, but not how to use the inserted material to its best advantage in a presentation for a specific audience. Overall such activities tended to focus on lower order skills, such as carrying out procedures, rather than higher order ones such as synthesizing and analyzing information (Hammond and Mumtaz, 2001). This can hinder understanding of why, where and when ICT should be used. Thus, the pedagogic potential of ICT is reduced by focusing on the use of lower order computer skills such as mastery of software procedures.

As indicated by QCA, key stage 2 pupils should develop their research skills and decide what information is appropriate for the purpose of their work and how to present it in such a way that it suits its audience. However, there is little emphasis on the purpose of using technology to create a piece of work. For example, activities with a weak focus on purpose involved the mechanistic transformation of data, e.g. entering a prepared text into a word processor and changing the formatting in a prescribed fashion. Moreover, the audience did not appear to be a major consideration of any of the pupils observed or questioned. This may have stemmed from the feeling that the majority of school work is always for the same audience (the teacher). Awareness of audience is quite a difficult concept for children to grasp since it requires them to understand how their work may be viewed through the eyes of a third party. It is somewhat easier for them to target a peer group audience on a wider scale when first producing multimedia. At least they have a more real insight into the needs, likes and dislikes of their own peer group by thinking about what they themselves respond to. However, in the lessons I observed, even this audience of peers was generally not considered.

Secondly, ICT assessment is limited either to the content of the ICT work or to the technical skills. This is associated with the first problem that teachers focus on the technical skills in their teaching.

Thirdly, home use of ICT; during this study teachers pointed to the difficulty of adopting lessons to the different levels of ability in the class, brought about home use of
computers. This confirmed the literature findings (McCormick and Moon, 2003; Valentine et al, 2005; Leask and Pachler, 1999; Downes, 1997; Facer et al., 2001).

Fourthly, teachers indicated that the ICT curriculum as conceptualized in the DfES teaching framework, school handouts, and worksheets was beyond the ability of the students and difficult for them to implement due to their lack of subject knowledge.

Fifthly, teachers lack of ICT Knowledge. The lack of teachers ICT knowledge might explain why they just focused on technical skills. As they could not be expected to help pupils cope successfully with more complex information skills than they possess. Teachers need not only to acquire the skills of information handling but also to understand the underlying concepts so that they (and subsequently their pupils) can move easily between media.

Two solutions are suggested to overcome these problems. Firstly, provide teachers with ICT training. If the primary school teachers do not have good ICT skills themselves then the learning environment between the teacher and the pupil will be inept (Forcheri and Molfino, 2000). This need was identified by the UK government. Hence, it is now mandatory for all UK primary school teachers to take ICT training via the Department for Education and Employment (DfEE). It was expected that all teachers would be trained by 2002 (Wheeler, 2000). However, training has disappointed teachers and has failed to meet their needs, whatever their level of ICT expertise. A common failing has been the lack of differentiation in the training programmes, to extend the highly competent ICT users, while also meeting the needs of those teachers who have limited confidence. Training has not met the pedagogic need of the teachers to apply ICT to lessons in other subjects (Ofsted, 2002). Also training is limited to technical and integrative skills in the classroom. The integrative training include ICT resource skills such as the ability to timetable lessons, offer learning material, offer examinations, check pupil assignments and other extra curricula activities (Riel, 2000). Wheeler (2000) suggested including skills such as change management, progress monitoring methods, pupil-teacher communication skills, and the use of ICT educational spaces to enable network communications between teacher and pupil.

Where training has not yet started or has failed to meet the needs of teachers, the use of ICT is usually undeveloped. In schools where this is the case, teachers are only too
aware that their lack of confidence and expertise was restricting pupils’ progress in using and applying ICT.

Given that teacher training is focusing on technical and integrative skills this might lead them to continue to teach just technical skills they have been taught. Thus, there is still a need to train teachers on how to teach the ICT curriculum, not only on how to integrate ICT as a tool across curricula.

Secondly, use of e-learning supportive material; BECTA /CAB (Content Advisory Board) (2004) report the ICT curriculum is less served by e-learning products than any other curriculum. As e-learning is used to improve teaching and learning across the curriculum (BECTA, 2006) it could be used to assist in the delivery of information and communication skills, in order to overcome present problems in the teaching of ICT. Such material if appropriately designed could capture young learners' imagination and provide opportunities for them to engage painlessly with underlying concepts of ICT, which may not overtly be taught, such as audience awareness, or the suitability of the produced work to the purpose. Moreover, e-learning material might help teachers to keep a record of the pupils ICT progress not only the final saved version of their work. E-learning material can also provide formative assessment for children in a fun way such as a scoring system of a game. It could even help the teacher look at the level of ICT attainment of the children if they used a log system which records the user performed tasks, and might have a scoring system which reflects the development of the pupils' skills.

Teacher interviews confirmed that the Multimedia Presentation Unit exemplifies the problems found in the wider ICT curriculum; hence, this Unit has been selected to represent the part of the curriculum that will be developed as an e-learning game (See Section 5.2).

Given that no rules or framework exist for designing e-learning material for children in either the UK or Saudi Arabia, the second research objective is to develop an e-learning design process that supports the teaching and learning of ICT in primary schools based on the requirements of the age group, teachers and curriculum in a British primary school context, for later translation to Saudi Arabia.
3.6 Summary

This chapter reports two studies undertaken to understand the way in which ICT is taught in primary schools as a discrete subject. The following issues have been determined: content of the ICT curriculum, current teaching practices during the ICT lesson, the use of e-learning materials, the problems in teaching the ICT curriculum.

Results revealed four main problems; 1) teachers are focusing only on the "How" aspect of the ICT capability with a poor understanding and knowledge of the audience, the purpose and the quality of the produced work; 2) The teacher's lack of ICT knowledge and their lack of experience in teaching it. 3) Limitation of ICT assessment; 4) Diverse home use of ICT and gap between school and home use.

Two solutions are proposed to these problems, providing primary school teachers with better ICT training and the use of e-learning support material.

Thus, further studies are needed to investigate whether these would improve the teaching of the ICT curriculum. This research will focus on how the ICT curriculum might be enhanced using supportive e-learning material. There is a need for resources specifically to address weaknesses in the teaching of "why, where, when, who " in producing ICT work. E-learning could be developed to give an equal balance to each of the three elements –information, communication and technology.

Before developing such e-learning material there is a need to identify what criteria teachers consider when they select, or evaluate such material in order to use them in schools. Such an investigation will be described in Chapter 4. More details about the development and evaluation process of the proposed e-learning material can be found in Chapter 5 and 6.
CHAPTER 4: SELECTION, EVALUATION AND DESIGN OF E-LEARNING MATERIALS OF PRIMARY CURRICULUM IN UK

This chapter reports on two studies conducted to gain an understanding of the current design practices applied by designers in e-learning publishing companies and the criteria considered by primary school teachers in the selection and evaluation of e-learning materials.

4.1 Introduction

The use of supportive e-learning material was proposed as one of the solutions that will be studied to improve the teaching of the ICT curriculum in primary schools. In order to achieve the third research objective (i.e. the creation of e-learning material for part of the UK ICT curriculum for key stage 2 children based on the requirements of the age group, teachers and curriculum in a British primary school context), the criteria teachers use to select or evaluate e-learning material for use in schools should be identified. See section 4.3.

Moreover, at this stage of the research it was not known whether practicing designers consider end user needs or involve users in the design process. Thus, current design practices need also to be identified. This in turn will illustrate the characteristics of the material to be developed and will feed into the design process to be followed, details of which are discussed in Chapter 5.

Therefore, this chapter reports on two studies as follows:

1. Study 1: An investigation of current design practices of e-learning material in UK;
2. Study 2: An investigation of the selection and evaluation criteria of e-learning materials associated with the primary school curriculum in UK;

4.2 Study 1: An investigation of current design practices of e-learning material in UK

The most effective way of ensuring that e-learning material meets the needs of the users is to involve them throughout the development process (Section 2.5). Before
developing the design process, current design practices in e-learning publishing were examined.

4.2.1 Aims and Objectives

This study aims to investigate current design practices in e-learning publishing companies, particularly those associated with the involvement of end users. This can be broken into the following objectives:
1. To identify when and how pupils and teachers participate in the design process;
2. To determine how material is evaluated in publishing companies;

4.2.2 Methodology

During 2005 and 2006 visits were made to three trade exhibitions; the Design Technology with ICT Education Show in 2005, British Education and Training Technology (BETT) 2006 and the Education Show in 2006. Presentations about the e-learning products offered in the shows were attended and demonstration copies ordered and reviewed. Trade publications, industry reports, publishers and retailers websites, such as catalogues, shop displays, and corporate publicity, were also reviewed and analyzed.

Moreover, using information provided by TEEM (a British educational organization which supplies evaluations by teachers of educational software and curriculum content) 30 companies were selected. Afterwards, referring to the list of the winning companies at BETT 2006, 10 of the 30 companies were selected as providing a sample of the leading producers of e-learning materials covering all parts of the curriculum. An invitation was sent to 10 UK producers using an online survey tool (SurveyShare). 6 responded. The survey focused on the areas outlined above. See Appendix B.2 for details about the survey questions.

The participants had between 3 to 20 years working experience and were from the following companies - Harcourt, Gradepoint UK limited, Dolphine Learning, Sherston Publishing Group, 2Simple Software, and NumberGym Software
4.2.3 Results

Regarding the participation of teachers in the design process, 5 out of 6 felt that teachers did participate in their design process. However, a formal User Centred Design approach was not adopted, either with predetermined criteria or with rules for participation. One designer indicated that teachers were not involved and that all design decisions were taken by the designers.

Communication with teachers was by e-mail, telephone, fax, or post. However, teachers only participated in the final stages of the design process, on the full product prior to publishing.

Students were not involved in any stage of the design process in 5 companies. Only one designer indicated that he involved the students as design partners to test the suitability of the language, the suitability of the tasks, and the usability of the e-learning material.

Regarding the evaluation of the products, 4 out of 6 indicated that they attached an evaluation form (check list) to the product when they sent it to schools (for examples of this see Appendix B.1). They added that only half of these forms were returned. The remaining 2 companies visited a school to run a pilot study during a 30 day evaluation period but did not send an evaluation form with their products because teachers are too busy to complete them and would not return the forms.

However, all the companies indicated that they used sales income as an indicator of success of their products. They did not rely on the teachers’ evaluation, as 4 out of 6 indicated that evaluation might be biased because the teacher's lack of ICT knowledge when they tested the products. 2 indicated that this was because of the teachers' workload which meant that they did not have time to evaluate the products.

Concerning the criteria considered by the companies in their evaluation, the following were identified:

- Technical issues such as ease of installation (considered by all companies)
- Association of the material to the curriculum (considered by 4 out of 6 of the companies)
The enjoyment level and the appeal of the interface (only considered by 2 of the companies);

4.3 Study 2: Primary school teachers selection and evaluation of e-learning materials in UK

The market review of products revealed that much of the material covers the same content but with different designs and functionality, making it important for teachers to check the quality and select the most effective material for their needs. Identifying the way teachers select and evaluate current e-learning products reveals the type of products they need and what features they value most. Such information is helpful for specifying the characteristics of the proposed e-learning material in the present research.

4.3.1 Aims

This study aimed to identify the selection and evaluation criteria of e-learning materials used by UK primary school teachers.

Unfortunately teachers do not use e-learning materials in teaching the ICT curriculum (Section 3.4.1.3) per se, so this study was enlarged to consider selection and evaluation criteria for e-learning materials across the primary school curriculum, i.e. not just those that are designed to support ICT classes.

4.3.2 Methodology

An invitation to take part in an online survey (Survey share) was sent via e-mail to a random sample of 300 primary school teachers in the UK including the schools participated earlier in the study (Section 3.2). See Appendix B.3 for the survey questions. The results are based on the replies of 14 teachers. 4 of those had participated earlier in the research. The survey was designed to provide information on the way information was received about e-learning products, the evaluation and selection criteria, how teachers conducted the evaluation, and the way they used the e-learning materials in the classrooms.
4.3.3 Results

Most of the teachers received information about e-learning products through the post, 10 received information via e-mail and 7 through search engines. 8 received information through educational show visits.

Regarding the selection of e-learning materials, all the teachers indicated that they would review a demonstration copy themselves. 5 indicated that they would involve students in the selection process and 13 said they would consult other teachers. However, the final selection decision was theirs.

Regarding the reasons that would lead them to reject e-learning material, 11 indicated that they would reject a product if they felt it was beyond the ability of their students. Only 6 would reject it if it did not match the curriculum.

10 teachers indicated that they would not use an evaluation form with pre-set criteria to evaluate the material such as ease of installation, content value. The remaining 4 indicated that they used the evaluation form attached with the e-learning material as provided by the publishing company (See Appendix B.1).

Moreover, when the teachers were asked to prioritise their selection criteria, the following were ranked to be the most important criteria (See Figure 4-1):

1. 10 ranked the educational value;
2. 6 ranked the correlation to curriculum;
3. 5 ranked the students preferences;
4. 5 ranked the ease of initial use.

The following criteria were ranked as important

1. 11 referred to quality of graphics and sounds;
2. 8 ranked the cost;
3. 5 ranked correlation to the curriculum ;
4. 5 ranked students preferences;
5. And 5 ranked ease of initial use.

The following criteria ranked as the least important:
1. 10 ranked the entertainment value criteria;
2. 5 ranked ease of initial use;
3. And 5 referred to students preferences.

![Selection Criteria](image)

**Figure 4-1**: Selection criteria considered by teachers

Regarding the use of e-learning products in the classroom, all teachers indicated that they would use such material with all the students and would not limit its use to low or high ability students. 11 already used such products as supportive tools in their teaching while 3 felt these were vital to their teaching. 9 of the teachers preferred e-learning products that supported the curriculum.

**4.4 General discussion**

The present research aims to develop e-learning material that supports the teaching and learning of ICT in primary schools.

Early user involvement and feedback has been shown to be more effective and indicate different types of usability problems (Gulliksen, 2000) in other domains, so
there is reasons to believe it could be effective in developing an e-learning material. Please see section 2.5 for details. However, investigating the current design practices in e-learning publishing companies indicated that although there is some teacher involvement this may be informal and occur late in the design process. Given that BECTA (2005c) indicated that the most effective way of ensuring that e-learning material meets the needs of teachers is to involve them throughout the development process, there is a need to provide a more rigorous participatory design process which allows teachers and pupils to input into the earlier stages of the design process.

However, teachers may not be adequate proxies for pupils (Puphaiboon, 2005; Abu Hassana and Woodcock, 2007). Hence, children must also be included as part of this process. The Child Centred Design Approach might ensure that the material developed suits the students' needs (Section 2.5). Therefore, the present research aims to develop an e-learning Child Centred design process and apply it to develop an e-learning material that supports the teaching and learning of ICT in primary schools.

Regardless of the design process followed by publishing companies, teachers will only choose to use a resource if it is appropriate to their lesson and will enable them to deliver a particular curriculum objective to the group of pupils they are teaching (BECTA, 2006a). Teachers become aware of available e-learning products in many ways, but there is little formal, independent information to help them select which might be most appropriate for their school. Choosing e-learning material for curriculum subject teaching can be time consuming and costly, but reference to how effective other teachers have found the material can provide additional information which could help decision making (BECTA, 2006a). Although websites exist such as (TEEM website http://www.teem.org.uk/) that offer expert, independent evaluation of e-learning products, these are not used by teachers. Such websites provide guidance on the suitability of products for teaching objectives, relevance to the curriculum, ease of use, quality of content and advice on how to use materials in teaching.

Results indicated that the final selection of e-learning material used in schools is dependent on the teacher's decisions. As teachers are the gatekeepers who make the purchase recommendations for the school, it was necessary to identify the selection criteria used by them to inform the development of the proposed e-learning material in the present research. However, Puphaiboon (2005) indicated that the design process
can not rely solely on the teachers input and children should be involved in the process (Section 2.5).

Teachers’ selection is usually made without the use of a formal set of criteria, unless this is provided with the product (See Appendix B.1). To evaluate material in a standard way, teachers would need to create their own evaluation forms. Such forms would also help designers to formalize the specification. Comparing the teacher’s selection criteria with that considered by the production companies revealed a mismatch in priorities. Most companies evaluation forms concentrated on technical issues (such as ease of installation and ease of use) while teachers consider the educational value to be most important. Although Lee et al. (2004) showed that education is more effective when learning is enjoyable, through traditional or technological methods, the enjoyment level of the material was considered to be the least important either by the companies or by the teachers. Moreover, BECTA (2006a) has pointed out that it is vital to determine whether e-learning material can support individual, pair or group work, and how this is achieved. However, this was not considered in either the teacher’s selection criteria or in the publishing companies’ evaluation. All teachers surveyed indicated that they would use e-learning materials with all the students and would not limit its use to low or high ICT ability students.

4.5 Conclusion

This chapter reported two studies undertaken to understand the current practices associated with end user involvement in the design process and the criteria considered by primary school teachers in selecting and evaluating e-learning materials.

Teachers have a limited participation in the current design process and children are not involved, accordingly, there is a demonstrable need for research to be undertaken to improve the current design process and to develop a framework to involve children and teacher in the design of an e-learning material. Therefore, the present research aims to develop an e-learning Child Centred design process (CCDP) and apply it to the development of e-learning material that supports the teaching and learning of ICT in primary schools (Objective 2). In addition, further studies are needed to consider how children could be involved in the design of e-learning materials.
Studies reported in Section 2.3.1.2, indicated that the design process should not be based solely on the inputs of adults (parents, teachers and designers) when designing e-learning material for children. However, purchasing decisions in schools is made by teachers, using educational value as the most important criteria. Hence, teachers will be involved in the present design process (Chapter 5), particularly in issues associated with the educational value of the material. Moreover, the criteria identified by the teacher’s selection will contribute to the development of the material. The differences in priority between the e-learning companies and the teachers’ selection criteria will be addressed through referring final decisions to children.

It is believed that such a CCDP could be applicable to the wider area of e-learning design and could be tested as best practice for Saudi Arabia design companies. This will be discussed in detail in Chapter 7.
CHAPTER 5: DEVELOPMENT AND TESTING OF E-LEARNING MATERIAL

This chapter outlines the child centred design approach taken to the development of e-learning material for the Multimedia Presentation curriculum Unit which forms part of the UK ICT National Curriculum, followed by the usability test undertaken to identify usability problems prior to the school evaluation (described in Chapter 6). The chapter begins by a discussion of the way the material was developed, the usability test conducted, the results, and a discussion of these in relation to the overall objectives of the research.

5.1 Introduction

It has been hypothesized that a user centred design approach might lead to the development of e-learning material that more closely matches the end user (teacher and children’s) needs and therefore has a wider uptake in the target community. In Section 2.3.1.2, it was indicated that Puphaiboon (2005) had developed a Mathematical Diagram Design Method (MDDM) for designing and assessing diagrams to teach mathematical concepts to primary school students aged between 9-11 years old. However, he collaborated mostly with teachers in the early design stages to understand the children’s requirements. This was not satisfactory, as when the children were asked to evaluate the material they were found to have different needs (e.g. in terms of the timing of the animation and the aesthetics) from those anticipated by the teachers. Thus, in this research, his method has been adapted to involve both children and teachers in the early stages of the process.

Section 4.2.3, showed that e-learning publishing companies do not have a framework or rules for involving users in the design process. Thus, the present research aims to develop such a process (Objective 2) and to show its efficacy by creating e-learning material (Objective 3) for part of the UK ICT curriculum for key stage 2. The proposed method enables the capture of user requirements from the pre-concept stage onwards; the rationale being that by doing this the designer will be able to capitalize on the teachers and students’ opinions from a teaching and learning perspective. This can be characterized as understand, propose, realise and evaluate process. See Figure 5-1.
Understanding is gained through discussion with teachers and children prior to any design work. ‘Propose’ is the stage at which the designer produces a set of concepts based on the knowledge gained. Sketches or storyboards are used to discuss ideas in more detail with representative end users before the prototype is realized and evaluated with children.

As indicated in Section 4.5 teachers input in the present design process is mainly concerned with issues associated with the educational value of the material while the design preferences will be captured directly from the children. However, there is a need to identify and remedy existing usability problems to ensure that the final school-based evaluation was conducted on error free, usable software. Hence, a usability test was conducted with external experts to determine usability problems in the revised material that were not identified by the students or the teachers.

5.2 Development design process

The following section describes each stage of the development process, the methodologies used and the role of the child. In general, the researcher decided the direction the design process should take but the children and teachers were given the opportunity to provide input and suggestions at all stages. There is no single technique that can be used through the whole design process to achieve the milestones, so a combination of techniques has been adapted that together formed a methodology of cooperative inquiry. These techniques do not necessarily offer a magic formula for working with children, but rather a philosophy and approach to research that can be used to gather data, develop prototypes, and forge new design directions.
5.2.1 Understanding stage

5.2.1.1 Content selection, game type and design specification

1. Content selection

Part of the ICT curriculum was selected to form the educational content of the e-learning game as it was not possible to develop material to support the entire key stage during the PhD. The Multimedia Presentation Unit (Unit 6.A) was chosen because the researcher gained a good understanding of the teaching practices and problems associated with this when she undertook the school visits earlier in the research (See Chapter 3). Details about the aims and objectives of the Unit can be found in Section 3.3.1. In addition, research indicates the importance of teaching multimedia authoring to children encouraged the choice of this unit.

Moreover, research has shown the need to improve the multimedia authoring skills of children, because children are immersed in multimedia from a young age. They spend large proportions of their time watching TV, playing computer games, browsing the internet and conversing in chat rooms. The medium of expression in the classroom is no longer print. It is a hybrid of print, video, audio and multimedia. Unless access to the tools to compose this medium is provided in schools, students are trained to be readers (viewers) but not authors. Thus, children should develop a critical awareness and understanding of what they are seeing, hearing and reading, when they use multimedia in terms of where it came from, how it got there, and who put it there. Reilly (1996) believed that children benefit by being able to express their idea in movies and that digital media can provide learning opportunities and access to filmmaking tools previously reserved for experts.

Multimedia technologies offer children the opportunities of learning actively by allowing them to construct knowledge as interactive multimedia presentations. Multimedia authoring enables children to be active in the construction and representation of their knowledge with a variety of sources of media, developing their roles as critical and creative authors who will be able to evaluate and improve their work for a range of audiences. Authoring multimedia presentations forces pupils to organize their thoughts, and clarifies their understanding. As shown by Penuel et al. (2000) when students
design multimedia products to meet a given specification, they learn not only academic content but also critical thinking, problem solving, and teamwork. In a multimedia project, students are not simply consumers of advanced technologies, they learn how to use and adapt the particular tools to meet the challenges posed by a complex communication task. Additionally, Carver et al. (1992) have developed a cognitive framework which outlines design skills that students typically develop in the course of such projects. Teachers believed that when students worked on a multimedia project they learned the following skills: how to allocate resources and time for different time segments, how to search for information, how to analyze and interpret information, how to organize a presentation, how to catch and maintain audience interest, and how to revise a presentation on the basis of feedback and self-reflection.

Having reviewed the literature on the importance of improving the children’s skills as multimedia authors, it was decided to select Multimedia Presentation Unit to be developed as an e-learning material.

2. Type of the game and game idea

Section 2.3, indicated that computer gaming forms the main use of ICT by 9-11 year olds and it can have a positive impact on their education. Therefore, it was proposed to design e-learning material as a game. The first stage in this was to determine what sort of game should be developed.

During the earlier observational study (See Section 3.3) 5 children were selected randomly from each of the schools and asked about the type of computer games they preferred. Responses, differing according to gender, included the following.

Speaking about knowledge – based games, one girl said:
"I like character based game because it has a quiz where you can play against a friend, and also the building and management of virtual environment"

Another said:
"My favourite game is a hospital simulation game; it is great fun making the hospital".
Boys on the other hand, although not exclusively, identified skill and strategy games which entailed navigation around an environment and dealing with perilous situations.

Regardless of gender, all the interviewed children indicated that they liked to play problem solving games as they felt proud when they succeeded. Most of them took on ‘adult roles’, navigating around an environment and solving ‘complex’ problems.

Thus, a game idea which includes playing an adult role was proposed. The idea was based on applying for a new job and being an apprentice. The game was proposed to include the following roles: 1) Gallery manager; 2) TV Director; 3) Civil Engineer; 4) Nursing; 5) Doctor. However, it was not possible to develop a full working game with all the jobs roles during the PhD. Hence, it was decided to involve children in deciding the role that they prefer to play. This was conducted in the following stages.

3. Game idea approval and design specification

At this stage discussions were held in the Swift Centre of Coventry Transport Museum. Semi-structured interviews were conducted with five primary school teachers and three educational advisors, who work in collaboration with the Technology Centre of the Transport Museum.

A week prior to the interview, a description of the game and the intended learning outcomes (See Appendix C.1) were e-mailed to the participants. This allowed them to look at the material carefully and actively contribute to its refinement.

30 minute, semi structured interviews were conducted to achieve the following aims:
1. Select the job role that suits the Multimedia Presentation Unit and children’s preferences;
2. Identify sources of potential confusion for the intended audience.
3. Assess the appropriateness of the material in terms of the story, game, educational value, and design (2D or 3D) for the intended audience.
4. Confirm the value of the material and its contribution to learning.
The following are a sample of the questions:
1. How appropriate is the (design, story, or game) to achieve the learning outcomes of the Unit?
2. How easy would it be for pupils to understand the material?
3. What ICT information is missing?
4. What would you suggest to improve the (story, game, design)?

All ideas were documented for later consideration.

All the teachers and advisors indicated that they liked the idea of children playing an adult role. 2 suggested "Future Job" to be the name of the game. 6 believed that the children would prefer the role of the gallery manager. In this, an artist has been called away to an emergency and is not able to sort out his gallery in time for an exhibition. All the paintings, text description, sound CDs and multimedia animations are available in the gallery. The player's main task is to organize this correctly e.g. through associating text descriptions with the correct paintings (See Appendix C.2 for further details). In this game, learning occurs mainly by moving objects and doing the task, not by listening. In addition, the participants believed that the gallery manager game was more associated with the QCA (Qualifications and Curriculum Authority) learning outcomes of the Multimedia Presentation Unit.

5 teachers said that they could not predict whether the pupils would understand the game as it was not developed, but they believed it sounded interesting and that their students would like it.

Teachers were asked to provide any suggestions regarding the game idea, tasks, or usability. 5 suggested that the game should be designed so that it was easy for them to use, and should reflect the level of games pupils play outside school, so they would not find it boring or below their IT level.

Regarding the children's involvement in the identification of the design specification, a poster was designed for the Museum to recruit parents and children to participate in a game development event (See Figure 5-2).
People enter the Swift Centre randomly. 10 children, aged 8-11 years were selected to participate. Five were interviewed individually and the others participated in a focus group. Design principles of e-learning games for children identified in Section 2.4, were used as prompts to start an informal, and guided discussion to determine children's likes and dislikes.

The identified design principles include the following:

1. Interface
   - Use of text and textual inputs
   - Colour scheme
   - Quality of pictures and videos
   - Position of icons
   - Mouse functionality
2. Instructions
   - Text or audio
   - Provided by a character
3. Audio
   - Use of Music and voice
4. Instructional structure
   - Complexity level of activities
5. Feedback and Guidance
   - Amount and frequency of actions
   - Provided by character
6. Motivation
• Use of scoring system
• Multimedia Messages and online chat

Afterwards, children were asked to choose the job role that they are interested in. 8 selected the gallery manager role. Hence, the story and the idea of the intended game were explained to the children and their comments noted.

The game concepts were developed as storyboards and sketches for discussion with children, as Druin et al. (2001) indicated that children (aged 5-10 years) have difficulty with abstract concepts and will not be able to communicate if the game ideas and design principles are discussed without images, sketches or storyboards. Hence, screens from existing e-learning materials were used in children discussions.

When asked about their preferences regarding watching multimedia movie or having interactive multimedia, all children indicated that they preferred using interactive material rather than passive viewing.

Regarding the interface, 8 of the children indicated that they do not mind whether the buttons were placed vertically or horizontally as long as they were clear. While the other 2 said that they preferred to have buttons at the bottom of the interface.

8 out of 10 indicated that they preferred an interface with the minimum amount of text and the instructions to be in both written and audio format, while the other 2 said that they preferred audio instructions. However, all 10 gave the impression that they do not like to read while they are playing.

7 said that they preferred colours that reflected the real environment, as they were bored with cartoon styles and bright colours. They felt bright colours were for younger children. 3 said that they did not mind whether the colours were dark or bright as long as it looked good.

When asked about the quality of pictures and videos they all said that they preferred it be clear and displayed as a full screen.
Also, all children indicated that they preferred 3D games as these looked more realistic and were more exciting to play in.

Regarding the character, when they were asked whether they preferred to play a role of a character or not, 7 said that they preferred to play without a character so that they could imagine themselves moving in the game environment. While the 3 who said that they preferred to play the role of a character, when asked whether they preferred to choose a pre existing character or to create their own, 2 indicated that they preferred to create their own and if possible would like to use their own personal images. The other said that he would prefer to select from character options.

If the instructions and help were offered through a character, 7 said that they would not mind whether it was male or female, but they would prefer a character who they could believe to be old enough to have the experience to tell them what to do.

9 said that they would like to see the scores on the screen while they are playing as this is more challenging than pausing the game to check scores.

5.2.1.2 Discussion

This stage of the development process helped in generating an explicit specification based on an understanding of the teachers and students requirements.

The final specification was for a problem based game, in which the player can select a preferred job role. Such roles should be gender neutral. As the game was produced for research purposes only the gallery manager role was selected to be developed as the full working option in the prototype. This selection was based on the discussion with teachers and was based on their belief that it better suited the children’s needs and the learning outcomes of the Multimedia Presentation Unit.

Results from the children’s interviews and discussions also fed in to the specification as follows.

5 teachers pointed that the level of the game should reflect the types of the games that children are using outside the school. Virvou et al. (2005) confirmed this saying that the
The game environment of an educational game has to be competitive with commercial games to attract a high degree of interest from students. This is because children are familiar with commercial games and therefore have high expectations.

With regard to interactivity, children confirmed the results revealed from literature in Section 2.4. The interest and attention levels of students may be kept to a high level during browsing of the e-learning material content, if they are required to make choices, answer questions, perform tasks and receive direct feedback on their actions. Thus, the proposed material will be designed with the maximum interactivity.

Although product interfaces define the experience of the product and limit its use (Stoney and Wild, 1998), the 8-11 years olds interviewed in this study did not show any concern about the interface as long as it was clear how to use it. At a more concrete level they were concerned about the placement of buttons and the style of the design, the use of colour, 2D and 3D representations.

Regarding the colour scheme of the interface, early designers assumed that bright colours and cartoon style characters are appropriate for children (Druin, 1999). However, the present research revealed that this assumption does not suit the children preferences.

The gallery environment was designed to look like a real environment bearing in mind the children's preferences. This need for a degree of realism is also supported by Lennon and Maurer (2004) when they said, for children to play and learn, the game should be an extension of the real world, media–rich, challenging, controllable, and leave room for creative activity. Hence, to allow the player to feel the reality of the environment, objects were designed in a 3D environment.

Moreover, children indicated that they prefer the interface to include the minimum amount of text. Mitropoulou and Triantafyllidis (2005) discuss problems that arise from reading text from the computer screen; this is 28% slower in comparison to reading printed text from books and the effectiveness of reading decreases. In order to improve the effectiveness of reading from a computer screen, Mitropoulou and Triantafyllidis (2005) suggested using text in a variety of forms taking care with alignment, placement and direction. Children indicated that they would like both written and verbal formats;
this was acknowledged by providing material in both formats. Detailed verbal instructions are proposed to be given at the start of each activity by the character on how to carry out the required task. If playing the game for the second time, the player could skip the instruction.

In addition, as children indicated that they preferred to receive instructions from a character rather than reading it, a character was used as an interface agent. Nijholt (2001) said that interface agents can not only act as a guide, navigating the learner through a virtual world, but can also perform the teaching tasks (delivering knowledge to the learners, asking questions, providing feedback). It was also found by Lester et al. (1997) that life-like animated agents have an exceptionally positive impact on children and can increase their motivation and attention. This also confirmed the results of Section 2.4.

As female students do not have special preferences regarding the gender of the character, and males prefer male characters, the agent was chosen to be a male. Moreover, the character was designed to be old enough for children to respect and to receive instructions from, as the children pointed out that they do not want to receive instructions from a young character or one within their age group (see Figure 5-3).

Mitropoulou and Triantafyllidis (2005) indicated that tests in e-learning materials should be embedded within the instruction itself and not presented as a separate test. Thus, questions about the taught content were embedded within the game content, received
as an SMS on the mobile on which the player has to choose the right answer (see Figure 5-4).

![Figure 5-4: Questions as SMS](image)

In summary, according to the discussions with teachers the gallery manager role was selected to be developed in the prototype. In addition, discussion with children helped the researcher to specify the design specification for the proposed e-learning material. These are presented in the following section.

### 5.2.2 Propose stage

The proposed design specification for the e-learning material was as follows:

1. Interfaces should be
   - Strongly visual, avoiding text as much as possible and reducing cognitive load;
   - Buttons should be placed horizontally at the bottom of the screen;
   - Interactivity should be kept to the maximum level;

2. Instructions should be:
   - Provided in both verbal and written format but written instructions should be kept to the minimum;
   - Provided with a male adult character;
   - Presented in an understandable language without the use of abstract concepts;

3. Pictures and videos should be of a good quality;
4. User preferences with regard to the color scheme should be considered, which is a 3D environment with realistic colours;

5. Feedback
   - Actions should be fast;
   - Rollover audio, animation, and highlighting should be used to indicate where to find functionality (Hanna et al., 1999);

6. To hold children’s motivation:
   - Animated pedagogic characters should provide instructions (Lester et al., 1997) and should be supportive rather than distracting (Hanna et al., 1999)
   - Activities should be inherently interesting and challenging so children will want to do them for their own sake (Hanna et al., 1999);
   - Scoring system should be updated on the screen (Pausch, 1992; Hanna et al., 1999)

In the following stage of the research a prototype was developed according the specifications determined in this stage.

5.2.3 Realise Stage

1. Prototype Development

The outcome of this stage was an interactive panoramic engine (360°) of the gallery (see Figure 5 – 5). This was produced by:

1. Sketching: drawing the room, determining its dimensions, the number of paintings, objects to be placed in the gallery, the sizes of the paintings etc.
2. Digital imaging: Adobe Photoshop was used to produce the digital images used for the textures of the modeling of the gallery as a room and the objects in it.
3. 3D modeling: 3D Studio Max was used to create the gallery and the objects, because:
   a. According to the analysis of the children's responses from stage 1, children of the target age prefer to play in a 3D context which tends to be more realistic.
   b. The task assigned to the player in the game was based on the exploration of objects in the gallery. Thus, having the object as 3D could
allow the player to investigate it from all angles, drag it, drop it or rotate it.

4. Programming:
Lingo in Macromedia Director was used to program the 3D gallery, so that it worked like a virtual reality engine, showing the 360° panoramic view according to the mouse movements. Moreover, all the objects in the gallery were programmed to be movable.

![Print screen of the first developed version of the Gallery](image)

Figure 5-5: Print screen of the first developed version of the Gallery

This stage and the evaluation stage feed into each other in an iterative cycle.

5.2.4 Evaluation Stage

5.2.4.1 Formative evaluation with teachers

1. Methodology

The iterative design was based around formative evaluation from the early stages of the project, in a way that would encourage input and reflection. The prototype (working interactive gallery produced at the previous stage) was evaluated and the results are described in this section. The version used in this part of the evaluation can be found in Appendix D.1: Prototype version 1.

The evaluation was informal, using semi structured interviews. 3 teachers of year 5 and 6 participated. It was not possible to involve the same teachers who had participated in
the earlier stage. However, all three had participated in the investigation of the teaching practices of the ICT curriculum presented in Chapter 3.

The interview started by presenting the prototype and explaining briefly why the game was developed. The interview considered the extent to which the game would capture the children's interest and excitement, and the relation between the game context and learning outcomes. The main issues considered were the following:

1. The extent to which the material supports the achievements of the learning outcomes;
2. The entertainment value and its suitability to the targeted children;
3. The suitability of the game functions, instructions, design and tasks in relation to children preferences and understanding;

In addition, possibilities of improvements to the game were also regarded such as

1. The paintings in the gallery
   Since the paintings are targeted for different audiences and purposes, the teachers were required to assess the appropriateness of the paintings for the children and whether they would appreciate the variation and meanings.

2. Verify the objects in the gallery
   The gallery includes several objects such as CDs, printers, camera, book, text descriptions, paintings, CD player, projector, projection screen and laptop. The teachers needed to confirm whether additional objects should be added to enhance the understanding of the intended learning outcomes.

2. Results

Results of the interviews indicated the following:

Regarding the appropriateness of the design and proposed scenario in meeting the learning outcomes, all three teachers agreed that the design was appropriate and relevant to the learning outcomes assigned by QCA for the Multimedia Presentation Unit. Moreover, they all confirmed that it was within the understanding level of year 5 and 6 students. One felt that the students would like the design; the other two believed
that it would be better to discuss this with the students themselves. They both added that students play computer games outside school, but did not know what sort of games were played or preferred.

All 3 teachers agreed that the number of the paintings (14) was acceptable. Also they all agreed that the duration of each stage (15 minutes) was reasonable for the students to complete the required tasks, even for low ability students. Details about the task assigned to the player in each stage of the game are described in detail in Appendix C.2.

The interface of the game includes a timer at the lower bottom right of the interface which shows the time remaining for the player to complete each stage. All the teachers believed that this should be clear in order to encourage the player to complete the assigned task within the specified time. However, when asked about the type of the timer, 2 indicated that the digital counter with minutes and seconds moved too quickly and would make the player nervous, while the other indicated that it would be better to ask the students which type they preferred.

Comments regarding the entertainment value and its suitability to children included:

School 1 teacher said:
"I think they will like it, it is really interesting. They will like the idea of moving around the gallery and exploring stuff especially that they already knew about Van Gogh paintings and will recognize it once they see it"

School 6 said:
"I think you should ask the students themselves I can not answer this question, I do not know what do they like or dislike"

School 9 said:
"Yes, I think they will like it, especially that we do not use educational games in our school"

Regarding the style of the imagery, all teachers agreed that students will like it.
School 1 teacher said:
"I think children will like it because it looks like real and it is different from stuff that they used to play with in key stage 1"

While school 6 said:
“Yes they will like it"

School 9 said:
“Children will like the style of the images as it looks real”

All the teachers agreed that the instructions were understandable, and the delivery was clear. They all believed it was preferable to have a mixture of both voice and text instructions so students would not have to read every thing.

All three teachers indicated that the game would help pupils to improve their literacy skills, for example when filling the application form they have to write about their gallery visit without spelling errors. Moreover, in the proposed scenario of stage 2, when children have to read the text description and find the most suitable version of the text for the image, they improve their comprehension skills.

All three teachers indicated that the aspect they most liked about the game was the possibility of using it as a template so they could replace the images, text and sound files with their own material.

When teachers were asked what might stop them from using the game, their answers were as follows:

School 1 said:
"As long as it fits with the learning outcomes and the students like it I will use it"

While school 6 teacher said:
"It should be easy to use, and until now it looks simple to use"
School 9 said:
"If it is easy to replace the templates and I understand how to do the replacements, I will use it"

5.2.4.2 Formative evaluation with students

The need for testing the prototype with children has been pointed out in the literature review in Section 2.3.1.2, and was again confirmed by teachers during the formative evaluation.

1. Methodology

There are two approaches to measure usability (e.g., Berkovitz, 1994; Noirhomme-Fraiture et al., 1993; Moshell & Hughes, 1996; Strommen, 1994). 1) Users adopt the role of the child as a tester. In such cases the evaluator observes what happens, noting evidence of usability problems as they occur during interaction; 2) Ask the users (i.e. children) for their own assessments of the usability in the interactions.

Both approaches were used at this stage; children were observed while they used the prototype and then a group discussion was undertaken to gather their opinions.

15 year 5 and year 6 pupils from three schools in Coventry participated. 5 participants were selected from each school by their teacher to include 3 different abilities - high, medium and low. Different year groups had to be used because in one school the MPU was taught a year later, as staff was not sufficiently trained to teach this.

All participants were familiar with the use of PCs, primarily for playing games and browsing the Internet. None of them had previous experience of e-learning material that taught skills associated with authoring multimedia presentations.

Since it is extremely important in working with children as research partners to collect data in the environment in which that material is going to be used (Druin, 1999), the testing was conducted in the school ICT suite, with each student sitting on a PC.
The evaluation started with an explanation that the students were participating in the
design of the game and that the version they would be using was a prototype under
development, which needed their comments to improve it.

The children played the game individually for 15 minutes; they were encouraged to
verbally express their thoughts and reactions to the game based on their likes/dislikes
of graphical characteristics, tasks and teaching content. The researcher observed the
students and kept notes of their comments for analysis in further design stages.

For each activity the researcher noted usability problems, indicators of enjoyment and
engagement such as comments, smiles, laughter, or positive body language, and also
noted signs of lack of enjoyment, boredom and frustration, including for example
looking around the room. Such behavioural signs are usually more reliable than
children's responses to direct questions (Hanna et al., 1997).

Data was recorded using a form that included a checklist and space to write
observational notes (see appendix D.2). Video cameras were not used following Druin
et al's (1997) remarks about children acting unnaturally on video – either freezing or
performing.

After the students played the game, a discussion was initiated which considered overall
impressions about the appearance, colours, the idea of the game, and the playing
environment. Some direct questions were also included such as “What did you like?”,
“What was boring?” “What was too hard?”

2. Results

Results of the evaluation indicated the following:

While children are playing the game, they all showed excitement in exploring it and its
functions. None of them became distracted with other activities and they all showed
interest in playing the game
Their comments were as follows:

When the first interface appears (See Figure 5-6):
"It is very interesting, fantastic"
I think it should be called "The Art Gallery", "The Gallery Challenge", "Future Challenge".

Once they started moving around the gallery, (see Figure 5-7) comments noted were as follows:
"I feel that I am living in a real environment"
"It looks like a real gallery"
"I really like it"
"Can we open the doors? Why not?"
"Wow, what are these paintings?"
"How many paintings are there?"
"They are Van Gogh paintings. I saw them in the art lesson"
"Are they all nature paintings?"

Regarding the usability, all students asked how they could view it as a full screen. As the instructions had not been recorded at this stage, students tried to find out what to do by themselves without asking the teacher, the researcher or their peers.
After playing the game, a discussion was undertaken during which the following issues emerged.

All the participants liked the game. Following are some of their comments:
Comments included, "Nothing I did not like", "I liked it, it is really very interesting"

Regarding the colours, design and the context, 13 said that they liked the colours as they were realistic.

Following are some of the comments from School 1:"I like the colours, they are good, it got a different mixture, bright, nice colours; look like a real thing."

In school 6:"We studied about Van Gogh paintings …yes it was in our art lesson"

Regarding playing in 3D environments, all students indicated that they enjoyed playing in 3D environments more than 2D ones. Their comments included: In school 1,"I liked playing in 3D; it is very exciting to move as you are in a real room";
In school 6: “You feel that you are in a real gallery”;
In school 9: “Interesting, it looks like real”

Regarding the mouse movements and keyboard arrow usage, 12 out of 15 of the participants said that the mouse movements are controllable while the other 3 said that it was too fast.
Following are some of the students’ comments: "Maybe it is quick"; "No it depends on my own control to the mouse, so if I move it quickly it is going to move quickly"; "I feel that it is controllable"; “Yes, it is controllable”; “I am controlling the mouse”

When asked about their preferences in receiving instructions all students indicated that they preferred to both listen to and read instructions. When asked about the CDs that are in the gallery (see Figure (5 - 8)), they all agreed that it was a nice idea.

Some of their comments were as follows:

"I like it; it makes you feel as if you are in a real gallery"

“CDs exploration is a quite good idea ... it makes you get going, working, like thinking... Make you feel that you are in the picture"

Regarding the timer, 12 said that they preferred to have the timer on the screen through the whole game. The other three said that they preferred to have the option of hiding or showing the timer. However, all agreed that the timer should be a digital counter with minutes and seconds (Figure 5-9), and not a sand clock (Figure 56-10). The sand clock does not show the remaining time clearly, though it turns to red when time runs out (see Figure 5-11), the duration of the time left is not clear.
Some of the students' comments are as follows: "It is better to see the timer rather than trying to look for it and pause while you are playing", other student said "yes, because you have a time limit to win in the game", "Timer is ok", another student said, "It makes me hurry up in my exploration", "it keeps me considering the time"

When students were asked for their opinions about having a virtual laptop in the gallery that they could use to ‘chat’ to the artist, they thought it was a good idea, Comments included, "How, are we going to use MSN", other student said, "Is the artist really going to go online", "So do we have to play the game online?"
These comments were taken as indicating that the children were involved in the game.

![Laptop in the gallery](image1.jpg)

**Figure 5-12 : Laptop in the gallery**

### 5.2.4.3 Usability testing by experts

As indicated in Section 5.1, there might be several usability problems that have not been identified either by the teacher or the children; hence, there is a need to conduct a usability test with external experts prior to school evaluation.

**1. Methodology**

Invitation letters were sent to 10 PhD researchers in Coventry University School of Art and Design to participate in the usability testing. A sample of the letter is available in the Appendix D.3. 5 agreed to participate. All either had experience of working with children or with multimedia material.

Tester 1 is currently researching the use of e-learning in teaching dyslexic children, and has worked as a software tester, mainly focusing on user interface design, usability, logic, quality and navigability of commercial software.

Tester 2 is a digital abstract artist, creating 3D multimedia animations. He was an art teacher in a primary school and then in higher education.
Tester 3 has worked as a graphic design teacher in higher education and is currently researching the redesign of signage in Jordan.

Tester 4 has worked as a primary school teacher for several years and is currently looking at pupil participation in school design.

Tester 5 is a documentary film maker, who has worked with children in producing community art work.

The participants played the game for 30 minutes and then completed a usability check list; SUMI (Software Usability Measurement Inventory) test (cited in the ISO 9241 as a recognized method of testing user satisfaction) was adopted to the e-learning context (See appendix D.4: usability test form) in order to collect comments.

2. Results

The first section presents the tester comments while they used the material, followed by the Usability test form results.

On the first Interface, once the game started (see Figure 5-13), 3 out of 5 of the testers pointed that there is a need for a toolbar to:

- Enable the user to exit the game
- Mute the Music
- Minimize the game screen

![The Future Job](image)

Figure 5-13: First Interface of the game
On the Newspaper Jobs page (see Figure 5 – 14), 1 tester felt that it would be better if all the options were readable even in the prototype and were made inactive.

![Image](image1.png)

Figure 5- 14 : Newspaper jobs page

On the employment application form (See Figure 5 – 15), 4 out of 5 looked for linguistic errors and tested the navigation system. While the other tester also considered user input. All 5 agreed that the screen was comprehensible, free of spelling and grammatical errors and the links worked properly. The fields accepted input in the right format but a space between the input indicator and the letter entered might confuse a child.

![Image](image2.png)

Figure 5 -15: Employment Application Form Screen

On the Employment congratulation screen (see Figure 5 – 16), 2 testers pointed out spelling and grammatical errors in the text
Figure 5 - 16: Employment Congratulation

On the introduction screen (See Figure 5 – 17) where the character describes the game and explains the tasks of stage 1, 4 of the testers pointed to the need to have a control bar to play, pause, rewind and forward the introduction as well as the option to skip it. Moreover, all the testers indicated that there should be an option to play the sound after pressing mute.

3 testers indicated that once the introduction ends the gallery should start downloading immediately without waiting for additional input.

Each of the multiple choice questions appearing in the game had 4 options for the answers. As the interaction on the question screen is programmed to respond to the
keyboard, these should not respond to the mouse click to avoid user confusion. However, 4 of the testers found that 2 of the questions also interacted with the mouse click and returned to the gallery without affecting the timer or the scores counter. Thus, they suggested that responses should only be accepted from keyboard entry and that mouse clicks should not affect the game. One of the testers commented that a warning message could be sent to the mobile to inform the player that they should use the keyboard. See sample of the question screens in Figure 5 – 4.

Regarding the feedback given to the player, one tester indicated that the feedback provided should include the right answer and that it should be provided both written and verbally.

All the testers indicated that when exit is clicked a confirmation question should appear in case this was presented by mistake. See Figure 5 -18.

One of the testers indicated that the timer should be smaller.

2 of the testers were not able to explore the content of the CD on the laptop. Once they dragged the CD and dropped it to the laptop, the CD disappeared without showing its content.

With regard to the information provided from the checklist used in the usability test form:
All the testers agreed that:

- Installing and operating the game was not difficult or time consuming,
- There was not too much text to read before playing the game
- Help was sufficient and available when needed
- They could understand and act on the information provided
- The mouse speed was acceptable
- The function of the icons and buttons were all explained
- When the mouse went over objects it was clearly indicated if they were interactive
- The speed of the game was satisfactory
- The game could be paused easily
3 of the testers were undecided as to whether the instructions and prompts were helpful.

4 felt that the feedback was given at the right time, tailored to the content, and provided the player with information concerning the level of achievement.

Regarding navigation around the gallery, 3 testers indicated that they could not decide whether the navigation took too long, whether it was easy to pick up and drop objects, or whether it is easy to locate objects. They added that the navigational system speed should be decided by the children themselves. Of the other testers, one pointed out that it was difficult to navigate, locate, pick, or drop objects in the gallery, while the other said that it was controllable.

5.2.4.4 Discussion

This stage provided some confidence that the material developed will be used in schools.

Although the teachers who participated at this stage were not the ones who had participated earlier, there was agreement on the specification and the appropriateness of the game in supporting the learning outcomes of the Multimedia Presentation Unit. Hence, involving the teachers in the understanding stage has led to the development of a prototype that corresponds to their needs.

Teachers were reluctant to comment on students' preferences and whether they would like the game as they did not know what type of games students played outside school. Although earlier, in the understanding stage, the teachers pointed to the importance of producing a game which corresponded to the level of games that they played outside the school, the teachers did not know what types of game children played outside school. This might be one of the factors that has led to the gap between the use of ICT in the schools and the children’s use of ICT outside the school which was indicated in Section 2.2.2. Hence, there is a need to consider this issue in teacher training.

Mitropoulou and Triantafyllidis (2005) showed that teachers will not use e-learning resources if they cannot include their own teaching strategies and modify material
according to their local needs. Also Nakatsu (1999) added that teachers should be
allowed to modify the content of the e-learning material. The results of the teachers’
formative evaluation in this stage confirmed that the main thing teachers liked about the
game was the possibility of using it as a template and replacing the painting, text and
sound files with their own material. Teachers requested that the adaptation /
modification of functions should be simple to accomplish. In conclusion, teachers’
formative evaluation was positive and did not require any amendments to the design
specification.

Results of the children’s evaluation indicated that although the children who
participated in the understanding stage were not the same as those who evaluated the
working prototype, they all agreed on the same design specification.

Moreover, some issues that were not discussed in the previous stage were raised,
such as the appearance of the timer on the screen, the speed of the mouse
movements and objects in the gallery (CDs, Laptop)

There were differences in opinion between the teachers and children on the
appearance of the timer – the teachers preferred an egg timer, whereas the students
preferred a digital counter, showing minutes and the seconds which they felt was more
challenging and clearer.

The pupils liked the idea of using a virtual laptop to explore the CD contents and to
request help from the artist. They preferred to drag the objects to the container rather
than clicking on them.

Bearing these comments in mind, the prototype was further developed before school
implementation.

Moreover, after modifying the material according to the results of the children and the
teacher's formative evaluation, the material was adjusted in line with the external
testers’ recommendations as follows:

1) A toolbar was added with the required functionality (Figure 5-19).
2) The text was proof read to ensure that it is was free from grammatical or spelling errors. Such errors may not be identified by children. Collins, Hammond, and Wellington (1997) said that children rarely read the text and mainly based on the verbal instructions. This was also shown in the testing of the prototype - children did not read the text. However, it is essential that all written material provided to children is of the highest standard.

3) The Newspaper page was rotated and blurred so that all options were readable. (Figure 5-20)

4) A control bar was added which allowed users to play, pause, skip and rewind the introduction. See Figure 5 – 21.
5) Once the introduction ends the gallery starts downloading automatically. See Figure 5 – 22.

6) If ‘exit’ is clicked, a confirmation question appears to give the player a second opportunity before exiting the game. See Figure 5 – 18.
5.3.1 General Discussion

It was hypothesized in Section 3.5, that e-leaning material could improve the teaching of the ICT curriculum in primary schools in UK. Investigating the current status of available e-learning material that could be associated with the teaching of ICT in primary schools indicated that available materials do not satisfy user needs. In Section 2.3.1.2, it was hypothesized that in order to design e-learning material that satisfied children's requirements, they should be involved from early stages in the design process. As teachers are the gatekeepers of e-learning materials in schools, their concerns should be considered as well during the design process.

With this in mind a more user participatory approach was developed around the understand, propose, realize, and evaluate lifecycle.

It was found that involving teachers in the early design stages was beneficial in ensuring the material was appropriate and would support the intended learning outcomes. Including children provided valuable insights into which factors were important to them (for example it might have been predicted that primary school children would have liked cartoon characters) especially since the teachers were reluctant to comment on (or did not know) children's preferences.

The game was modified according to the changes required by the teachers and children. Afterwards, the usability of the material was tested by designers within the School of Art and Design. Issues noted verbally while testing the game and the data collected through the usability test were considered and the game revised prior to its implementation in school. The school evaluation is described in Chapter 6.
CHAPTER 6: E-LEARNING MATERIAL SCHOOLS’ EVALUATION

This chapter reports on the school based evaluation of the final version of the game. The evaluation was designed to understand the teachers’ perception of the material and the extent to which they thought it might help achieve the learning outcomes, the pupils’ perception of the material, their likes and dislikes of the design specification and the influence the material had on their achievements. The following sections describe the aims, objectives, methods and results of each part of the evaluation. This is followed by an overall discussion of the evaluation in relation to the aims of the research.

6.1 Introduction

As indicated in Section 1.2, the third research objective was to evaluate the e-learning material produced using a Child Centred Design process which takes into account the requirements of the age group, teachers and curriculum in a British primary school context. In this chapter, an evaluation study is described, which was undertaken to explore the effectiveness of the e-learning material developed to support the teaching of the ICT curriculum in primary schools.

An evaluation of an e-learning material should include usage in the classroom, the learning process (Figure 6-1 illustrates various aspects of students’ learning experience (Bain, 1999)) and not just the learning outcomes.

Figure 6-1 : Stages of the learning experience
Hence, in order to evaluate the effectiveness of material developed to support the areas specified by QCA but currently neglected, a comparison based study should be undertaken where two groups of students are compared on one or more dependant variables. One group would be exposed to the intervention, while the other receives the traditional method of instruction. Many evaluation studies of educational software are comparison based (Puphaiboon, 2005). Unfortunately, implementing the e-learning material in a school, as an integral part of the ICT curriculum was not possible due to the lack of collaboration offered by the schools, therefore the evaluation was limited to interviews with teachers and students and classroom observations.

A mixed method approach was used in the evaluation combining qualitative and quantitative research techniques (Collins and Onwuegbuzie, 2004). This provided an opportunity to triangulate results from different approaches. The learning change is reflected by the quantitative data gathered by comparing the pupils' pre and post trial scores. Pre and post written test results have been used to determine the impact of an intervention on the learning outcomes (Sim et al., 2006; Van Leeuwen, 2004). However, the use of these alone does not provide feedback regarding the user satisfaction and can be of little value for design purposes. Therefore, to capture the student’s feedback on the design issues associated with the material, paired interviews with the children were undertaken.

Though the pre and post test mostly rely on children perceptions of what they think they learned, little attention is given to the behaviours that take place during the interaction (Beattie, 1994). Therefore, observations were undertaken to capture the students interaction with the material and teachers were interviewed to determine what they think the children could learn using the e-learning material. Adding qualitative interviews and observations to quantitative data provides an opportunity to understand the phenomenon from the participant’s perspective (Johnson and Onwuegbuzie, 2004; Merriam, 1998). Qualitative data was gathered from interviews (semi structured, paired interviews), classroom observations, field notes and student work, which were coded to identify and categorize recurring themes. Figure 6-2 shows the evaluation methods used and the type of data collected.
The evaluation assessed:
1. The extent to which the material was designed to meet the underlying requirements.
2. The effectiveness of the material, and its design quality, in achieving learning outcomes and enjoyment.

The evaluation consists of four parts as follows:
1. Semi structured interviews with teachers to assess the extent to which the e-learning material facilitated teaching and learning in a school context (Details in Section 6.3).
2. Assessment of learning gains using a pre and post tests (Details in Section 6.4)
3. Children's reactions to the game were collected through classroom observations (Details in Section 6.5).
4. Further information was collected on specific likes and dislikes of the children through a focused discussion and a likeability box after they had played the game, This would feed into the iterative development of the game (leading to its eventual use in Saudi Arabia) (Details in Section 6.6).

6.2 Participants

The evaluation took place in three primary schools in Coventry, considered to be representative in terms of the level of ICT usage. The schools were rated as low (very few computers and reported low priority given to ICT), medium (computers in the
classroom but reportedly low priority given to ICT) or high (computers in the classroom and suite and reported high priority given to ICT) by Ofsted. For each school, one year 6 teacher and 10 year 6 children were selected to take part in the study. As Diana et al. (2005) indicated that results conducted through children's involvement in the design process can not be generalized, one of the schools had participated earlier in the design process was involved in the evaluation in order to determine whether this group would evaluate the effectiveness of the material differently. This would confirm whether it is possible to generalize the design specification of the participants.

6.3 Assessment of the teacher's view of the e-learning material

This part of the evaluation assessed what teachers felt about the e-learning material, it's potential to support them in teaching the learning outcomes that they neglected within the ICT National Curriculum (Details can be found in Section 3.3.2) and their overall perception. The views of the teachers are important because they are indirect users of the material and also the gatekeepers of the e-leaning material in schools (Section 4.3.2). It is their decision to use or not use the material, they may use it how they like in their lessons, and if this was commercial software they might influence its purchase.

6.3.1 Methodology

One to one semi structured interviews were undertaken in which the teachers reviewed the material, assessed its appropriateness and the extent to which it could facilitate the teaching of ICT skills in primary schools.

The selection criteria used by teachers in judging e-learning materials (see Section 4.3.3) had been considered in the overall design of the material and was also used to shape the interviews. Teachers were asked to rate the appropriateness of the material in relation to children's preferences and understanding (from 1 to 5; 1 is the least, 5 is the most) according to its game concept, game tasks, rules, instructions, character, text, images, interface design, speed of the mouse movements, use of keyboard keys, and fun. In addition, they were asked to assess the educational value of the game idea, task duration and scoring system. The opportunity for self assessment of ICT skills and the sufficiency of feedback provided by the game were also considered. Finally
teachers were asked to report any obstacles or limitations that might prevent the use of the material in school. For details about the interviews questions see Appendix F.3.

6.3.2 Results

The teacher who had participated in the earlier design process ranked the material differently than the other two – consistently giving full marks to the suitability of the game in terms of its concept, tasks, instructions, character, text, images, interface design, speed of the mouse movements, and use of the keyboard arrow keys. The other teachers mean scores on all items was slightly lower at ‘4’. They added that the instructions were especially clear, with not too much to read, making it possible to use the game even with students who had a low reading ability.

Assessing the educational value of the game (its overall rationale, tasks, questions, duration, and scoring system), two of the teachers (including the one who participated earlier in the design process) indicated that it had good educational value as it had been provided with a template that could allow them to add their own material, thereby making it tailor to their needs. They added that the tasks would lead to the fulfillment of learning outcomes, the duration assigned for each task was suitable and the scoring system could be used as evidence of the pupils ICT attainment. While the third teacher ranked the idea of the game, tasks, duration and the scoring system 3 out of 5 without adding any comments.

All the teachers appreciated the value of the online record system which showed the number of wrong attempts, time spent on each task, and the number of points collected through achieving the task correctly. One of the teachers added that she liked the musical background of the game.

Regarding the implementation of such a game in the classroom, two (including the one who had participated in the design) indicated that the game was easy to use, and did not need a high level of technology skills. It could be easily integrated in the ICT lesson. While the third teacher mentioned that it would be difficult to use this game with low ability students. In addition, all teachers appreciated that the game could be used in different subjects, if different content was provided (for example, for geography, images from different countries/scripts written in different languages could be used).
However, they all agreed that the game can be used effectively in achieving the learning outcomes that were not covered currently.

In summary, the teachers believed that the e-learning material (game concept, task, instruction, images, text, and character) suited the pupils understanding and preferences. Moreover, they all agreed that the material was easy to use and could support them in teaching the skills that not currently considered when teaching the Multimedia Presentation Unit (MPU). Though the teacher who participated in the design from early stages showed more satisfaction with the appropriateness of the material and in his willingness to use it, all teachers showed that they would be able to use the material to support their teaching of the Multimedia Presentation Unit. The ability to modify the game to include other material was well received. Furthermore, teachers pointed to the possibility of using the material to support them in assessment.

6.4 Assessment of the learning outcomes gained using the e-learning material

This part of the evaluation aimed to assess the extent to which the material contributed to the learning outcomes. This involved a comparison of the performance of students before and after using the e-learning material.

6.4.1 Methodology

6.4.1.1 Participants and materials

10 participants from Year 6 were selected by their teacher from each school. All were accepted for the study after having acquired parental permission (See Appendix F.4) for them to take part. The mean age of the students was 9.8 years. They were required to carry out a pretest (See Appendix F.5) before using the e-learning material. They were then exposed to the game on their own workstations. The study was administered for one hour, after which a post-test (See Appendix F.5) was administered to determine whether exposure to the material had affected learning.
6.4.1.2 Treatments

Students were given ten questions in the pre and post tests, generated by the researcher in collaboration with the teachers, in the form of a multiple choice quiz, with four possible answers to each question. The tests focused on the skills that the e-learning material was teaching, such as the ability to categorise information according to type, to match different information types (text, images, sounds) according to their compatibility to each other, suitability to purpose, context or audience.

6.4.1.3 Procedure and measures

This study was administered in the following manner;
1. Introduction to the study and procedural rules such as no copying or discussion with others.
2. Paper based pre-test
3. 40 minute interaction on the game
4. Paper based post-test, using the same questions as in 2.

During the study, if a participant did not understand the question, clarification was provided.

6.4.2 Pre and post test results

Regarding the effects of playing the game on learning outcome, Table 6-1 and Figure 6-3 presents the results of the pre and post test and the skills improved after using the material.

12 students achieved higher results in the post-test than the pre-test. 18 students achieved the same results in both tests, and 12 of these had already achieved full marks. 6 out of 18 answered the same question wrongly in both the pre and the post test, such as the type of information that can be stored on a CD.

In summary, the comparison of the pre-and post-test results indicated that the pupils' skills associated with MPU either increased or remained at the same level.
Skills measured in pre and post test

<table>
<thead>
<tr>
<th>Skills</th>
<th>Pre-test</th>
<th>Post test</th>
<th>students achieved higher results</th>
<th>Students achieved same results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer</td>
<td>Wrong answer</td>
<td>Correct answer</td>
<td>Wrong answer</td>
<td></td>
</tr>
<tr>
<td>Understand what Multimedia presentation is.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 14 20 10 4</td>
<td>26 (16 Full Mark, 10 No change)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recognize the difference between multimedia and other forms of media.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 12 18 12 0</td>
<td>30 (18 full mark, 12 no change)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify the storage medium of different types of information (i.e. text, images and sounds can be stored on a CD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 18 24 6 8</td>
<td>22 (12 full mark, 10 no change)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6-1: pre and post test results

<table>
<thead>
<tr>
<th>No Change</th>
<th>Full Marks</th>
<th>Same results</th>
<th>Higher results</th>
</tr>
</thead>
<tbody>
<tr>
<td>60%</td>
<td>66.6%</td>
<td>33.3%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Figure 6-3: Pre and post test results
6.5 Observations to assess the children's reactions to the e-learning material

This part of the evaluation aimed to assess the pupils' interaction with the e-learning material.

6.5.1 Methodology

The study took place in a quiet ICT room with the researcher standing in the middle of the room, and students seated at workstations.

The pupils used the e-learning material individually on separate workstations. As video recordings were not allowed, the researcher organized the class in such a way that children could be observed in 3 groups.

Structured observation using previously defined categories (engagement, facial expression, interaction with peers etc.) was used. An observation form (See Appendix D.2) was constructed on which activities of interest could be recorded. The researcher explained the details of the trial to the participants at the start of the session.

6.5.2 Results

Once the students started the game all of them concentrated on the screen, holding the mouse, ready to respond and interact with the game. All students were excited by the game.

On the first screen (see Figure 5-19), 27 of the students clicked apply now without any hesitation, 3 commented as follows and then clicked apply now:
"I do not have a job, so I will apply for a new job"

On the second screen "Find your job" (see Figure 5-20), students moved the mouse over the jobs and their response can be classified as follows:
1. 12 recognised that the "gallery manager" was the only active link and clicked on it;
2. The remaining 18 students were confused what to do on this screen. 13 did not know what to click, and 5 did not want to click on any of the options. Comments
from this latter group included "I am not interested in any of these jobs", "Why is it the only working option?"

After they had asked these questions, they either realized what they needed to do or were guided by their peers with phrases such as

"Click the word apply now at the lower right corner";
"You can only work as a gallery manager"

Occasionally the observer advised them what to do.

After applying for the job, the player moved to the third screen, which required an application form to be filled in (See Figure 5-15). All the students filled in their own information. 3 did not understand the meaning of the words "submit", and "reset" and 5 asked their teacher about the spelling of some words.

On the log in screen (See Figure 5-16), where the player creates a user name and a password for the game, 18 understood that they had to create a new username and password while the remaining 12 students were confused about which user name and password they had to enter. This was because they already had an account on the school computers and did not know that they needed to create another.

Once they created a user ID and a password they proceeded to the introduction screen where the artist explains the instructions of the game. When the character appeared some students commented:
"Ohh", "who is he",
"Ohh, he is the owner of the gallery",
"that's cool",
"I like it",
"Oh, interesting",
"Are we the first one to play it?"

One of the students repeated what the character said in a similar voice and made exclamations with his hands.
16 students listened carefully to the instructions given by the artist and used the pause button when their peers talked to them to avoid missing any of the instructions. 10 skipped the introduction, 4 just watched part of the instructions and then responded to their peers who had asked them to skip the instructions. Comments included:

"Just press skip he speaks too much"
"Click skip to start playing"

Once the game loaded, the students could start playing it and moving around the gallery (See Figure 6-4).

During the first stage students could be divided as follows:

1. 27 moved the mouse trying to pick objects and drop them in the right container.
2. 6 looked at their peers’ screens, either to see how far they had proceeded with the game, what their score was, or to find out what to do.

Comments from the students at this stage were either related to their performance, (e.g. "I scored 30", "I scored 45"), or the design (e.g.: "ohh, this game got a mobile in it", "wow, I like this game"), some asked who designed it and how. 70% of the comments and interactions with peers were related to score comparison.

Students who had not listened to the instructions or had skipped it frequently asked their peers for guidance.
Comments included:
"I do not know even what to do",
"How to zoom in",
"How can I move around the gallery?"
"How do you walk around?"
"How can I pick this",
"I can not hold it, how can I hold it?"
Such questions were either ignored or peers commented as follows:
"See you do not know what to do, because you did not listen to the artist".

In most cases the observer did not answer such questions, and the students either got an answer from their peers, or found out what to do by themselves.

10 students played silently. 20 commented throughout, such as:
While picking the objects, students’ comments were as follows:
"Oh, my god, it is not picking the object. This is hard",
"Why is it falling?"
"If I put it in a wrong container, does it fall on the floor?"
"Why does it fall down?"
"I can not pick it up any more?"

When they did the task correctly and received scores they commented as follows:
"Oh, now I have 30 scores"
"I got 10 more scores"
"I have more scores than you"

All the students who listened to the instructions dragged the CDs to the laptop (Figure 6-5) to explore its content, while the students who did not listen to the instructions dragged the CDs to the sound container assuming that the CDs only contained sound. They did not know how to explore the content.

When the questions popped up such as what does multimedia include?, 21 students read them carefully and tried to answer them correctly, while 9 just clicked any answer to continue playing the game. To answer the question, 18 of the students tried the mouse to click on the right answer and when it did not work they used the keyboard.
When the question about multimedia popped up, 10 of the students asked what multimedia meant!

As the pupils moved through the game, their speed increased, questions became less and their comments related to their scores.

After 13 minutes from starting stage 1, time started to run out, their comments were as follows:
"Can I exit and play the other stage?"
"I want to restart it and play it again".

Generally, through the whole game, the students were busy with the game itself and were not distracted by other events.

6.6 Study 4: Assessment of the children's' opinions about the game

Williams (2002) indicated that the value students place on e-learning can be at variance with the expectations of their teachers; hence, it is important to collect the students' feedback as they are the primary users of the e-learning material.
This part of the evaluation therefore aimed to understand the pupils' perception of the learning intervention. The evaluation conducted using the pre and post test and the teachers interviews would reflect the extent to which the material could assist the teaching of the Multimedia Presentation Unit. However, this part of the study was undertaken in order to assess the children's satisfaction with the design as this would be an indicator to the effectiveness of the child centred design approach undertaken in terms of providing a useful design for the material from the child’s perspective.

6.6.1 Methodology

This study was undertaken using two methods: 1) A 15 minute paired interview; 2) quantitative assessment using a ‘likeability box’. As children find it difficult to answer usability questions, a verbal/action method was developed to capture data on what aspects of the game they had liked. See Appendix F.6 for the criteria considered in the Likeability Box Activity and the questions of the paired interviews. Four boxes were placed at the front of the classroom, each box indicates a different level of likeability (a lot, a little, not at all, not applicable). Each participant had 10 cards -one for each criterion (see Table 6-2) - after the researcher explained the criteria on which they had to judge the game, they move to the front of class and dropped the card in the boxes based on their feelings about the game.

6.6.2 Results

The results from the ‘voting’ are shown in Table 6-2. This shows the criteria and the number of students who agreed, or disagreed with the statement.

The results can be interpreted as showing that two thirds of the students indicated that they liked the game - they said that they would like to play it again and thought that their friends would like the game. Only 3 indicated that they did not like it and 1 thought that his friends would not like it either. 19 liked the colours of the game, 15 liked the story and 18 enjoyed playing in a 3D environment. While 6 believed that the game was hard, and it was not easy to pick up objects. 8 thought that the speech was boring while 12 said that the music was interesting.
Considering the group of students who had participated in the actual design process, 8 out of 10 indicated that they would like to play the game again and all of them thought that their friends would like to play it. The entire group liked the colours and playing in a 3D environment, 8 liked the story a lot. Regarding the movements in the gallery, 2 indicated that it was not easy at all to move in the gallery, while 6 thought it was somewhat difficult to pick up objects. 5 thought that the game was hard and the rest considered this criterion to be not applicable. 6 thought that the speech was not boring and 3 thought that it might be a little boring. 9 thought that the music was interesting, and 1 thought that it was not.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Yes</th>
<th>A little</th>
<th>Not at all</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would like to play it again</td>
<td>21</td>
<td>6</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>My friends will like this game</td>
<td>20</td>
<td>6</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Playing with the game made me want to explore more about what I saw</td>
<td>13</td>
<td>8</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>I liked the colors</td>
<td>18</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>I liked the story</td>
<td>15</td>
<td>12</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>I enjoyed playing in a 3D environment</td>
<td>18</td>
<td>11</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>I could easily move around the gallery</td>
<td>3</td>
<td>14</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>It was easy to pick up objects</td>
<td>6</td>
<td>16</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>The game was easy</td>
<td>7</td>
<td>16</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>The speech was interesting</td>
<td>8</td>
<td>14</td>
<td>8</td>
<td>-</td>
</tr>
<tr>
<td>The music was interesting</td>
<td>12</td>
<td>5</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>142</td>
<td>114</td>
<td>61</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 6-2 : Students feedback from the Likeability box

Following are the results of the paired interviews. The interviews considered the design specification proposed in Section 5.2.2.

1. Interfaces issues
   - Colour Scheme: 18 indicated that they liked it because it looks real. 6 said that it was acceptable. No improvement was required on the colour scheme.
   - Graphical Style: Most students said that they enjoyed working in a 3D environment and it was better than playing in a 2D one because it makes you feel that you were in a real environment. However, 9 suggested that it would be more interesting and
realistic if the gallery was larger, with people moving around it and walking through doors.

- Interactivity and Navigational System: When asked what they did not like about the game, two thirds commented on the interaction with objects- they did not like the level of precision required to pick up objects. Moreover, when asked about movement in the gallery and moving objects, 9 indicated that moving this was boring and frustrating, although half pointed out that moving around the gallery and picking up objects was hard only when you started the game, but once you had practiced it, it became easy. Improvement suggested to the navigational system was limited to the removal of the skip button from the introduction. This was suggested by 2 students because pupils skipped this and then did not know what to do.

2. Audio
- Music: 6 suggested having a variety of music, where you can choose the one that you would like to be played during the game.
- Voice of the character: All students indicated that the voice was clear and understandable.

3. Instructional structure
- Instructions: All the pupils agreed that the instructions were clear as they explained exactly what to do.
- Questions: 3 indicated that the questions that appeared in the game were hard and that they did not understand them.
- Levels of Activity :Regarding whether pupils saw this game differently from other games they played before, and how it was different; Most of the students indicated that it was different - 21 said it was more artistic, 12 said that it was challenging. Another pair added that this game was not as adventurous as other games; that it had tasks whilst others were more fun. 12 indicated that they had never played games with similar tasks and 8 said that it was the first one that they had played on job role.
- Learning outcomes: When asked about what they learned from the game, 9 indicated that they learned about art, 12 learned about jobs and how to apply for a
job, and 15 pointed out that they had learned about CDs, what they may store, and what multimedia was.

4. Motivational Factors

- Timer: All the pupils said that the timer was good, because it let you know how much time you had left and kept you moving because you had to do the task before the time ran out.
- Rewards: All the pupils indicated that having the scores shown on the screen was exciting. 21 said that they watched them through the game. 1 added that they should not loose scores if they do the task incorrectly.

Character: 8 students said that they did not like the character. However, the group of the pupils who participated in the design process liked that character and thought that it was better to have an older man as this reflects that he is an expert, so they would accept his advice. If he was young they would not accept what he said. When the possibility of improvement was discussed, 15 suggested changing the artist to a younger man, 9 of the girls questioned why it was male. Also 19 suggested having a character moving in the gallery instead of the mouse movement, 7 added that it would have been better if they were given the opportunity to create their own character and play with it.

In summary, most children liked the game colours and, story, and thought that their friends would like it. Playing in a 3D environment was the most thing children liked about the game.

6.7 Discussion and Conclusion

The material presented in Chapter 5 led to the achievement of the second research objective which was to develop a Child Centred Design Approach gratitude for the creation of e-learning material and the third research objective which was to develop the material itself. However, in order to fulfill the research aim which is to explore the effectiveness of using e-learning to support the teaching of the ICT curriculum an evaluation was needed to assess the extent to which the use of e-learning improved the teaching of the Multimedia Presentation Unit.
As indicated by Puphaiboon (2005), assessing the effectiveness of a teaching or learning method is difficult because the learning experience includes several interdependent variables including individual factors such as background, gender, culture, background, perception and usage of technology outside school; institutional factors such as quantity and quality of technology. See Figure 6-6.

Thus, it is difficult to find whether students like something because it’s new, or dislike it because it’s unfamiliar, or if it is actually good or bad. Accordingly, in assessing the students' performance, it is not possible to isolate the effect of the new medium, and its perception by different cohorts of students. This is addressed as one of the main limitation of the evaluation conducted in the present research (See Section 9.4).

The development of students’ ICT skills is affected by their use of ICT outside school (Section 2.3.2); As the teachers indicated that the pupils use of ICT at home influence their ICT ability at school (Section 3.4.1.4), the researcher questioned whether this would be the case when pupils use the e-learning material. However, the pretest and post test were undertaken at the same session, so the pupils home use would not affect their scores.

Several researchers have found that attitudes toward technology differ significantly between males and females, with males indicating greater interest and knowledge
Moreover, other researchers have found that female students perceive technology as more difficult and less interesting than their male counterparts (Teasdale and Lupart, 2001). However, in the evaluation of the game there was no difference between the responses of the pupils according to their gender except in questioning the gender of the ‘expert’ in the game. Males prefer the character to be male while girls prefer it to be female, but do not mind if it is male.

The evaluation revealed that the material designed in collaboration with students and teachers could support the teaching of the ICT curriculum. This was confirmed through the interviews with teachers who said that the material could help them to teach the skills that they neglected in teaching Multimedia Presentation Unit. Also the results of the students pre and post test showed that the material helped them to achieve the intended learning outcomes. This answers the research question raised in Section 1.1.

Moreover, to assess the extent to which the child centred design method used has created material that satisfies the user requirements, an evaluation was conducted through children's interviews and a likeability box to determine their level of satisfaction. Results indicated that the material satisfied the children. This indicated that it is worthwhile including children in the design process. It can also be concluded that child centred design can be applied effectively to 9-11 years old as their collaboration showed that they can make sophisticated comments even if these are impractical. They showed understanding of how people use the interface, this was mainly reflected by the way they divided their answers to what the like or dislike about the game.

Abras et al. (2004) indicated that products developed using user centred design only satisfy the end users who participated in the design process, not other users. However, involving children who participated earlier in the design process in the final evaluation indicated that there was no difference between the satisfaction level of the children who participated earlier in the design process and those who were introduced to the e-learning material in the evaluation stage.

There are other factors that should be considered in order to determine the effectiveness of the design process. These include the management of the project, the
participants involved in the design process, the designer capability. The practicability of the design process is assessed by Saudi designers in Section 7.5.

Although of a limited nature, the evaluation has shown that the material designed using a child centred design approach has satisfied the children. Therefore, a set of guidelines for the design of e-learning material for children can be developed.

Moreover, the mixed method evaluation approach produced useful, pertinent feedback. Hence, it could used to inform future research.
CHAPTER 7: ICT TEACHING, E-LEARNING DESIGN AND ASSESSMENT OF THE CHILD CENTRED APPROACH IN SAUDI ARABIA

This chapter presents four studies conducted to gain an understanding of how ICT is taught in Saudi Arabia and how e-learning material is designed. These were undertaken to enable the understanding ground in the UK to be transferred to Saudi Arabia. Moreover, an assessment of the practicability of the child centred approach to designing e-learning material in Saudi Arabia was conducted.

The following sections describe each study. This is followed by a discussion of the results and the overall objectives of the research.

7.1 Introduction

As indicated in Section 1.1, there is a need to improve the teaching of the ICT curriculum in Saudi Arabia. As ICT has been taught for longer in the UK, it was hoped that lessons learnt from the development of a more mature system could be applied in Saudi Arabia with regard to teaching ICT. All investigations conducted earlier in the previous chapters were undertaken in the UK. In order to understand how material could be applied to Saudi Arabia a further set of investigations were undertaken to investigate current teaching practices of the ICT curriculum, use of e-learning materials and design practices in Saudi e-learning companies in order to determine whether the child centred design approach developed would be commercially viable to Saudi Arabian companies.

7.2 Study 1: An investigation of the current teaching practices of ICT in schools; compared to UK

When the Kingdom of Saudi Arabia was founded in 1932, opportunities for education were not widely available. This has changed dramatically over the intervening years. Since the formation of the Saudi Ministry of Education in 1954, the Kingdom has devoted vast resources to an ongoing educational program covering primary, secondary and high schools. Structure of the Saudi education is presented in Table 7-1.


<table>
<thead>
<tr>
<th>Age</th>
<th>Level</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-12</td>
<td>Primary</td>
<td>6</td>
</tr>
<tr>
<td>13-15</td>
<td>Secondary</td>
<td>3</td>
</tr>
<tr>
<td>16-18</td>
<td>High school</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 7-1: Structure of Saudi Education

For the last few decades, technology has been revolutionising every aspect of life. Saudi Arabia has responded to the technological expansion in most areas, including education. However, the use of technology in education is still not widespread and many schools may be categorised as being at a transitional stage in their movement towards e-learning.

7.2.1 Aims and Objectives

This study aims to determine the current status of teaching ICT and using it as a tool in Saudi education. This aim was broken down as follows:

1. To explore the practice of ICT as a tool in teaching and learning (e-learning) in Saudi Arabia.
2. To determine the current status of the ICT curriculum in terms of divergence between public and private schools, content, teaching practices and techniques.
3. To compare the current teaching practices of the ICT curriculum in Saudi Arabia and UK referring to the results presented in Chapter 3.

7.2.2 Methodology

The study included secondary, public high schools (funded by the government to provide free education) and primary private schools (run and supported by private individuals or a corporation rather than by a government or public agency). The ICT curriculum is currently being taught in public high schools, has just started to be introduced in public secondary schools and has not yet started to be taught in public primary schools.
30 secondary, public and private high schools and private primary schools were contacted in Riyadh. Using information provided by the head teacher or educational consultation company 'E-learning Solutions', 10 of these were selected as providing a representative sample in terms of the catchments areas, provision of ICT facilities and usage levels. See appendix G.1 for the list of the schools who participated in the research. 14 ICT lessons were observed and semi structured interviews were conducted with the ICT teacher in each school. This was the same method as used in the UK (described in Section 3.2). The interview questions were divided into two main themes:

1. ICT as an educational tool (e-learning) in the school (including use of software packages, CD-ROMs, websites, and technological tools such as projectors);
2. The ICT curriculum (content and teaching practices).

7.2.3 Results

This section describes the results associated with both private and public schools and as a conclusion to the results section, the main differences to UK have been indicated.

7.2.3.1 ICT as a tool

The decision regarding the use of ICT across the curriculum is made at school level and not by the teachers in either type of school. For example, 2 out of 5 of private schools required all teachers to embed ICT in their subjects. No public school has trusted teachers to integrate ICT across curriculum. Thus, school management influenced the extent to which ICT was integrated across the curriculum in both private and public schools.

3 of the 5 private schools used ICT to support other parts of the curriculum (i.e. not computer studies/ICT itself) and teachers were excited about integrating technology across the curriculum.

However, the public school teachers were not in favour in integrating ICT across the curriculum for the following reasons:
1. Lack of technological competence, confidence and experience. This was felt to be an issue by 4 out of 5 teachers, evidenced in comments such as “the computer always goes wrong when one most needs it to work”, “It would seem that the computer has a mind of its own! It knows how we feel, and plays up for us and will always work for other people”. Thus the computer can become a real threat, undermining the authority of the teachers. This is especially problematic when the pupils have more expertise than the teachers and can make the machine work.

2. The computer is considered a time-consumer, not a time saver. This issue was pointed out by 3 of the teachers; some of their comments were as follows:

“I don’t have time to learn new things. I have lots of work to do “;
“I know that children will like it, but I will spend a long time to learn how to use it, even longer than the children themselves”.

Furthermore, none of the public schools used e-learning. 4 of private schools were moving towards integrating some form of e-learning, with 3 using e-mail as one of the main correspondence tools between the student and teacher and between the students themselves. 3 of the private schools had a website that either included information about the school, or that could be used as an interaction tool between the students and teachers, and between the parents and the school. The private schools and individual students represent the major clients for commercially produced e-learning materials in Saudi Arabia.

E-learning material is selected by the teacher. This decision is based on educational value, correlation with the curriculum, ease of use, cost and level of entertainment. 4 of the teachers selected e-learning materials to support the curriculum content while the other looked at entertainment value.

Currently there are two private secondary schools in Riyadh (Kingdom School and Najd School) and two in Jeddah (Dar – Al Feker, Al-Andalus) that are implementing e-classrooms where every pupil has their own laptop to access the curriculum online. This was developed by an external company. Additionally, three schools in Riyadh (Manarat Al – Riyadh, Al-Rawad, and Al-Madrasa) are publishing lessons of core subjects such as
Interviewing the primary schools teachers about their experience of implementing e-learning indicated the following:
1. Schools do not have any evidence of improvements in learning outcomes following the introduction of e-learning.
2. All the teachers agreed that students were motivated and excited about the use of e-learning in classrooms. However, it was not clear whether they were motivated by the implementation of the e-learning, its integration in the teaching and learning process, or the design of the content.
3. All the teachers enjoyed using e-learning, although it required more effort in planning their lessons and managing the teaching experience.
4. 3 teachers felt they needed to be trained on how to integrate e-learning effectively in their classrooms.

In summary, regarding the use of ICT as a tool across the curriculum, a divergence has been identified between public and private schools in the quality and quantity of usage. Private schools are more advanced than public ones due to the financial resources available for teacher training, the purchase of IT equipment and teaching material. In addition, pupils at private schools come from higher socio economic areas and have good access to IT resources outside schools. The public schools had not yet started to trust teachers to integrate ICT across the curriculum; their teachers were not in favour of using e-learning material to support the curriculum. However, all private schools were using e-learning.

A comparison between the results and these from the UK study is presented in section 7.2.3.3.
7.2.3.2 ICT as a subject

7.2.3.2.1 ICT teaching practices

In both public and private schools the ICT lesson was divided into two parts; 1) the teacher centred part in which teachers focused on the theoretical issues involved in carrying out the task on the application being taught in the lesson; 2) pupil centred part in which the students have the opportunity to apply and practice what they have learnt on their PCs.

Microsoft PowerPoint was the most common application used in the private schools and by one of the teachers in a public school. Teachers preferred using PowerPoint because of its easiness in creating, using and updating presentations and because it is a readily accessible for presentation that can be conveyed to the whole class by means of a projection device or the intranet. Teachers created a PowerPoint presentation which contained the lesson objectives, bullet points of what would be discussed during the lesson and sometimes printed screens off the computer application. The presentation was projected during the teacher centred part of the lesson.

When teachers were asked about the implementation of other forms of e-learning, rather than their own PowerPoint presentations, 7 of the 10 teachers referred to the unavailability of such material associated with the National Curriculum. While 3 knew of some curriculum related e-learning materials, they indicated that these were not what they needed, and that using such material caused them to plan their lessons around the material and sometimes use different learning pedagogies, with little benefit.

7.2.3.2.2 ICT curriculum

Evaluation of the curriculum revealed a large divergence between public and private schools and between the private schools themselves in terms of the content and the age at which ICT education begins. ICT literacy is relatively new, Doheash and Aloreani (2001) noted that the "ICT has just started to be taught formally in Saudi public schools in 2000". However, most private schools started to teach aspects of ICT studies in 1995.
ICT is taught in public high schools to students aged between 15-16 years old. However, 2 out of 5 of private schools started to teach ICT from Kindergarten, 2 from Primary or Secondary level. Only one started to teach ICT in high school. Although in 2005 the Ministry of Education formally approved the teaching of ICT in all public primary and secondary schools, this has not yet been implemented.

Regarding the content of the curriculum, public high schools teach the unified curriculum as specified by the Ministry of Education in 1999 (see Table 7-2 for an overview of the curriculum content in public high schools). Currently two ICT courses (one course a year – 2 classes a week) are required for all students at grades 10-12. However, schools in remote areas have not introduced ICT as a subject yet.

<table>
<thead>
<tr>
<th>Course syllabus</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 2: Computer science</td>
<td>Operating system, Programming, Decoding and numbering</td>
</tr>
<tr>
<td>Part 3: Computer application</td>
<td>Types of software, Data entry, Word Processing, Desktop Publisher, Excel, Computer and Education.</td>
</tr>
<tr>
<td>Part 4: Information system</td>
<td>Databases</td>
</tr>
<tr>
<td>Part 5: Information age</td>
<td>Computer careers, computer and social services.</td>
</tr>
</tbody>
</table>

Table 7-2 : Computer Curriculum Content in Public High Schools

The curriculum specified by the Ministry of Education concentrates on theoretical aspects. All public schools and most of the private high schools teach this curriculum. However, primary and secondary private schools may teach a different curriculum from public schools, leading to variation within the private school sector. This again confirms the finding of Almoneea (2001) that “in primary and secondary private schools, ICT curriculum varied from one school to another. Since it is not created by a specialist, it depends on personal diligence more than educative groundwork.”
Private school teachers create their own curriculum and 4 of them considered it as a ‘fun’ class. As a result the curriculum may concentrate on entertainment such as games, colouring and storytelling for amusement purposes. Although computer applications such as Microsoft Office, Flash, Photoshop, 3D Studio Max were taught there was not any standardisation. It may be concluded that the Ministry of Education has not managed to unify the ICT curriculum across private and public schools. Additionally as the grades from ICT subjects are not included in the students GPA (Grade Point Average), teachers may strategically concentrate more on subjects that are examined. This means that the ICT class timetable may be reduced when extra time is needed for other core subjects such as mathematics or science.

Regarding the qualifications of ICT teachers, the majority were trained as engineers or specialists in computer science and not educators. This confirms Al-Moneea’s (2001) finding that the majority of the ICT teachers in private schools are not educational specialists. This may cause “difficulties in information delivery, weakness in students gaining skills, and weakness in utilising modern teaching methods.”

Table 7-3 presents a comparison between public and private schools with regard to the use of ICT as a tool and teaching ICT as a subject.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Public Schools</th>
<th>Private schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT as a tool (e-learning)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integrate e-learning across curriculum</td>
<td>No</td>
<td>• Integrate e-learning in core subjects such as Mathematics and science</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Use e-mail to communicate students and teachers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Has an official website</td>
</tr>
<tr>
<td>ICT curriculum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start teaching ICT</td>
<td>2000</td>
<td>1995</td>
</tr>
<tr>
<td>Age</td>
<td>High School (15-16 years old)</td>
<td>Either Kindergarten, Primary, or Secondary</td>
</tr>
</tbody>
</table>
### Table 7-3: Differences between Private and Public Schools

<table>
<thead>
<tr>
<th>Content of the Curriculum</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Unified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Based on theoretical issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Differs between schools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mostly practical and associated with fun</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teachers qualification</td>
<td>Mostly educators</td>
<td>Could be graduated as computer scientist, or engineers</td>
</tr>
</tbody>
</table>

#### 7.2.3.3 Comparison to UK results

The main similarities between the two countries are as follows:

1. The use of ICT as a tool
   a) Teachers believed that the integration of ICT in teaching and learning could improve the pupils learning, however, some teachers lacked general knowledge about and confidence in ICT. Additionally, e-learning is a recent innovation which challenges traditional ways of teaching and requires teachers to think how best to use it;

   b) E-learning was particularly used to support the teaching of core subjects such as mathematics, literacy and science;

   c) There is a divergence between schools in both countries regarding how ICT is integrated across the curriculum. This divergence is larger in Saudi Arabia;

   d) Teachers’ attitudes towards ICT influence the extent to which it is integrated, unless specified by school policy;

2. The ICT curriculum

   a) The focus is on teaching IT techniques (i.e. How to use specific computer applications).
b) There are limitations in the way in which ICT skills are assessed. Where ICT is used to support other parts of the curriculum, the focus might be on the subject area and not the effective use of ICT.

c) There is a divergence between the use of ICT at home and school.

The differences between UK and Saudi Arabia are as follows (See Table 7-4):

1. The use of ICT as a tool
   a) UK schools are more developed than Saudi private schools in terms of the extent to which ICT is used across the curriculum. Saudi private schools are, in turn, more advanced than the public schools.

In order to investigate the possibility of the transference of knowledge, it was important to understand the reasons behind the difference between the two countries. This can be attributed to the following:

   1) The educational system in the UK is mature, with a history of technological innovation and a willingness to embrace new ideas and technology;
   2) ICT training is provided to teachers in UK. However, ICT training in Saudi Arabia is limited to private schools teachers;
   3) The development of supportive material for teaching all subjects including ICT in UK such as lesson plans, and work sheets. No such material has been developed for Saudi Arabia either by the Ministry of Education or by private companies;

b) In UK e-learning is used as a supportive tool to enhance more traditional teaching methods. However, the plan in Saudi Arabia is to move to a full e-learning system. This is problematic as it may be argued that e-learning has not been proved to be the most effective method of tuition for all students, in all subjects. The current transitional stage – in which a blended learning approach is used (featuring both e-learning and traditional teaching methods), may be more effective. Saudi may move so quickly to full e-learning that it neglects to consider the benefits of dual teaching methods.
c) As indicated by BECTA, teachers’ ICT training in UK includes how, why, where, and when ICT can be integrated across curricula although this was not indicated by the teachers (see Section 3.4.1.4). In Saudi Arabia teachers are trained on how to use IT, and not how to integrate it or how to teach it significantly.

2. The ICT curriculum
   a) The ICT curriculum is relatively new in Saudi Arabia. It is not yet considered a formal subject in most schools. The Ministry of Education has not unified the curriculum content or the age at which ICT starts to be taught, particularly between public and private schools. But in the UK the system is more matured;

   b) ICT is taught from primary school in the UK. This only happens in Saudi private schools- so only privileged children may be taught about this;

   c) There is no generally available guidance or framework that primary school teachers may use as a reference to develop lesson plans; In the UK, teachers follow the QCA National Curriculum attainment gains and create their own lesson plans according to it.

   d) In Saudi Arabia, the focus is on computer literacy. In the UK, it is stated that the ICT curriculum should also involve communication using information technology tools.

The following table summarizes the differences between the two countries.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>UK</th>
<th>Saudi Arabia</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT as a tool</td>
<td>Matured system of integrating ICT across curriculum</td>
<td>No framework or guidelines of integrating ICT</td>
</tr>
<tr>
<td>E-learning use</td>
<td>Supportive tool</td>
<td>Moving towards a full e-learning system</td>
</tr>
</tbody>
</table>
| Teachers training | • How to teach ICT skills (How, why, where, when)  
                    • Integration of ICT across curriculum | • Limited to technical skills  
                    • Limited to private school teachers |
• Mandatory

| ICT curriculum | • QCA developed an attainment gains of all National curriculums in UK  
• Balance between the Information, communication and technology | • No reference or guidelines that can be used by the primary school teachers to develop lesson plans  
• Focus on computer literacy skills, mainly technical skills |

Table 7-4: Differences between UK and Saudi Arabia

7.3 Study 2: The design of e-learning material in Saudi Arabia

7.3.1 Aims and Objectives

The primary aim of this study was to determine how e-learning material is designed in Saudi Arabia. This aim was broken down as follows:

1. To determine the role of the producers of e-learning material in the e-learning development in Saudi Arabia.
2. To explore the extent of collaboration between the Ministry of education and the e-learning production companies.

7.3.2 Methodology

Semi structured interviews were conducted with the Educational ICT Manager in the Saudi Ministry of Education, and representatives from nine educational software companies (Sakhr, Al Dawalij Technologies, Al-Mareefa Al-Saudia Company, Obaikan Home Interactive, and Al-maalim, Ariss, Turath, Semanour, and Harf); who together have 90% of the e-learning market in Saudi).

Questions related to the level of understanding about e-learning, the use of e-learning in the ICT curriculum, implementation of e-learning in schools; cultural obstacles to the implementation of e-learning.
7.3.3 Results

7.3.3.1 Concept of e-learning

All company representatives agreed that e-learning material can be designed easily by transferring educational materials into a format suitable for either CD/ROM and/or the internet. All believed that it was simply a case of taking existing course materials and adding images, sound and animation and saving this in a multimedia format.

Although none of the companies have any statistical records about the effectiveness of their material on students learning outcomes, they all believed that e-learning would improve education and help pupils to gain greater learning outcomes.

7.3.3.2 E-learning and the curriculums

Commercial educational software packages formed most of the e-learning resources used in private schools and by individuals. This material was provided by five national software companies; Sakhr, Al Dawalij Technologies, Al-Mareefa Al-Saudia Company, Obaikan Home Interactive, Al–maalim and other international Arabic software companies (such as Ariss and Turath) that market and produce their products in Saudi Arabia.

The software produced by Al-Dawalij Technology, Semanour and Al-Mareeefa was intended to match the Saudi curriculum. Other educational software companies produce software that is merely supportive.

Emad Al-Doghairther, the manager of Semanour education and training company mentioned that their suite of e-learning material had been approved by the Ministry of Education and was implemented in Riyadh, Jubail and Al Madina. The material contains electronic books, publishing tools to help teachers convey the material in better ways and interactive multimedia libraries that include photos, videos, sounds, and flash movies.

All the national companies seemed to concentrate on producing multimedia CD-ROMs in science studies because of customer demand. However, at present no company produces
the ICT curriculum as e-learning material. All CDs related to computing are for teaching specific applications such as Microsoft Word, Excel, PowerPoint and Photoshop.

The companies claimed that they did not produce the ICT curriculum for commercial reasons, because of the divergence in content between the public and the private schools. Additionally the curriculum is still not an approved subject in most public schools.

However, there are three drawbacks with the existing educational CD-ROMs. Firstly, from the interviews it became apparent that material produced to conform to the curriculum content suffered from a general lack of copyright control and quality assurance. Secondly, its effectiveness was not evaluated. Thirdly, most programs simply re-presented the content of books on the computer screen without any significant treatment to assist or enhance usage. Even the same pictures and questions are used. So opportunities for engaging and motivating children to learn, have fun, and experience the wider potential of computers is lost.

7.3.3.3 Ministry efforts to integrate e-learning

To integrate ICT into classrooms, the Ministry needed to give both teachers and students a fundamental knowledge of computers. Accordingly, it embarked on an ambitious e-learning project to train teachers how to use major Microsoft applications (Al-Awaished, 2006 Educational ICT Manager, Saudi Ministry of Education). However, there is no collaboration between the e-learning companies and the Ministry of Education. The companies’ materials are still not subject to any quality or content assurance assessment by the Ministry of Education.

7.3.3.4 Obstacles to e-learning production

Obstacles to producing e-learning in Saudi Arabia, as indicated by the companies, are as follows;

1. The absence of standards for developing e-learning. USA released the first approved e-learning standard that depends on XML - the Sharable Content Object Reference
Model (SCORM) which is currently the standard followed by all e-learning companies in Middle East (Al-Mosa, 2002);

2. The rules, methods and ways of e-learning are still unclear, thus, there is not any enthusiasm to push this;

3. All the people working in e-learning are technicians, and usually decisions are taken by them relying on their personal experience, regardless of user needs. Experts in education at a theoretical or practical level do not have any input into e-learning, or if they do, they are not the decision makers. Therefore, there is a need to involve teachers, trainers, and educationalists in decision making.

Al-Mosa (2002) recommends the following to ensure successful development of e-learning:

1. Society prepares to accept and interact with this type of education;

2. Provision of an infrastructure to e-learning which includes trained human resources and technical resources;

3. A training program is anticipated for both pupils and teachers.

In summary, results indicated that:

1. E-learning producing companies believed that producing e-learning material can be simply done by taking existing course materials and adding images, sound and animation and saving this in a multimedia format.

2. E-learning materials were produced for core subjects only such as Mathematics, science and literacy due to market demand.

3. E-learning materials were produced without any collaboration with the Ministry of Education or quality assurance assessment.

4. The effectiveness of the materials was not evaluated by teachers before it was released.

5. Obstacles faced by the companies are associated with unavailability of rules or methods for designing e-learning and the gap between the producers and the end users.

Comparing this situation with the UK, although e-learning producers in the UK do not have a unified framework for designing e-learning material, each company has its rules and
quality assurance process and they do not copy from books. Hence, in Saudi Arabia there is a need for more collaboration between the companies, the end users (teacher, students) and the Ministry of Education. Section 8.5 presents a set of recommendation to the Ministry of Education associated with the design of e-learning materials.

7.4 Study 3: An investigation of current design practice

E-learning design is defined as the overall effects of the cognitive activity that takes place within the design team during the conception and formulation of a learning product, produced to meet some pre-defined pedagogic requirement (Barker, 1995). In addition, Barker (1995) indicated that the culture in which e-learning is developed and the cultural values brought to it by users should influence the design process. Therefore, it is important to understand the current design process, its shortcomings and the requirements of the e-learning designers in Saudi Arabia who will be the end users of the proposed method, in order to find whether it is similar to the design practices undertaken by designers in UK (See Section 4.2).

Interviews with teachers in UK, as indicated previously, showed that available e-learning materials, particularly the ones associated with the ICT curriculum are not used as they do not satisfy their requirements. Therefore, six educational designers responsible for the development of e-learning design in their respective companies were interviewed to determine how e-learning material was developed.

7.4.1 Aims and objectives

The primary aim of this study was to understand the current design process used in e-learning publishing companies. This aim was broken down as follows:

1. To determine whether formal methods currently exist and are used.
2. To establish the current design process and the roles of different stakeholders.
3. To consider issues in the current design process that might affect the quality of design.
7.4.2 Methodology

Semi structured interviews were undertaken with representatives from six major e-learning leading companies; Semanour, E-learning Solutions, Harf, Al Dawalij Technologies, Al-Mareefa Al-Saudia Company, Obaikan Home Interactive.

The interviews were carried out in the designers’ office on a one-on-one basis, where all comments were gathered through open-ended questions and audio recorded for later transcription (see Appendix E.1). Each interview lasted approximately 30 minutes with the researcher guiding discussion and asking questions when clarification was required.

7.4.3 Results

The designers followed an ADDIE instructional design model (Analysis, Design, Development, Implementation, and Evaluation), where each step has an outcome that feeds into the next stage.

The analysis stage focuses on matters relating to finance, marketing, and culture. Regarding the requirements of the target audience, designers differentiated only between wide categories of audience i.e. material designed for adults have different specification from material designed for children. Thus, only general user needs were considered such as: 1) In- direct instructions; 2) gaming factor; 3) stories; 4) use of attractive colours, images and sounds. After specifying the design requirements, the project manager passed these to the designer who then carefully copied the text book on to a computer screen. They assumed that the original author had already considered the suitability of the material in relation to user characteristics and skills, particularly if the material is authored by the Ministry of Education.

In the development stage, the marketing and finance departments influence the style and quality of the material. Marketing will consider the graphical style (2-D, 3-D and cartoon) used by other companies. Moreover, the marketing and finance departments plan the overall production in terms of design budget, evaluation, and launch time.
All designers indicated that they converted the text and graphics as presented in the textbook to an electronic form. They added extra graphics and sounds when they felt it was needed. Animations are usually used when the lesson, or part of it, requires the presentation of mechanical steps and to attract viewers. Though designers respect the use of animation and 3D features and used software (such as Macromedia Flash and Director), when asked about the possibility of using 3D graphics, they felt that it would be difficult, expensive and time consuming (e.g. rendering and modeling). Most designers did not have computer skills for working in 3D environments. Adding 3D graphics would increase the cost of the final product, without guaranteeing an increase in sales. Therefore, designers avoided using 3D software.

All the designers argued that designing educational material for children requires the use of stories, games, bright colors, animations and graphics. None of them were familiar with teaching and learning theories, they merely focused on producing attractive material (style and graphic).

The Evaluation stage did not include feedback from users. Instead, sales figures and the editor's acceptance were used to indicate success. Two of the designers indicated that the quality of the e-learning material is constrained by the budget and time to launch.

Four designers indicated that they used the above design process because of the following reasons: 1) Practicability; 2) Cost effectiveness; and 3) Quality assurance.

When asked about what problems they would expect to face if they were to produce e-learning material that teaches ICT skills, they indicated that they had little understanding of the ICT curriculum and the pedagogy of teaching it, as with other subjects.

Thus, the current design process appears not to be systematic: the design stages rely on a brief provided by the project manager which has little information about the end users; marketing decisions influence the overall development; and no evaluation takes place with the end users. In the previous study (Section 7.2.3.2) the teachers expressed dissatisfaction with the material currently available and which has been produced using this method.
7.5 Study 4: An assessment of the practicability of a child centred design method in Saudi Arabia

As the participatory design method developed in this research has been created outside of general design practice, its application in the real world needed to be assessed. Although the evaluation conducted with UK schools showed that more effective e-learning material was produced, if the method itself is to be transferred to Saudi, the cultural context needs to be investigated. In order to address this, Saudi Arabian designers were interviewed to ascertain whether a child centred design method would be used in practice. Unfortunately it was not possible to apply this to a real project due to development time; instead designers were walked through the method they asked to comment on its potential.

7.5.1 Aims and Objectives

The primary aim of this study was to determine whether the proposed method was likely to be used by designers. This aim was broken down as follows:

1. To assess the usefulness of the proposed method;
2. To acquire information that could be used to make it more acceptable to designers;

7.5.2 Methodology

7.5.2.1 Participants

A series of interviews was undertaken with six practicing designers from the major e-learning companies in Saudi Arabia (as in study 7.4);

7.5.2.2 Structure of the interview

The interview commenced with a graphical flow chart presentation of the proposed method (See Figure 7-1) and the resultant e-learning material (See Appendix F.1) so that the designers would understand how it would work. They could then judge whether they thought the method had a place in their design process. The interviews lasted two hours. All comments were gathered through open-ended questions.
7.5.3 Results

The results will be discussed in relation to the effectiveness of the method (e.g. in terms of production time, accessibility to end users, cost), benefits, and implementation obstacles.

4 designers did not recognize the concepts of User Centred Design, Participatory Design or Child Centred Design. Thus, these had to be defined at the beginning of the interview.

All the designers believed that the proposed method could provide an explicit design brief that satisfied the end user needs, thereby potentially enhancing the usability and efficiency of the e-learning material. However, half of them thought that it would be impossible to apply such a method in their organisation.

After reviewing the proposed method, overall, the designers were satisfied with it and the e-learning material produced from it. Designers agreed that it would be of benefit in the following ways:

1. Analysis of the user requirements through school visits could provide the company with knowledge about the market needs and user requirements. It could provide the designer with a deeper understanding of the psychological, organisational, social and pedagogical factors that affect the learning of communication skills through the use of technology;

2. Discussions with teachers would improve the design practice as the teachers could edit the material to provide a more understandable educational concept to the students. The designers may face difficulties in understanding some concepts as they are not subject specialists; also the project manager does not have knowledge about e-learning. Thus, a mechanism needs to be provided through which the teacher can review the designer’s understanding of the learning concepts and provide them with information about how the subject would be taught;

3. Initial discussions with children would improve the designers’ knowledge of their preferences and needs. This would help them to take into account specific end user queries, not just the wide general characteristics of the end users;
4. The prototype testing phase with children would help to identify mistakes or weaknesses in the design and usability issues and therefore allow these to be fixed at an early stage with minimum cost;

5. A usability test with designers and end users would ensure that usability problems in using the material were minimized and material developed according to the needs of the users;

However, all the designers felt that such an approach would be time consuming. In addition, they would find it difficult to access schools and interview teachers and children. Although the designers felt that the early involvement of children could reduce misunderstanding about children’s needs and interests, one company had tried to do this and suffered from the unreliability of decisions taken by the children. In addition, all designers pointed out that children are imaginative and will ask for impossible things, particularly as they do not have any knowledge of how their requirements can be met. Furthermore, reshaping the design team and creating new roles was thought to be difficult.

Figure 7-1: Child Centred Design Approach applied in the present research (Chapter5)
7.6 General Discussion

The studies described above were conducted to understand how the understanding derived from the UK could be applied to the Saudi educational environment, both with regard to the e-learning material and the proposed method.

With this in mind, comparisons were made of the current teaching practices in ICT in Saudi and UK schools; See Table 7-4). Since the UK is more advanced in the use of e-learning across curriculum and teaching ICT, it is possible to examine the opportunities and challenges this has created and adopt these to the Saudi context.

Given that the trend in Saudi Arabia is towards full e-learning, the obstacles that may limit its usage are resistance to the new system, training, awareness and suitable teaching material. Most Saudi teachers expressed a need for e-learning material, particularly materials that support the teaching of the ICT curriculum because of their lack of knowledge in this area. Although there is a market demand for such materials, these are not produced.

In general, schools are not involved in the development of e-learning material. This may be one of the reasons why these materials do not satisfy the teachers’ requirements or the students’ needs. Designers develop material without proper consideration of the nature of the medium, the product or the learning tasks. The key to e-learning lies in concentrating on employing the unique advantages of the computer in searching, animating, linking and visualising information. Current material does not utilise the technology to achieve maximum benefits. This might be due to the unavailability of any framework or standards that can be followed and the absence of quality assurance or supervision.

Although the companies' representatives indicated that they used an ADDIE instructional Design Model, when questioned in detail their answers revealed that ADDIE was not used to its fullest potential.

In the ADDIE approach the analysis stage consists of gathering information about the target audience’s learning style, content analysis of the curriculum; and environmental
feature analysis which takes into consideration matters relating to finance, marketing, and culture (Dick and Carey, 1996; Leshin, Pollock, and Reigeluth, 1992; Kemp, Morrison, and Ross, 1998). However, the Saudi educational publishing companies only considered financial and cultural issues at this stage and the age of the end users.

In the ADDIE model, the author should prepare an analysis report for the designer which conveys a clear understanding of the "gaps" between the desired outcomes or behaviours and the end user's existing knowledge, characteristics and skills. It should also consider the learning environment, any constraints, the delivery option and the timeline of the project (Dick, and Carey, 1996; Leshin, Pollock, and Reigeluth, 1992; Kemp et al., 1998). This again was not the case in the Saudi companies where such reports were not generated. The design requirements were given directly to the designer by the project manager.

If a full ADDIE approach is adopted the manager should develop a design report which outlines the specific learning objectives, assessment instruments, detailed storyboards and prototypes, exercises, graphic design, textual content, font size, cartoon type, caption heading and user – interface. The designer's role would then be to follow the design report.

It is assumed that the designer is fully aware of the teaching techniques, values, and approach that the student requires. The designers believed that effective e-learning material could be produced simply by copying existing material into a computer format, the following information was omitted from the design report:
1. The teaching strategies used for each part of the curriculum;
2. Pedagogic information (the purpose or the need) to guide the of use of animation, graphics or sounds for specific parts of the lesson;
3. Discussion or contact between the project manager and the designer.

Designers hypothesised children requirements and designed the product according to these. This indicates that designers need to know more about the children's needs, and
the link between design principles and their use for educational purposes.

In the ADDIE model the effectiveness of the materials should be evaluated. In Saudi companies, this is limited to the use of sales figures and editor’s acceptance. This may reduce checks for accuracy. Particularly, there is no external supervision or quality assurance department in the Saudi Education Ministry that checks on the quality of the material or assesses its effectiveness. In the UK, some designers involved end users in evaluating the product at this stage.

Having identified such problems, the most important seems to be the lack of information provided to the designers about the end users. In both the UK and Saudi Arabia there is a noted lack of early user involvement. However, in UK users are involved in the final evaluation of the product. As indicated earlier in Chapter 2 and as hypothesised in Chapter 3, involving users in the design process might lead to the improvement of the current design practice and therefore, more effective materials.

These problems highlight the need for an effective design process that would increase information delivered to the designer about end users. A participatory design approach might be useful in this context (Puphaiboon, 2005). This and previous research has shown the benefits of a more user centred or participatory approach to the development of teaching material. Moreover, the commercial success of companies (such as Ragdoll Ltd in UK) which have pioneered the use of children's responses in their product development process, have increased interest in this area. However, Branton (2003) indicated that the majority of companies producing children's technology products have failed to see the benefit that child research can add to their products. In addition, Kelly et al. (2006) indicated that user centred design methods can be seen as intensive and unsuitable for commercial environments.

The interviews showed that all designers were satisfied with the quality of the e-learning material produced and believed that the proposed method could lead to products that would be suitable for their intended purpose in the usage environment. However, they felt that it would be difficult to implement such a method because it would create increase in time and cost. Indeed, creating the method in an academic context was a lengthy process.
It took 24 months in total (see Table 7-5), the first phase alone taking 9 months. This entailed establishing working relationship with schools, developing communication patterns with teachers and students, researching, literature reviewing, preparing observational forms, and interview schedules and market analysis. The development took 12 months, while the evaluation stage took an additional 3 months.

In the propose phase most of the time was spent preparing children's sessions to gather their inputs and find their design requirements, while during the realisation stage the time was spent on developing the technical skills needed to create the material that satisfied the children's requirements. In the evaluation stage, time was spent on school visits observing and interviewing students and teachers.

<table>
<thead>
<tr>
<th>Stages/Time</th>
<th>1-3</th>
<th>4-6</th>
<th>7-9</th>
<th>9-12</th>
<th>13-18</th>
<th>19-24</th>
</tr>
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<tbody>
<tr>
<td>Understand</td>
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<tr>
<td>Realise</td>
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<td>Evaluate</td>
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</table>

Table 7-5: Time plan of the developed e-learning material

However, for e-learning production companies outside academia, the process would be shorter as they have qualified design teams working with professional technical skills. They know the market they are working with, and could use the existing observational forms and interviews schedules. If the company developed collaborative relations with schools, it is estimated that the overall design process would only increase by 10%, as the only difference would be in meeting with teachers and children.

The remaining main difficulties identified by the companies with regard to applying the proposed child centred design approach were as follows:

1. Schools accessibility
2. Unreliability of children decisions
3. Creating new design teams
Several researchers have pointed out that if a user centred design approach is to be employed the various roles of stakeholders are unclear (Cecilia and Medina, 2000; Shabajee, 1999; Romiszowski, 1981).

Moreover, designing user centred e-learning material requires several stakeholders, designers and developers of educational material to be organized or involved in the process. Taking a more child centred approach requires input from different disciplines, such as psychologists, sociologists and anthropologists whose job it is to understand user’s needs and communicate them to the technical developers in the team. This interdisciplinary requires organizational and communication skills that design companies may feel are beyond their needs. Management may question whether this added value is worth the cost (Preece, 1994).

Solutions to such difficulties are proposed as follows:

1. Training should be offered to the project manager as they are the gatekeepers (Meister, 1982), which should highlight the following topics: (1) Ways to create a cultural context for user participation; (2) Organisation and individual attitudes about users and usability as well as the role of the designer; (3) Project organization; the role of management in a project; (4) Methods, techniques and tools that suit user participation.
2. At governmental level, authorities could build partnerships or networks with schools which would be of wider benefit as schools should work as research partners with the developers of new educational material;
3. A clear set of guidelines should be produced for the developers of educational material, which should include sections relating to the human factors associated with children as learners, teachers as educators and a clear specification of the usage environment (i.e. the situation in which the material will be used);
4. A children’s champion is established in each of the companies who can lead on children’s issues and the evaluation of the effectiveness of the material in terms of educational outcomes (Woodcock and Galer Flyte, 1998);
5. The Saudi Ministry of Education should take steps to ensure that the highest quality educational material and training are available in all schools by establishing quality assurance and training department (See Chapter 8).

7.7 Conclusion

The present chapter reports the studies undertaken to:
1. Understand how the ICT curriculum is being taught, and the use of ICT as a tool (e-learning) in Saudi Arabia. This has completed the first research objective.

2. Understand the current design process for e-learning material in Saudi Arabia. This understanding feeds into the second and the third objectives of the research. (Objective 2: To develop an e-learning design process; Objective 3: To create and evaluate e-learning material).

3. Assess the practicability of the proposed design method, and the possibility of learning from the UK experience. This leads to the achievement of the fourth research objective which is to assess the practicability of the proposed design process with e-learning designers in Saudi Arabia.

Investigating the teaching of the ICT curriculum revealed that the ICT curriculum is relatively new and may be poorly taught. Teachers are inexperienced in the use and the teaching of ICT, which means that more e-learning supportive materials are needed. No such materials are available in the Saudi market. The situation in the UK is better but still not optimum.

It is proposed that one way of improving the quality of teaching is to provide appropriate, effective e-learning materials. To be most effective these need the input of teachers and students so that their design can be grounded by teaching strategies, students’ ICT ability, learning styles and preferences. This would help to satisfy the requirements of the end users and improve the learning outcomes.
Results showed that the current design process is flawed and that this could contribute to the design of inappropriate e-learning. Development is driven by marketing opportunities and the current design process does not provide scope for communication between stakeholders particularly students, designers and teachers. The designer works with little understanding of the learning context in which the material will be used, the user characteristics or the teachers' needs. Thus, resultant e-learning materials available may be rarely used in schools.

As several problems have been identified in the current design process, a child centred design method was proposed which could lead to improvement in the design and usability of e-learning material. Therefore, interviews with Saudi designers were undertaken to understand the method's practicability in the Saudi design market.

Six designers assessed the potential value of the method for educational publishing. The interviews helped to ascertain the possible use of the proposed method and its shortcomings in terms of the production of effective e-learning materials. All designers agreed that the new method would be usable in the current design process with the aid of a high level budget and accessibility to children. However, the whole process was seen as greatly increasing the workload of all stakeholders, the designers in particular.

Therefore, in order to address this, a set of recommendations were made which would ensure a more UCD approach.
CHAPTER 8: RECOMMENDATIONS TO THE SAUDI MINISTRY OF EDUCATION

This chapter presents a set of recommendations to the Ministry of Education on teaching ICT in primary schools.

8.1 Introduction

As indicated in Chapter 1, one of the wider aims of the research was to improve the teaching of the ICT curriculum in Saudi Arabia. Hence, this chapter provides a list of recommendations to the Saudi Ministry of Education to improve this.

Comparing the teaching of ICT in Saudi Arabia and the UK revealed that the UK is more developed than Saudi Arabia. Thus, the recommendations have been drawn on the successes in the UK in moving forward in this area, moderated by knowledge of Saudi culture.

The recommendations were sent to the ICT Educational Manager in order to obtain feedback from the Ministry.

The recommendations are divided into four main parts:
1. The ICT curriculum
2. The use of ICT as a tool (e-learning)
3. Teacher training
4. E-learning design

8.2 ICT curriculum

1. Start teaching the ICT curriculum formally at an earlier age

Almoneea (2001), the Councillor of the Arabic Open University said that "the computer subject is significant (enough) to be taught to all levels in public education." It does not have to be limited to high school only; it has to be included in both secondary and primary school (Abu Hassana and Woodcock, 2006b).
In the UK, ICT is compulsory throughout primary and secondary schools (Ages 5 to 16) (DfEE 1999:96) and several studies in UK (QCA, 1998) and Saudi Arabia (Almoneea, 2001) have pointed to the rationale of teaching the ICT curriculum to young children. The earlier children improve their ICT capability the better understanding they will form about when, where and why to use it.

There is a need to consider teaching ICT skills at an earlier age in Saudi schools (Abu Hassana and Woodcock, 2006b). Hence, the Ministry of Education should provide a curriculum for primary schools.

2. Content of the curriculum

As indicated by Abu Hassana and Woodcock (2006b) and Almoneea (2001) most public high schools teach the unified curriculum as specified by the Ministry of Education, while in the private schools the content of the curriculum varies. It may not created by a specialist, but personal enthusiasm rather than educative groundwork.

However, in the UK the QCA (Qualification and Curriculum Authority) produce schemes of work which illustrate how the National Curriculum programme can be transferred to lesson plans for Key Stages 1 and 2.

Although the Ministry of Education in Saudi Arabia has a framework for most subjects this is not the case for ICT. Therefore, a framework should be developed that teachers could refer to in order to develop their lesson plans.

Additionally, the Ministry of Education should structure the curriculum in a way that is relevant to the students ICT experience outside school so the students do not feel unmotivated or bored. This need for an ICT curriculum that associates the student outside school experience was discussed earlier in Chapter 2 (and applies equally to the UK).

3. Teaching practices of the ICT curriculum

According to studies conducted in Chapter 3, the main problems identified in teaching the ICT curriculum in the UK are the focus on technical skills. Although the QCA
defined the ICT curriculum to include a mix of technical know how with conceptual understanding of information gathering, modeling, control and communicating in order to solve real world or simulated problems (Department for Education and Skills, 2002), teachers focus on technical skills.

The Ministry of Education should consider this shortcoming when developing a framework which can balance all three parts Information, Communication and Technology.

Also the Ministry of Education should set criteria for assessing the ICT curriculum and include it in the GPA (Grade Point Average) along with other subjects. This should equally consider Information, Communication and Technology skills, and should not be limited to the content of the ICT work or to technical skills.

In addition, the use of supportive e-learning material in teaching the ICT curriculum has shown a positive impact on the students learning outcomes as indicated in Chapter 6. Thus, the Ministry of Education could collaborate with the producers of such material to provide schools with e-learning materials that support the ICT curriculum. In Chapter 7, publishing companies indicated that they did not develop material in this area because there was no unified curriculum and ICT was not approved as a formal subject in all schools. Thus, if the Ministry unified the curriculum and included it in the GPA, there would be a commercial demand of e-learning materials associated with the ICT curriculum.

Furthermore, the Ministry of Education should provide training for teachers so that they can balance the Information, Communication and Technology sections of the curriculum. More details about this are provided in the following sections.

8.3 The use of ICT as a tool (e-learning)

The teaching of ICT in Saudi public schools is limited to the second and third year of high school. So public school students may have a very poor knowledge of ICT when they graduate from the school. Teaching this from an earlier age and integrating it across the curriculum will produce an increased ICT literacy. The Ministry of Education should propose a framework for doing this.
In the UK, BECTA leads the national drive to inspire and lead the effective and innovative use of technology throughout learning (http://about.becta.org.uk/). Also the National Curriculum in Action (http://www.nc.uk.net/nc/contents/ICT-2--POS.html) provides teachers with guidance for each subject on integrating ICT. The Ministry of Education needs to create a department that could be responsible for the use of ICT in Saudi education involving both its integration as a tool and its teaching as a subject. Consultations with BECTA in UK could be undertaken in order to benefit from their experience.

Moreover, private schools in Saudi Arabia are moving towards full e-learning, without evidence of its effectiveness in all subjects, for all learners. Abu Hassana and Woodcock (2007) indicated that a more blended approach might lead to the achievement of more learning outcomes than a full e-learning approach. Hence, there is an urgent need for evaluation of approaches being taken in the use of e-learning and its effectiveness in Saudi schools.

8.4 Teacher Training

It is now mandatory for all UK primary school teachers to take ICT training via the Department for Education and Employment (DfEE). The New Opportunities Fund (NOF) National Training Programme is designed to identify teachers individual, subject-based ICT training needs and supply appropriate personalized training through accredited training providers. Although mandatory, it is still not reaching all teachers, or not providing them with sufficient information to teach ICT with confidence (as indicated in Section 3.4.2).

In Saudi Arabia only private school teachers receive ICT training. Hence, the Ministry of Education should propose a training scheme for teachers. This training should design and make available funding to deliver mandatory training to all teachers to improve their ICT knowledge, awareness, teaching skills and approaches to integrating ICT across the curriculum.

Training should include the following topics:

1. Awareness of the importance of integrating ICT in education
Over several decades a major thrust in the school sector of most countries has been the search for ways in which teachers can be convinced that ICT should be an integral part of their teaching strategy (Galanouli et al., 2004). Several strategies have been tried including the dissemination of good practice and the investment in infrastructure and equipment. Prominent among these strategies are training programmes designed to raise skill levels and foster positive attitudes to computers among teachers.

2. Approaches to teaching ICT

ICT teachers should be trained on how to teach and assess ICT skills to avoid problems identified in UK (Chapter 3). Teachers should be trained to balance the three parts of the subject.

3. Ways of integrating ICT across curriculum

Regardless of the teachers' motivation and their awareness of the importance of ICT in education, they will not be able to integrate ICT in their teaching unless they have a clear framework they can refer to, to develop lesson plans. Thus, the Ministry should provide training on approaches to integrating ICT across curriculum, and specimen lesson plans.

8.5 E-learning design

As indicated in Section 7.3, there is no collaboration between the Ministry of Education and the e-learning publishing companies. The companies’ materials are still not subject to any quality or content assurance assessment by the Ministry of Education. This might lead to the production of e-learning materials that do not suit the curriculum or the schools' needs. Thus, there is a need for more collaboration. The Ministry of Education should provide the companies with a framework to design effective teaching materials for schools. Moreover, the Ministry of Education should evaluate the teaching material to ensure that high quality, error free, effective material is being produced.
8.6 Conclusion

This chapter outlines a set of recommendations to the Ministry of Education in Saudi Arabia based on the findings of this research.

Recommendations can be summarized as follows:

1. Start teaching the ICT curriculum at an earlier age and it should be relevant to the student experience outside school;
2. Develop a framework for teaching ICT curriculum in primary schools;
3. Develop a framework for integrating ICT across curriculums;
4. Collaborate with e-learning publishing companies particularly to ensure the quality of their production;

The research has been received favourably in Saudi Arabia. The ICT Educational Manager of the Ministry of Education has indicated that the recommendations have been reviewed, and their applicability will be further considered at the next ICT committee meeting.

The proposed design method has been presented to the Director of the Graphic Design Department of Dar Al Hekmah College in Jeddah in January 2008 and will be incorporated into the curriculum for undergraduate students, so they can use it to develop future e-learning material. The third year Information Design undergraduate students have applied, for the first time, a Child Centred Design method in their projects, to develop e-learning material for the ICT curriculum in Saudi Arabia.
CHAPTER 9: CONCLUSION

This chapter draws together the research undertaken. It is divided into four sections. In the first, the main findings of the research are outlined. Secondly, contributions to knowledge in the field will be addressed. Thirdly, the limitations of the research are considered, concluding with a summary of issues that need further research.

9.1 Introduction

The research was motivated by observations that the ICT curriculum needs to be improved in primary schools in UK (Ofsted, 1999) and Saudi Arabia (Doheash and Aloreani, 2001). It was also noted that e-learning had positive impacts in other areas of the curriculum (Ofsted, 2005; Higgins, 2001; BECTA, 2005b; Heemskerk et al., 2005; Schiller and Tillett, 2004; Harris et al, 2003; Maurer and Davison, 1999; Urban and Weggen, 2000; Pollard and Hillage, 2001), but had not been applied directly to the teaching of ICT.

Therefore, the research sought to determine and address problems in the delivery of the ICT curriculum by the creation of effective e-learning material. It was hypothesized that such material might overcome shortfalls in teachers ICT knowledge and if appropriately designed could capture young learners’ imagination and provide opportunities for them to engage painlessly with the underlying concepts of ICT (specified by QCA: Qualification and Curriculum Authority), which may not currently be taught.

However, it was also discovered that e-learning materials are designed with little or no user involvement – either by teachers or pupils. Ergonomists have recognized that a key factor in the design of effective products is the engagement of potential end users in the design process (Woodcock and Galer Flyte, 1998). No such design method has been proposed to develop e-learning material for children. Hence, the present research created a user centred design method that can be applied by e-learning designers.

A multifactor approach was formulated in order to evaluate the e-learning material, created using a more user centred approach. The evaluation sought to assess the effectiveness, and quality of the design, in achieving learning outcomes and enjoyment.
To enable the understanding grounded in the UK to be transferred to Saudi Arabia, further studies were undertaken to understand how ICT is taught there and how e-learning material is designed. A similar set of issues was found in Saudi Arabia to that in the UK with respect to the delivery of the ICT curriculum and design of e-learning material. The proposed child centred design approach was assessed by practicing designers in Saudi Arabia to determine its practicability and a set of general recommendations produced for the Saudi government on how to improve the provision of ICT teaching and learning.

9.2 Summary of main findings

The findings will be summarized in relation to: the greater understanding of current practices in teaching the ICT curriculum to Key stage 2; the development of the proposed solution to improve the teaching of ICT; formulation of the e-learning design method; and transference of knowledge.

9.2.1 Current practices in teaching the ICT curriculum

The first objective of the research was to understand the current teaching methods, practices, and e-learning with respect to the ICT curriculum in primary schools in the UK and Saudi Arabia before examining ways in which teaching could be improved. The literature review revealed no research concerned with this subject. Additionally, prior research (Ofsted, 1999; Hammond, 2004; Robertson, 2002) on teaching ICT indicated that teaching of the ICT curriculum was neglected compared to other subjects.

The empirical studies revealed that teachers adopted a pragmatic approach to their teaching. They provide a mix of whole class teaching and hands on activity. The approach currently used would seem to be sympathetic to recent government guidelines on teaching ICT as a subject in England and Wales through the publication of advisory schemes of work (Qualification and Curriculum Authority, 2001). However, several problems were identified.

1. Teaching focused on the technical skills rather than the task itself or the rationale for the use of ICT.
2. ICT assessment was limited to the content of the work or to the technical skills.
3. The gap between home use of IT and ICT provision and teaching in skills was not recognised.

4. Despite government initiatives teachers were not competent in their use and knowledge of ICT.

Several solutions have been put forward to address these issues such as providing teachers with training, or e-learning material that focuses on the skills, knowledge and understanding specified by QCA. E-learning was the solution considered in the present research.

9.2.2 E-learning as a proposed solution and its design method

The literature and state of the art reviews revealed that e-learning materials have been researched and developed to support teaching and learning across the curriculum (e.g., Ofsted, 2005). However, the ICT curriculum itself has been overlooked. Hence, the present research aimed to examine the effectiveness of e-learning to improve the ICT curriculum.

It was noted that neither pupils nor teachers have been involved in the design process of e-learning material and that teachers are not satisfied with resultant materials (Mitropoulou and Triantafyllidis, 2005).

The literature review provided evidence that a UCD approach can give designers greater insight into user perspective and preferences, allowing designers to rethink design goals and solutions. By such means a higher degree of usability can be achieved (Swann, 2002; Niederhelman, 2001; Sanoff, 1992). This body of work suggests that improvement may be possible if a UCD approach is taken to the design of an e-learning material that supports the teaching and learning of ICT. It was also concluded from the literature that there is a lack of useful and usable UCD informed methods for e-learning design for children.

This was corroborated in interviews with designers that showed their working methods were based on personal experience and preference. Additionally, no evidence was found that e-learning designs are evaluated prior to publication. The concern of publishers with profitability and the aesthetic seems to have led to a situation where it
is the need of the marketing department that drives design decision making rather than the effectiveness of the educational material and the teachers and students satisfaction. With this conclusion in mind, the research aimed to develop a new design method which involves teachers and students from early stages of the design process to resolve these problems.

A multifactor evaluation method which includes teacher interviews, children pair interviews, likeability box, observation, and expert usability testing has been used (See Figure 7-8). The paired interviews used in conjunction with the likeability box and the observational study usefully uncovered user problems arising from interacting with e-learning game in a manner appropriate for redesign. The interviews with the teachers established the extent to which the material could support achievement of the learning outcomes. Teachers' interviews confirmed that the use of the developed material could help them to teach the skills that they neglected in teaching the Multimedia Presentation Unit. Also the results of the students pre and post test showed positively that the e-learning material helped the students to achieve the intended learning outcomes. The usability test with experts helped to discover usability problems that were not indicated either by children or by teachers.

In summary, teachers revealed that e-leaning material designed in collaboration with students and teachers could support the teaching of the ICT curriculum. Moreover, the evaluation method used can be formalised into a procedure for practicing designers to use in the professional arena.

9.2.3 Establishing the practicability of the method and knowledge transference

The usefulness of the proposed design method could be influenced by the characteristics of the participants, project management, and the skills of the designer or design team. Whilst the limitations of the researcher also acting as the designer are recognized, the evaluation of the material by children and teachers revealed their satisfaction with the quality of the material produced as well as the extent to which it supported and matched their needs. This is indicating that the method which led to the design has some merit.
However, the method was developed in an academic context; as such it was important to discover whether it would be useful to practicing designers. Interviews were conducted with representative educational designers in Saudi Arabia to assess whether the method has a role in design practice.

These showed that the designers were satisfied with the quality of the e-learning material produced and believed that the proposed method could lead to products that would be suitable for their intended purpose in the usage environment. However, they felt that it would be difficult to implement because it would increase development time and cost.

Wider solutions were proposed that would help designers to take a more user oriented approach, for example:

1. Training should be offered to the project manager so that they were sympathetic towards user centred design and could accommodate this in their scoping of new projects;
2. At governmental level, authorities could build partnerships or networks with schools and design teams to ease access into schools and with end user groups;
3. A children's champion could be established in each of the companies who could lead on children's issues and evaluation;

The fifth research objective was fulfilled by developing a set of recommendation for the IT Department in the Saudi Ministry of Education with regard to the teaching of ICT in primary schools following a comparison between UK and Saudi Arabia.

9.3 Contributions to knowledge

The research makes contributions to knowledge in the following areas:

9.3.1 ICT curriculum teaching

Firstly, reasons have been identified that might have caused the teaching of the ICT curriculum to be rated more poorly than other curriculum subjects. Secondly, evidence
has been presented that e-learning can support teachers in their delivery of the understanding, skills and knowledge that are currently overlooked in the ICT curriculum. The teachers' interviews (see Section 6.3) revealed that students could achieve the intended learning outcomes using the e-learning material. This is taken as supporting the view that there is an identifiable gap in teaching in the curriculum, and that this can be filled through the provision of more user focused e-learning material.

9.3.2 Child centred design approach

Firstly, a Child Centred Design method was developed which provides a framework for designers wishing to create effective e-learning material for teaching ICT and possibly other subjects. This includes a framework for developing specifications (based on learning problems and user needs), design and evaluation. The method can be applied in the development of material to discover design problems in the early stages, such as material that is misleading, unusable, does not suit user preferences or is too complicated. This method provides a useful, usable user-centred approach, using iterative design and formative evaluation to identify learnability problems and success.

Secondly, evidence has been provided that children (aged 9-11 years old) can engage meaningfully in the design process and the evaluation of the e-learning material. They provide useful, sophisticated levels of input.

Thirdly, a multifactor evaluation method was developed (teacher interviews, children pair interviews, observation, pre and post test) to assess the effectiveness of the material in achieving the intended learning outcomes and the children's satisfaction with the design of the material. As far as can be determined no other studies have used the combination of these approaches with children in evaluating e-learning material.

Fourthly, although an e-learning design method has been developed which Saudi Arabian designers can use, the research demonstrated the limitations of such a method outside academia. This was indicated through the literature review and interviews with practicing designers. The interviews helped to ascertain the levels of change needed before such a method could be used by e-learning developers outside academia.
9.3.3 Transference to Knowledge

Lastly the Saudi Ministry of Education was provided with a set of recommendations to improve the teaching of the ICT curriculum in Saudi primary schools. These are associated with curriculum content, teaching practices and techniques, the use of ICT as a tool (e-learning), teacher training and e-learning design.

9.4 Limitations of the research

The research was subject to the following limitations:

9.4.1 Working with schools

It was difficult to locate schools that could commit to long term research. Teachers left schools and agreements were broken. Additionally any work conducted in schools generates significant planning and administrative overheads on both parties. It is not just a matter of going in to schools and testing out material, For example, police and ethical clearance have to be given, consent forms sent to and returned by parents, the material developed has to fit into the curriculum, the organization of the school day and relies on the goodwill of overworked staff. The difficulties experienced led to the following limitations:

a. The intervention was of short duration. Research (Clark and Craig, 1992) suggests that learning gains are most noticeable when the length of the intervention is increased. However, in the present research it was not possible to allow young students to train and demonstrate their ICT abilities during a long period eg over a month or a term. Long term improvements could not be assessed, because this would have entailed asking teachers to adopt different teaching styles and changes to the curriculum, which was not feasible in the time frame of the project. This had implications for the unit chosen (ie Multimedia Presentation Unit), the type of e-learning material produced (ie stand alone game that can be adapted by teachers) and the length of the evaluation (ie one lesson)

b. Changing the sample through the research

Due to changing schools and teacher’s withdrawal from the project, the participants in the evaluation process were not the same participants through the design process. This might have affected the results.
All Coventry, Birmingham and Solihul City Council primary schools were contacted by invitation letters through post and with follow up phone calls. Many schools were interested in the research, but could not support it because of time pressures. Additionally, the turn over of staff in schools meant that where local arrangements were made a term in advance, these were changed or not passed on. To overcome these problems for future developers of educational material, one of the recommendations to the Saudi Minister is that schools become ‘research partners’, and that guidelines are drawn up to facilitate the development of user centred material.

9.4.2 Traditional nature of education

1. The status of the ICT curriculum and the use of e-learning is changing rapidly due to the technological expansion and increase of knowledge in this area. Hence, some of the research problems identified may be transitory in nature.

The learning experience is affected by several variables that were difficult to control (such as learners' characteristics, teachers' attitudes, timing and resources). A number of possible reasons might affect the learning improvement such as the learners might not have liked the design of the e-learning material but they liked the approach of integrating e-learning material into teaching. Also the design of the material might benefit just one style of learner over another. Research (Presmeg, 1997; Krutetskii, 1976) suggests some learners may have difficulties in using visualization, if it is not their preferred learning style. A larger group of students is needed to study these effects in detail.

9.4.3 Methodological

1. Choice of content (MPU)

The Multimedia Presentation Unit (MPU) was running in schools during the term when the observational study of the research was conducted. Though interviews were conducted to confirm that the practices and techniques used in these were similar to those in other ICT lessons, if the observational study had occurred elsewhere other problems might have been raised. Additionally the design methodology and the e-learning solution were only tested in relation to material for the Multimedia Presentation Unit.
2. Sample selection

Only a small number of schools participated in the research. The UK survey was based on 15 schools, and the Saudi one on 10. Only three schools and 30 students took part in the evaluation. Although steps were undertaken to ensure these were representative of the wider population, clearly care must be taken in generalizing the results.

9.4.4 The Design Method

The design method was developed outside of the commercial context. Comments from participants highlighted several factors which would restrict its application, such as financial management, designers and other stakeholders’ communication, designers capability and project management. These factors could limit its applicability and indeed it is difficult to anticipate all the barriers to use of the method before it is tested in industry in real projects

Additionally, the researcher conducted all stages of the work - the design and implementation of the method, the design of the material and the evaluation. This multi-role approach, whilst unavoidable in small scale academic research may create a number of biases.

9.4.5 Cross cultural study and knowledge transfer

As the wider research aim was to improve the teaching of ICT in Saudi Arabia. It would have been more appropriate to have designed the material in collaboration with children and teachers in the Saudi context. Although this was not possible, steps were undertaken to ensure that the knowledge of teaching of ICT in Saudi Arabia was kept up to date, and where possible the situation in Saudi was interrogated directly (by observations and interviews). That the method is now being taught at undergraduate level, three papers have been presented in Saudi conferences and the Ministry is seriously considering the recommendations, is taken as evidence that a successful knowledge transfer could take place.
9.5 Outline of future work

Given the limitations outlined above, this section looks at ways in which the present research might be taken forward, also considering interesting directions that it was not possible to explore within the scope of the present research.

9.5.1 Research to overcome the limitations

Firstly, although the method is usable and practical, as indicated by Saudi practicing designers, they commented on its potential problems in the publishing design process. It remains to be determined whether the method would be applicable in limited budget projects. Obviously, future research should focus on measuring the actual costs and the way the method would work in practice.

Secondly, e-learning materials should be developed for other parts of the ICT curriculum in order to validate whether e-learning could support teaching the ICT curriculum.

Thirdly, the individual and environmental factors that affect student learning should be considered in evaluating the effectiveness of the material. Thus, an investigation could be conducted to assess the influence of internal and external factors on children’s use of e-learning materials.

Fourthly, further research needs to be carried out with larger sample sizes in order to more confidently assess the effectiveness of the e-learning materials produced using Child Centred Design Approach. The length of learning should also be considered, allowing for a fuller integration within the ICT curriculum. Research (Evans and Edwards, 1999; Hedberg et al., 1993) shows that the extension of learning interaction time with computers can improve learning performance. Moreover, to improve the validity of the methods on users’ learning improvement, we could address different learning styles, by applying learning style inventories, e.g., Kolb’s Learning Style Inventory, Vermunt’s Inventory of Learning Styles, prior to the test (Coffield et al., 2004).
9.5.2 Implications for further research

The first and the most important need for further research is on how additional stakeholders (from different disciplines) can inform early stages of the e-learning design process and to determine ways of ensuring that educational material is fit for purpose. UCD approaches need to be tested in industrial contexts and become embedded in the development of educational material.

Although teachers and students were involved in the design process the main direction of the design was proposed by the researcher. Having shown that young learners can contribute to design, it would be interesting to explore how they could contribute at more conceptual levels.

Moreover, as indicated in Section 3.5 two solutions were suggested to overcome the problems of teaching ICT; 1) provide teachers with ICT training; and 2) use of e-learning supportive material. The present research investigated the effectiveness of e-learning in improving the teaching of the ICT Curriculum. Further research is needed to investigate whether teacher training is keeping up with technological advances.

Furthermore, during the course of writing the thesis, informal comments have been gathered about the game from colleagues in Saudi Arabia. These include:
1. From Media Editors, the need to improve the transitions between scenes, from Graphic Designers, adjustments to the colours of the environment.
   These points to the need to investigate more closely a team approach to the design of educational material. Additionally some of the children’s requirements raised at the later stages of the research were not embodied into the final game, such as 3D characterisation.

9.6 Conclusion

The thesis concerns the way in which teaching the ICT curriculum can be enhanced through the development of an e-learning material using a Child Centred Design method. From the literature review, it has been argued that ICT is poorly taught and e-learning materials could be used to enhance teaching the ICT curriculum. Additionally, the literature and interviews with teachers and designers from educational publishing
design companies both show the weakness of the traditional design process and that users are not involved in the requirement and evaluation stages.

Therefore the present research set out to develop e-learning material using a new method to assist designers in their development of e-learning material, which in turn will lead them to adopt a more user centred approach. The method developed relies on the explicitness of the specifications and the evaluation of design effectiveness. Throughout, the research has sought to ensure the validity, practicability and usefulness of this approach for e-learning material designers.

In conclusion, the research has contributed to knowledge by identifying problems of teaching the ICT curriculum and proposing solutions to improve it. It has also investigated problems in designing e-learning material and proposed a child centred design method that designers can use with users to develop e-learning materials. Reasons why such methods are not used in the design of educational e-learning material have also been identified. Finally, a list of recommendations has been provided to the Saudi Ministry of Education to improve the teaching of the ICT curriculum.
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APPENDIX A: SCHOOLS VISITS IN UK

1. Appendix A. 1 : Sample of the research participation letter sent to schools

<table>
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<th>Headteacher Information sheet</th>
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Your school is being invited to take part in a research study made by research student studying within the School of Art & Design.; Miss Ruba Abu Hassana. Before you decided it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully.

The main aim of the study is to explore ways in which interactive multimedia material can be used to enhance the provision of e-learning in teaching the ICT curriculum in both UK and Saudi primary schools. The main outcomes of the study are as follows:

1. Develop part of the ICT National curriculum as an interactive multimedia e-learning module
2. Design approach for designing e-learning material in the teaching of ICT to 9-11 years old.

The research follows a design approach with four phases; understand propose, realise and evaluate.

In the understanding phase, the researcher is willing to investigate current teaching methods and practices, with respect to ICT curriculum in your school.

The researcher would like to visit your school to conduct the following:

1. Classroom observations
   An observation of ICT lessons (maximum 3 lessons) of any year in key stage 2 is required. The researcher intends to sit in the back of the classroom and take notes with out the use any form of recording equipment or interrupt the lesson flow.

2. Teacher Interview
   Semi structured interview with the teacher of the observed lesson is needed to understand the issues (ICT curriculum, use of ICT as a tool across curriculum) observed in the lesson in a wider perspective. If the teacher of the observed lesson is not the ICT coordinator, the ICT coordinator should be interviewed to discuss learning approaches issues related to the use of ICT in the school. The duration of the interview will not exceed 20 minutes.

3. Children's interviews
   Semi structured interviews with year 5 or year 6 children (maximum 5 children) to discuss issues related to their feeling and learning of ICT as a subject and a tool in the school.

The results of understanding the current teaching practices associated with ICT in the school will inform the design of the e-learning module for year 6 children.
During the propose and realise phase, the teacher and the children are required to participate and their inputs will be considered through the whole design process (storyboarding, initial prototype testing, developed prototype testing).

Thus, during propose and realise phase, the researcher needs to conduct the following:

1) Teachers semi structured interviews
2) Children's focus group (of 5 children) and semi structured interviews
3) the design, usability, and fun

Finally, the researcher will evaluate the quality of the design and the fulfilment of the intended learning outcomes. This will be achieved through the following techniques:

1) Teacher's semi structured interviews
2) "Think aloud" protocol: children will be observed while they are using the e-learning material.
3) Children pairs interviews

Please find attached a flow chart that shows the research stages and what will be done in each visit.

The project requires three years, the school participation represent 18 months- 2 years from the project duration. Five visits to your school are required to conduct the intended aims. Each visit will not exceed half day.

Your school do not have to take part in the study, and if you would like your school to participate in the research, you will be given an information sheet to keep and be asked to sign a consent form. You may “drop-out” at any time during the project.

Research participants (children, teacher) identity will not be shown in the research at all since the study focuses on the influence of ICT teaching and learning approaches regardless of their demographic information. And the researcher will not be using any recording media.

Regarding the children's participation in the research, parents / guardian consent form will be sent. If the parents sign the ascent forms, the nature of the research and their role will be explained to each child. The children can say whether they would like to participate in the research or not. It is also explained that they can quit at any time if they don’t feel comfortable to continue their participation in the project.

If you would like to take part in the project, please fill in the accompanying form. Should you need any further information or have any queries please do not hesitate to contact the researcher director of study, via post, e-mail (a.woodcock@coventry.ac.uk) or by telephone 02476 887832. Or contact the PhD researcher directly via e-mail (ruba_h_a@hotmail.com).

Thank you very much for taking part.

Yours faithfully

Dr Andree Woodcock
The Design Institute
Coventry University
CV1 5FB
## Appendix A.2: Profile of the visited schools

<table>
<thead>
<tr>
<th>School name</th>
<th>Summary of Information about the school</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>School 1</strong></td>
<td></td>
</tr>
<tr>
<td>Number of students on roll</td>
<td>324</td>
</tr>
<tr>
<td>Location</td>
<td>Coventry - West Midlands. The school serves its immediate surrounding area to the north of Coventry, which has a mixture of private and council owned homes. A significant number of pupils come from areas of high social deprivation.</td>
</tr>
<tr>
<td>Across curriculum teaching level</td>
<td>This is a satisfactory school because the progress pupils make in their learning from a very low level on entry to the school is acceptable by the end of Year 6. However, standards in comparison with all schools nationally are below expectations by the end of Year 6.</td>
</tr>
<tr>
<td>ICT in the school</td>
<td>Achievement in ICT is good.</td>
</tr>
<tr>
<td><strong>School 2</strong></td>
<td></td>
</tr>
<tr>
<td>Number of students on roll</td>
<td>276</td>
</tr>
<tr>
<td>Location</td>
<td>Coventry - West Midlands. The school serves a well-established community with pupils coming from a range of backgrounds. The vast majority of pupils are from a white British cultural heritage background.</td>
</tr>
<tr>
<td>Across curriculum teaching level</td>
<td>The quality of teaching and learning is good. Achievement is good for all groups of pupils throughout the school although standards remain consistently low. The majority of children start school with well below average levels of attainment for their age.</td>
</tr>
<tr>
<td>ICT in the school</td>
<td>N/A in Ofsted reports</td>
</tr>
<tr>
<td><strong>School 3</strong></td>
<td></td>
</tr>
<tr>
<td>Number of students on roll</td>
<td>186</td>
</tr>
<tr>
<td>Location</td>
<td>It is situated close to the centre of Coventry. The properties surrounding the school are small, low cost homes, although many pupils also come from a much wider area. Several of the pupils live in rented properties.</td>
</tr>
<tr>
<td>Across curriculum teaching level</td>
<td>The school is emerging from an unsettled period and provides a satisfactory education for its pupils, with strengths in the Foundation Stage and the infants.</td>
</tr>
<tr>
<td>ICT in the school</td>
<td>Provision in ICT is satisfactory. ICT is used well within other lessons. The subject co-ordinators have been looking at software to support learning in each of the subjects of the curriculum. Pupils have good opportunities to use the computers in the classroom to investigate aspects or complete work in other subjects.</td>
</tr>
<tr>
<td><strong>School 4</strong></td>
<td></td>
</tr>
<tr>
<td>Number of students on roll</td>
<td>190</td>
</tr>
<tr>
<td>Location</td>
<td>Coventry - West Midlands. Pupils come from a wide range of social backgrounds.</td>
</tr>
<tr>
<td>School</td>
<td>Across curriculum teaching level</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>School 4</td>
<td>The quality of education provided by the school is good. The attainment of the majority of children is below average overall, especially in key aspects such as communication, language and literacy, and mathematical development. Their attainment in personal, social and emotional development is average. Standards are above average in English and science and well above average in mathematics at the end of Year 6.</td>
</tr>
<tr>
<td>School 5</td>
<td>Pupils generally achieve well throughout the school, but in Years 5 and 6 achievement is satisfactory because pupils have not always experienced good teaching in previous years and, as a result of this, standards are well below average at the end of Year 6.</td>
</tr>
<tr>
<td>School 6</td>
<td>Teaching is satisfactory and there are good features in all lessons. Pupils' achievement is satisfactory and by the end of Year 6 standards are broadly average. Standards by the end of Year 6 are broadly average in English, mathematics and science. Pupils are now making good progress in English and mathematics from Year 3 to Year 6.</td>
</tr>
<tr>
<td>School 7</td>
<td>It largely serves the Coventry wards of Foleshill and Longford, which include some areas of social and economic deprivation.</td>
</tr>
<tr>
<td>School 8</td>
<td>Number of students on roll</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Location</td>
<td>Coventry - serves the area of Keresley to the north of Coventry. However, the intake is mixed, with significant numbers coming from both advantaged and disadvantaged backgrounds.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School 9</th>
<th>Number of students on roll</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Coventry - West Midlands</td>
<td></td>
</tr>
</tbody>
</table>

| School 10 | Number of students on roll | 142 |
| Location | It is situated close to the centre of Birmingham in an area of considerable deprivation, which is undergoing major regeneration with the demolition of blocks of flats, construction of new housing and ongoing relocation of families. The school is rapidly establishing a new identity for itself, provides a satisfactory standard of education, but it has some very good features and is improving rapidly. |

| Across curriculum teaching level | The school provides satisfactorily for its pupils. The school offers a good, varied and interesting curriculum. Teaching is satisfactory and examples of good and outstanding lessons were seen. However, achievement in the school is only satisfactory because teaching is inconsistent. Too much is routine and does not always challenge the most capable enough, so that learning overall is satisfactory. |

| ICT in the school | No information available in the Ofsted report |

| Across curriculum teaching level | The quality of teaching and learning throughout the school is judged to be sound overall. Pupils attain below average standards by the end of years 2 and 6 but they are improving. |

| ICT in the school | The skills of ICT are taught effectively in timetabled lessons in the computer suite but the application of these skills in other subjects is less well developed in the classroom. |

| Number of students on roll | 15 |
| Location | Coventry - West Midlands |

| Across curriculum teaching level | This is a satisfactory school with good features. Pupils' achievement is satisfactory. Children make a sound start to their education in the Reception Year, although most are working below the levels expected for their age by the time they start in Year 1, particularly in communication, language and literacy and mathematical development. Pupils continue to make satisfactory progress in Years 1 to 6. By the end of Year 2 and Year 6, standards remain below average in English, mathematics and science. Standards in writing are a particular weakness and not all pupils, especially the more able, make enough progress in this subject. Pupils make good progress in speaking and listening, and standards in this aspect of English are broadly average. |

| ICT in the school | No information available in the Ofsted report |

<p>| Number of students on roll | 142 |</p>
<table>
<thead>
<tr>
<th>School 11</th>
<th>Across curriculum teaching level</th>
<th>The results of the national tests at the end of Year 6 in 2003 were well below the national average in English and amongst the bottom 5 per cent of schools in mathematics and science.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT in the school</td>
<td>Provision for information and communication technology is poor, although this weakness is in the process of being rectified.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of students on roll</td>
<td>481</td>
</tr>
<tr>
<td>Location</td>
<td>It serves an area of owner-occupied housing about one and half miles from Leicester city centre.</td>
<td></td>
</tr>
<tr>
<td>Across curriculum teaching level</td>
<td>This is a very effective school which provides a good quality of education. Standards in English, mathematics, and science at the end of Key Stage 1 are very good.</td>
<td></td>
</tr>
<tr>
<td>ICT in the school</td>
<td>Pupils’ attainment in ICT is in line with the national expectation by the end of Key Stage 1 and below the national expectation by the end of Key Stage 2.</td>
<td></td>
</tr>
</tbody>
</table>
### Observational Record Form

This form is used to record the researcher observation during the ICT lesson.

**1. Demographic Information**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) School Name _________________________ Located in the city of ______________.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Type of school</td>
<td>Private</td>
<td>Public</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) School Stage</td>
<td>Primary</td>
<td>Secondary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Year</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
| e) Lesson title __________________________________. Unit _________________.

**2. Technologies used in teaching ICT**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Interactive whiteboard</td>
<td>Blackboard</td>
<td>Projector</td>
<td>computer</td>
<td>PowerPoint</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**3. Use of educational CD-ROM**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Does the teacher use an educational CD during the lesson?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
| b) Name of software ________________________________.
| c) Reason of use ________________________________.

**4. Use of storytelling (narrative)**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Does the teacher use narrative or stories during the lesson?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
| b) Name ________________________________.
| c) Type ________________________________ Source ________________________________.
| d) Reason of use ________________________________.

**5. Flow of the lesson**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Does the teacher starts with questions about the previous lesson?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>b) Does the teacher links the knowledge of the new lesson with previous lessons?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>c) Does the teacher tried to get out the topic of the new lesson from the students?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
| d) How does the teacher show them the steps of using the software?
Orally |   | do it on computer+orally+projected | asked them to use the books | Animated tutorial |

**6. Students Interaction**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Are they asking any questions about the previous lesson?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>b) Are they asking any questions about the new lesson?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>c) Are they motivated to raise their hands to participate in the lesson?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### d) Are they answering the right answers?

<table>
<thead>
<tr>
<th>All</th>
<th>70% and above</th>
<th>50%</th>
<th>30% or less</th>
</tr>
</thead>
</table>

### e) Questions asked are about

- The use of the software (where to find a command)
- The concept of the lesson

### f) Are they busy in any other activity rather than paying attention?

<table>
<thead>
<tr>
<th>All</th>
<th>70% and above</th>
<th>50%</th>
<th>30% or less</th>
</tr>
</thead>
</table>

### g) Does the teacher ask them to perform some tasks on the his/her computer (projected)?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

---

### 7. During practicing the prompt sheet

<table>
<thead>
<tr>
<th>a) Do the students ask about the steps of performing the commands?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>70% and above</td>
<td>50%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b) Students perform the requirements of the prompt sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>c) Do they need an instructor assistance on their computer them?</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
</tr>
</tbody>
</table>

### Comments

_______________________________________________________________________________________

_______________________________________________________________________________________

...
4. Appendix A.4: Interviews with teachers in primary schools

<table>
<thead>
<tr>
<th>School Name _______________________________</th>
</tr>
</thead>
</table>

### 1-ICT curriculum teaching

**a)** Is there any teaching practices performed in the observed lesson differed from your teaching in other ICT lessons?

**b)** Do you usually divide the ICT lesson into two parts: teacher directed and student centred parts?

**c)** In the teacher centered part you focused on demonstrating the technical skills do you do that in all the ICT lessons? Why?

**d)** How do the students understand where and how to apply the learnt technical skills?

### 2-Use of e-learning materials

**a)** Do you use educational CD-ROM in teaching the ICT curriculum?

- [ ] No
- [ ] Yes

If yes, specify the type the educational CD-ROM used?

- [ ] Matches the content of the curricula
- [ ] Supportive nature of the curricula

**c)** Do you use computer as a supporting tool in audio, visual presentations in teaching ICT?

- [ ] No
- [ ] Yes

**d)** Have you ever tried any e-learning material in teaching the ICT curriculum? what was it?

**e)** What is your idea about e-learning?

________________________________________________________________________________
________________________________________________________________________________

**f)** Are you using the e-mail in communicating with your students?

- [ ] No
- [ ] Yes

(If yes please specify-regularly, emergency)

**g)** Do you request your students to do any job using the internet?

- [ ] No
- [ ] Yes

(If yes please specify)

### 3-Curriculum

**a)** Are you convinced with the curricula quantity?
<table>
<thead>
<tr>
<th>b) Are you convinced with the curricula content?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ☐ Yes ☐</td>
</tr>
<tr>
<td>(Please specify, why? How to improve it?)</td>
</tr>
<tr>
<td>(Please specify, what are the themes that has to be deleted or added)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>c) Are you interested in creating exciting curriculum that involves and motivates the students?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ☐ Yes ☐</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>d) Do you feel that the students grasp to the theoretical part of the curricula?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ☐ Yes ☐</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>e) Do you feel that the students grasp to the practical part of the curricula?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ☐ Yes ☐</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>f) Do you feel that the use of e-learning materials can affect student achievement?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ☐ Yes ☐</td>
</tr>
</tbody>
</table>

### 4- Problems and obstacles of teaching the ICT curriculum

<table>
<thead>
<tr>
<th>a) What are the main problems that you face in teaching the ICT curriculum?</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) Does your school provide you with any ICT training? What is the training about? Who offered it?</td>
</tr>
<tr>
<td>c) How do you assess the students ICT skills?</td>
</tr>
<tr>
<td>d) Do you have any records of the students ICT skills?</td>
</tr>
</tbody>
</table>
APPENDIX B: E-LEARNING PUBLISHING COMPANIES

a. Appendix B.1: Sample of the Evaluation Forms used by the companies

Please assist us in offering you the most efficient service possible by completing this form. Thank you!

Name of program: ________________________

Do you find it easy to install the software? _ YES _ NO

Did you access the teacher options? _ YES _ NO

Did you find the support videos useful and informative? _ YES _ NO

How did the software aid your curriculum requirements?
___________________________________________________________________
___________________________________________________________________

Which year group did you try the software with? ____________________________

Which feature did you and your pupils enjoy the most?
___________________________________________________________________

Do you have any other comments or suggestions on how we can help you further?
___________________________________________________________________
___________________________________________________________________

Overall feedback:
___________________________________________________________________
___________________________________________________________________

_ Please tick if you are happy for us to publish and share your feedback with other teachers and users.

How would you prefer us to contact you in the future?
_ By phone - tel: ______________________________________________________
_ By email: ___________________________________________________________
_ By post - address:
____________________________________________________________

Your name:___________________________
Position:_____________________________
School name: _________________________ Telephone:___________________________
b. Appendix B.2: Current design practices of e-learning material in UK

**Design and Evaluation of ICT educational products: producers perspective**

1) What is the name of the company?
__________________________________________________________________

2) How long have you worked in producing ICT educational products?
__________________________________________________________________

3) Who is the target audience of your products?
   a. Teacher
   b. Students
   c. Other

4) Is there any of your products can be used by the students at home?
   a. Yes
   b. No

5) Please specify the name of the product.
__________________________________________________________________

6) What are the schools that are using your product in West Midland, particularly Coventry, Birmingham?
__________________________________________________________________

7) How your product is being used in the school?
   a. Supportive tool
   b. Revision Purpose
   c. Individually by students
   d. under teacher supervision
   e. Projected by the teacher to the whole class
   f. Other

8) Are you familiar with teaching and learning theories, and do they inform your design?
   a. Yes
   b. No

9) What software does your company use for designing the ICT products (Animations, games etc)
__________________________________________________________________
__________________________________________________________________

10) Do you use 3-D modeling software to construct a part of any animation, or interface design?
    a. Yes
    b. No

11) Please specify why?
__________________________________________________________________
12) Is there collaboration between designer and teacher/subject specialist?
   a. Yes
   b. No

13) How do you talk to the teacher (e.g. is it face to face, over the phone, do you talk over and around initial concepts) and what contribution are you expecting from her?

14) Do you apply the User Centered Design Approach in your design process?
   a. Yes
   b. No

15) How do you consider the users needs in your design? Particularly, if they are children?

16) How do you evaluate your products?

17) With whom do you evaluate the design of your product?
   a. Experts
   b. Designers
   c. Teachers
   d. Students
   e. Other

18) What are the main criteria that you consider in your evaluation?

19) When you send your product to schools, do you send and evaluation form with it? If yes, how often do you get these forms back?

20) Do you involve the students in the evaluation process?
   a. Yes
   b. No

21) When do you involve the students in the evaluation process?
   a. During the formative evaluation
   b. During the summative evaluation
   c. Other

22) What is the most important feedback you get from teachers?

23) What are the main difficulties that are facing the students and/or teachers in using your products?

24) Do you develop your products according to the schools feedback?
   a. Yes
   b. No

Thank you
c. **Appendix B.3: Teachers selection and evaluation of e-learning materials**

1) Name of the school_______________________________.

2) How do you receive information about the educational software available in the market?
   d. Internet (Search Engine)
   e. E-mail
   f. Post
   g. Educational show visits
   h. Colleagues
   i. Other

3) Do you use an evaluation form with pre-set criteria when you review the software for your first time?
   a. Yes
   b. No

4) If yes, do you
   a. Create the form your self
   b. Use the form attached with the software you received from the company
   c. Other

5) Do you
   a. Review the demo with the students
   b. View it by your self
   c. Other

6) Do you……………………in the selection and evaluation process
   a. Involve the students
   b. Consult other teachers
   c. Make the decision yourself

7) When you try the software for the first time, what is the main feature that led you to reject the software?
   a. Disagreement with the curriculum
   b. Complex to the students to use
   c. Other

8) Which type of educational software do you prefer?
   a. Matches the content of the curricula
   b. Supportive nature of the curricula
   c. Other

9) Do you use the software as
   a. Vital teaching tool
   b. Supportive learning tool
   c. Other

10) Do you use the educational software with
    a. All the students in the class
    b. Only weak students
    c. Other
11) Prioritize the following criteria of selecting educational software in an ascending order from 1 to 8 where 1 indicates the (8 indicates the most important)
a. Entertainment value  
b. Correlation to curriculum  
c. Ease of initial use  
d. Age appropriate  
e. Students preferences  
f. Quality of graphics and sound  
g. Educational value  
h. Cost

12) Do you use any educational software correlated to the ICT curriculum?  
a. Yes  
b. No  

13) Please specify the name of the software  
__________________________________________________________________  

14) The type of the software  
a. Application (tool)  
b. Tutorial  
c. Other  

15) Please tell me any further comments (it would be very useful to provide me with any additional information –observation about the above topics)  
__________________________________________________________________  
__________________________________________________________________  
__________________________________________________________________

Than you for your time.
Appendix C: ABOUT THE GAME

Appendix C.1: Game description and intended learning outcomes

Game description
It is an educational game designed to help year 6 pupils to achieve the attainment gains of Multimedia presentation Unit - UK ICT National Curriculum focusing on understanding, knowledge and skills specified by the QCA schemes of work currently neglected by the teachers in schools. The game should be used as a supportive tool in a blended learning context, i.e. the pupils use the CD as an e-learning tool while the teacher is available in the class. It can be used by a group of 2 or more sharing the same PC or can be used individually by pupils.

The game tasks and the intended learning outcomes

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Learning objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1: To explore the content of the gallery.</td>
<td>Pupils should be able to………</td>
</tr>
<tr>
<td>• Classify the different elements available in a multimedia environment. (graphics, text, animation, sound)</td>
<td></td>
</tr>
<tr>
<td>• Understand the potential of multimedia</td>
<td></td>
</tr>
<tr>
<td>• Identify the storage mediums of each information type.</td>
<td></td>
</tr>
<tr>
<td>• Investigate different ways information can be presented.</td>
<td></td>
</tr>
<tr>
<td>Task 2: To classify and sort different types of media according to their information type by picking them into containers.</td>
<td>• Categorize information according to type, purpose and characteristics.</td>
</tr>
<tr>
<td>Task 3: To organize and match objects from different type of information according to their correspondence to each other.</td>
<td>• Identify the appropriateness and complementation of different types of information to each other.</td>
</tr>
<tr>
<td>4. To chat online in a virtual environment.</td>
<td>• Understand the communication ways</td>
</tr>
</tbody>
</table>
| Stage 3 : Proposed | • Understand why certain software packages are more appropriate for screen presentation rather than on paper.  
• Show an increase of awareness of the intended audience when communicating information.  
• Recognize the concept of “fitness for purpose” when using images, text, colour, and sound. |
Appendix C.2 Game details

1. Story of the game

- The events of the game is presented in a 3D gallery which is filled with scattered stuff (paintings, recorder, PC, DVD’s, video, animations, light...etc). The artist faces some difficulties that wouldn't allow him to arrange his gallery for the show, so the player will be asked to do this task.
- Objects available in the gallery contain all types of information (sound, text, images) in either a digital or hard copies.
- The painting and text available within the stuff is from various levels of complexity and from different categories- for different purposes (i.e. nature business, food) so the player can choose what suits his audience level.
- From the stuff available in the room the player will understand –recognized the different types of information.
- The help in the CD is represented by an online simultaneous chat with the teacher. In the game context, there is going to be a PC inside the gallery, the player can use it to contact the artist of the gallery to get his help in the show arrangement. This artist is the teacher.
- The game is divided into stages, each stage focus on specific educational aims; so each stage can be used in a lesson to achieve the learning outcomes of that lesson.

2. Game stages

The game is divided into 2 stages; at the beginning of each stage, a brief explanation is given to the player explaining what the stage about, how it can be passed and why this stage is important to the artist (how completing this stage can help the artist).

In stage 1 “Categorize the gallery stuff”, the player is required to classify the objects according to their information type, i.e. text, images, sound or multimedia.

The gallery contains 4 containers (text, images, sound and multimedia) and the player should put each object in its appropriate container.

The four containers are as follows:

1. Text Container
   All the objects that contains text should be dragged to the text container, including CDs that contain text files, digital print outs, and the hand written piece of text.

2. Sound Container
   Contain the objects that consist of sound files, including cassettes and CDs.

3. Image Container
   Should contain all the objects that contain images-pictures including paintings, CDs that contain images.

4. Multimedia Container
   For all the CDs that contain the multimedia files.
The contents of the 5 CDs are as follows:

There should be 5 CDs in the gallery, when dragged and dropped on the laptop it should allow the exploration of the contents of the CD on the laptop as if you exploring the content of any CD on the normal PC or laptop. The contents of the 5 CDs are as follows:

1. Multimedia CD:
   Should contain any piece of animation as a sample (avi file) that can be replaced in the same way of replacing the paintings and the text description Jpeg files.
2. Audio CD
   Two audio CDs each contain 4 audio files that can be replaced also.
3. Text files
   Should contain 4 text files (.doc) that can be replaced.
4. Image CD
   Should contain 4 image files (.jpeg) that can be replaced.

In stage 2 “Matching gallery stuff”, the player is required to organize the objects according to their appropriateness and complementation to each other.

At the beginning of stage 2, 50% of the paintings should be on the walls and 50% muddled on the floor. Also the text descriptions 50% should be on the walls and 50% on the floor. It is possible to have 2 or sometimes 3 text files that is appropriate to the image but only one of them is the most suitable one. So when the most appropriate one is matched with the image the number of scores added is more than when any of the other two is added.

3. Profile
   A profile is being saved for each player showing the following:
   - The name of the player
   - The time spent in the stage completion.
   - The scores achieved.
   - The time and date of entering the stage.
   - The application form information (Have you ever visited a galley? What was the gallery about? What did you like or dislike about that gallery?)
   - The overall number of the wrong attempts

4. Questions
   Multiple choice questions would appear after achieving the task correctly. For example, if a right object has been dropped to the sound container, the question about the sound should appear.

5. Rewards
   - Bonus: during all the stages, awarding answering the questions differs from dragging and dropping. Answering the question correctly will provide the player with overtime. (The count down will stop for 5 minutes after answering each question; giving the player a chance to get more scores through doing extra tasks but without counting the time).
If answered correctly then time counter = time counter +1 real min
Else if wrong answer then time counter = time counter – 30 sec real time

• Timing

A timer has to be on the screen through all the stages, the challenge of the game is accomplish the required task during a specified period of time. A counter will start to count down at the beginning of each stage ; and the game will over when the counters reaches zero and the scores is less than half of what the player suppose to collect.

• Scoring system

Generally , according to children’s preferences , the scores has to be shown on the screen through the whole game.

In stage 1 since the requirement is to categorize the objects according to their types, if any object is dragged to objects of a different type, 10 points will be lost. Otherwise, if the objects are categorized correctly; each attempt to add a new correct object, 10 scores will be added to the player's score account.

When any object is dragged and dropped in the right container, the scores= scores+5 else scores= scores -2 regardless of the attempts of dropping an object in the wrong container.

For example, the text container:
All the text descriptions, the book, the papers, the CD that contains text when dropped in the text container the scores= score+ 5 else if dropped in a wrong container scores=scores -2
Even if it is not the first attempt for a wrong dropping the scores=scores-2.

When the total scores= 100 the player should have a screen with three options (exit, go to stage 2, continue in the current stage until reach the time limit)

When the time limit reached and the scores is less than 100 the player should have the following two options: exit or start stage 1 again.
Else if the time limit reached and the scores>=100 then the player should have 2 options
Exit, go to stage 2

In stage 2: the challenge is to organize the objects and put them in their appropriateness and complementation to each other. if any object is not placed in its right place firstly (in the first try) the object will fall down (will not be hanged) secondly 10 scores will be lost. Otherwise, if the answer is correct the object will be placed from the first try, and 10 scores will be added.
The following tables explain clearly the matching between the objects that will affect the scoring system

<table>
<thead>
<tr>
<th>Object 1</th>
<th>Object 2</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>T1 a</td>
<td>Scores = scores +10</td>
</tr>
<tr>
<td></td>
<td>T1 b</td>
<td>Scores = scores +5</td>
</tr>
<tr>
<td></td>
<td>T1 c</td>
<td>Scores = scores +5</td>
</tr>
<tr>
<td>P1</td>
<td>With any other T*file</td>
<td>Scores = scores -3</td>
</tr>
<tr>
<td>P2</td>
<td>T2 a</td>
<td>Scores = scores +10</td>
</tr>
<tr>
<td></td>
<td>T2 b</td>
<td>Scores = scores +5</td>
</tr>
<tr>
<td></td>
<td>T2 c</td>
<td>Scores = scores +5</td>
</tr>
<tr>
<td>P2</td>
<td>With any other T*file</td>
<td>Scores = scores -3</td>
</tr>
<tr>
<td>Audio CD 1</td>
<td>If dragged to the CD player or the laptop and played then the sound file that it contain should play</td>
<td></td>
</tr>
<tr>
<td>Audio CD 2</td>
<td>If any CD other than the Audio CD 1 it played</td>
<td>Scores = scores -3</td>
</tr>
<tr>
<td>CD that contains the animation</td>
<td>played on the laptop and connected to the projection screen</td>
<td>Scores = scores +10</td>
</tr>
</tbody>
</table>

Once the scores = 100 or time limit reached then A congratulation message appears that player wins.

Else if scores < 100 and timer = 0 then The player will have 3 options - Game over.. Restart (start again stage 2 ) exit
Appendix D.1 has not been included in this version.
APPENDIX E: DESIGNERS INTERVIEWS IN SAUDI ARABIA

Appendix E.1: Current design practices in Saudi Arabia interviews questions

1. Background information
   
   a) Company name ____________________________________________.
   
   b) Products & services provided to support the formal curriculum
      
      • Educational software (in which subject, for which grade, what are they, what are the schools using it, best seller, consumers – schools, universities or individuals)
      
      • e-learning material (converts the Ministries curriculum to e-materials, what are these materials, do they a permission from the Ministry or is it done for a specific school, do you know a name of a company that is collaborating with the Ministry of education in developing the e-curriculum)
      
      • Building schools websites, uploading teachers own teaching resources.

   c) Which schools use the software? Do they make request for new material? Do they collaborate in the design in any way? If so how?

2. Background information about the designer
   
   a) What is your present position and title?

   b) How long have you worked in producing ICT educational products?

   c) Who is the target audience of your products?

   d) What duties do you carry out in your present position?
e) Do you have any feedback from the users about your products? If so, how is this provided, what do they say? Do you use any of this information in the design of new products? Provide examples if possible.

3. Design practice

Process
a) Using your most recent design process as an example: please describe the entire process (e.g. what was the form of the design brief, was it a re-design, how many people were involved in the process, how did you arrive at the final design? Did you need additional information/knowledge to complete the task?)

b) How long does it take you to complete a design of educational software- e-learning material of a single module?

c) What are the key issues that you consider in the design of educational computer games for children (e.g. attractiveness, aesthetics, fun..) what do you start first with? What issues are most important?

d) What do you think of the design process you use? How could it be more effective?

Design
a) Which design principles are most important to you in your design (layout balance, colour, typography)?

b) To what extent are you familiar with how the material will be used in the classroom? Do you provide guidance for its use? How does this influence your design?

c) How familiar are you with the subject matter of the game you are designing? E.g. did you learn about it at degree level, up to the age of 16?

d) How would you describe the games you design?

e) What is the main mechanism through which children learn when they play your game?
f) How it the extent of their knowledge tested?

_________________________________________________________________________

g) What software do you use in your designs?

_________________________________________________________________________

h) Do you use 3D modelling in your designs?

_________________________________________________________________________

i) How do you consider the users needs in your design, particularly if they are children?

_________________________________________________________________________

Evaluation

a) Do you evaluate your products?

_________________________________________________________________________

If yes, answer questions (b to e) and if no move to the following section

b) How do you evaluate your products?

_________________________________________________________________________

c) With whom do you evaluate your products (experts, teachers, designers, or real students)? If so how and at what stage?

_________________________________________________________________________

d) Please describe the assessment method with other agents (e.g. teacher, editor, committee, etc.) on your material design. How long does it take to achieve?

_________________________________________________________________________

e) What are the main criteria that you consider in your evaluation?

_________________________________________________________________________

f) Do you develop your product according to the evaluation process? How?

_________________________________________________________________________

Collaboration

a) Is there collaboration between designer/teacher –or subject specialist? if so, how do you talk to the teacher (e.g. face to face, over the phone) do you talk over and around initial concepts? And what contribution you expecting from her/him?

_________________________________________________________________________

_________________________________________________________________________

b) What resources (e.g. people, expert, knowledge programs, materials, approaches, etc.) do you draw on in design? How and why have these resources been useful to you?

_________________________________________________________________________

Thanks
Appendix E.2: Designers Interviews: Assessment of the research Child Centred Design Approach

Child Centred Design Approach Evaluation by designers

The educational game “The Future Job” will be examined by designers and the development process will be discussed.

Company name _________________________________.

1. Is it possible to use this kind of game in the Saudi school? Why?
2. What are the main obstacles – problems of implementing such games in Saudi schools?
3. What is your first impression when you look at the method in terms of its practicability?
4. What part of the method would you see as being most useful/difficult in the design process?
5. How do you think the method could affect the following:
   - The duration of the development process
   - Cost
   - Error

6. Do you think the method would benefit your design process. Please explain
7. How do you think the method can be improved?
Appendix F.1 has not been included in this version.
# Appendix G: Schools in Saudi Arabia

## Appendix G.1: Profile of visited schools

<table>
<thead>
<tr>
<th>School name</th>
<th>Summary of Information about the school</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>School 1</strong></td>
<td><strong>Private school (Kindergarten – High school)</strong>&lt;br&gt;North Riyadh. The school serves its immediate surrounding area to the middle of Riyadh, which has private owned homes. A significant number of pupils come from areas of high social economic group as the school fee is quite expensive.</td>
</tr>
<tr>
<td><strong>Across curriculum teaching level</strong></td>
<td>This school has a high level of technical resources. The pupils' level exceeded expectations comparing to other private schools. Teaching is satisfactory across curriculum.</td>
</tr>
<tr>
<td><strong>ICT in the school</strong></td>
<td>Achievement in ICT is excellent.</td>
</tr>
<tr>
<td><strong>School 2</strong></td>
<td><strong>private school (Kindergarten – High school)</strong>&lt;br&gt;Middle of Riyadh. The school severs the surrounding area to north Riyadh, which has a mixture of both private owned homes and rented homes. The fees is reasonable comparing to school 1 and pupils might come from middle and high social economic areas.</td>
</tr>
<tr>
<td><strong>Across curriculum teaching level</strong></td>
<td>The quality of teaching and learning is good. Achievement is good for all groups of pupils throughout the school.</td>
</tr>
<tr>
<td><strong>ICT in the school</strong></td>
<td>Provision in ICT is satisfactory. ICT is used well within other lessons. The subject co-ordinators have been looking at software to support learning in each of the subjects of the curriculum. Pupils have good opportunities to use the computers in the classroom to investigate aspects or complete work in other subjects.</td>
</tr>
<tr>
<td><strong>School 3</strong></td>
<td><strong>private school (Kindergarten – High school)</strong>&lt;br&gt;North West Riyadh. Pupils come from a wide range of social backgrounds.</td>
</tr>
<tr>
<td><strong>Across curriculum teaching level</strong></td>
<td>The quality of teaching and learning throughout the school is judged to be sound overall. Pupils attain below average standards by the end of years 6 but they are improving.</td>
</tr>
<tr>
<td><strong>ICT in the school</strong></td>
<td>Low level of teaching ICT comparing</td>
</tr>
<tr>
<td><strong>School 4</strong></td>
<td><strong>private school (Kindergarten – High school)</strong>&lt;br&gt;Riyadh, South east.</td>
</tr>
<tr>
<td><strong>Across curriculum teaching</strong></td>
<td>Pupils generally achieve well throughout the school.</td>
</tr>
<tr>
<td>School 5</td>
<td>ICT in the school</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>School type</td>
<td>Public primary school.</td>
</tr>
<tr>
<td>Location</td>
<td>North Riyadh. The school serves a diverse area, parts of which are socially and economically disadvantaged.</td>
</tr>
<tr>
<td>Across curriculum teaching level</td>
<td>Pupils generally achieve well throughout the school.</td>
</tr>
<tr>
<td>ICT in the school</td>
<td>ICT is not being taught or used in the school except by the science teacher and in a very poor level.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School 6</th>
<th>ICT in the school</th>
<th>Teaching ICT only in high school.</th>
</tr>
</thead>
<tbody>
<tr>
<td>School type</td>
<td>Private School</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Riyadh- serves the north of Riyadh. However, the intake is mixed, with significant numbers coming from both advantaged and disadvantaged backgrounds.</td>
<td></td>
</tr>
<tr>
<td>Across curriculum teaching level</td>
<td>The school provides satisfactorily for its pupils. The school offers a good, varied and interesting curriculum. Teaching is satisfactory and examples of good and outstanding lessons were seen.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School 7</th>
<th>ICT in the school</th>
<th>ICT is not being taught as a subject. and poorly used as a tool in core subjects such as Math and science.</th>
</tr>
</thead>
<tbody>
<tr>
<td>School type</td>
<td>Public Secondary school</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Riyadh West area. Serves surrounding area , where pupils comes form low economic social groups.</td>
<td></td>
</tr>
<tr>
<td>Across curriculum teaching level</td>
<td>Pupils attain satisfactory level across curriculum.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School 8</th>
<th>ICT in the school</th>
<th>ICT is taught satisfactory level. And poorly used across curriculum</th>
</tr>
</thead>
<tbody>
<tr>
<td>School type</td>
<td>Public high school</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Riyadh North</td>
<td></td>
</tr>
<tr>
<td>Across curriculum teaching level</td>
<td>This is a satisfactory school with good features. Pupils’ achievement is satisfactory.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School 9</th>
<th>ICT in the school</th>
<th>The level of the pupils is below the standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>School type</td>
<td>Public high school</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>It is situated close to the centre of Riyadh</td>
<td></td>
</tr>
<tr>
<td>Across curriculum teaching level</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


### School 10

<table>
<thead>
<tr>
<th>ICT in the school</th>
<th>Provision for information and communication technology is poor, although this weakness is in the process of being rectified.</th>
</tr>
</thead>
<tbody>
<tr>
<td>School type</td>
<td>Public high school</td>
</tr>
<tr>
<td>Location</td>
<td>South Riyadh. It serves an area of owner-occupied housing</td>
</tr>
<tr>
<td>Across curriculum teaching level</td>
<td>This is a very effective school which provides a good quality of education.</td>
</tr>
<tr>
<td>ICT in the school</td>
<td>ICT is not used across curriculum and teaching ICT is of a good level.</td>
</tr>
</tbody>
</table>
Appendix G.2: Recommendations to the Saudi Ministry of Education

Bismilrahman rahim

Saadaa Madiir Qasm Tyeenah al-muwarrada al-tibryah wal-tibulis mahurum

al-salam alilam wa-rhamatullah wa-barkatuhu, wabid

Afizkm anaa ana rahman abu hassan tabiyan daeras ubiya fi mirahala al-akhirah, adrs halia fi Britaniya byawmah

konfortri wadrasati ttaaliqu tylkumil alectryniti ltasyowri adhara al-alii fi mirahala al-abdiyaha. Waa ta

han jah alectryniti al-akhirah wajra al-mirahala al-abdiyaha britaniyaha wargah maa in fi

taaazir alectry adhara al-alii fi al-mamlaka al-urbiyyaha aswat al-soudadala faqma ba ajar al-mirahala maqar aindin wawat qaama

balaltusia tyyafa tasyowri alectry adhara al-alii fi al-mirahala al-abdiyaha.

tanqam qaama al-altusia taaist preemaiy:

1. Menji alectry al-alii

2. Asistum alectry al-alii

3. Tdrub areadum

4. Tshim alectry al-akhir

1. Menji alectry al-alii

A ba alectry alectry al-alii maa san misakia

naqoora la kon areadum areadum maa kinu aksesumha la taayri alectry wawat al-manahaj maa Sakhal al-abdiyaha faani

aqhoor rasywata alectry alectry al-alii maa sanahat al-alii fi mirahala al-abdiyaha hani ywakom talibom min faam

kahefa aksesum al-technia waa waa awin maa kinu aksesumha, waq taymim al-anin (2001) ba al-sharri ila alectry

al-alii maa Sakhal al-abdiyaha kaayi maa saisa aakhir.

wahu ina fi Britaniya ta alectry alectry al-alii ebiyari fi ajaal al-mirahala al-abdiyaha faani ywakom

al-astaadaa min al-tajribi britaniyaha.

b. Mawtayi menji
أشارت نتائج الدراسة إلى تفاوت كبير بين محتوى منهج الحاسب الآلي بين المدارس الأهلية والحكومية، لذا فمن الضروري توحيد المناهج والسعي إلى وضع منهج ينتاسب مع استخدامات الحاسب في الحياة اليومية للطالب فلا يقتصر فقط على الجانب النظري للمادة.

وتعتبر مناسبة منهج الحاسب الآلي لتجربة الطلاب خارج المدرسة من أهم النصائح التي يجب أخذها في الاعتبار لتجنب وجود فجوة حتى لا يشعر الطالب بالملل أو عدم الرغبة في تعلم مادة الحاسب الآلي.

ونظراً لوجود جهة تتعلق بوضع خطة عمل تدريس منهج الحاسب الآلي في بريطانيا فإن المراجع لهذه الخطة والاستفادة منها لوضع إطار مناسب لمادة الحاسب الآلي شرط أن يتناسب مع الثقافة العربية الإسلامية.

ج. طرق تدريس الحاسب الآلي

أشارت نتائج زيادة المدارس وملاحظة طرق التدريس المتباينة حالياً إلى وجود مشاكل في طرق التدريس القائمة حيث أنها تركز بشكل كبير على تدريس المهارات التقنية باستخدام برامج الحاسب الآلي بالرغم من أن المنهج مدع لتشمل مهارات معرفية ووعي وفهم كيفية استخدام وتطبيق المهارات التقنية. لذلك يجب الأخذ بالإعتبار ضرورة أن يتم تصميم منهج الحاسب الآلي بحيث يوارز بين الجانب النظري والتطبيقي.

إضافة إلى ذلك فإن تدريس الحاسب الآلي كمادة دون أن تؤثر درجاتها على نجاح أو رسوة الطالب يتعكس بشكل سلبي على طريقة التدريس، لذا فمن الضروري أن تعمل مادة الحاسب الآلي كمادة أساسية تؤثر درجاتها على مستوى الطالب، نجاح أو رسوة.

كما وضح أن الدراسة أن استخدام التعليم الإلكتروني له أثر إيجابي على مستوى الطلاب الأكاديمي، لذا فإن استخدام التعليم الإلكتروني في تدريس مادة الحاسب الآلي قد يساعد المعلم على التغلب على مشاكل التدريس القائمة.

وقد أشارت الشركات المنتجة للتعليم الإلكتروني في المملكة العربية السعودية إلى تجربة إنتاج مادة الحاسب الآلي نظراً لعدم وجود طلب من قبل الطلاب المستهدف لكونها مادة غير أساسية من الوزارء أيضاً بسبب عدم وجود منهج موحد بين المدارس الأهلية والحكومية مما يعني ضرورة وجود تعاون بين الشركات المنتجة للتعليم الإلكتروني ووزارة التربية والتعليم إضافة لتجديد منهج الحاسب الآلي ودروسه كمادة أساسية.

إضافة لذلك فإن هناك مشاكل تدريس منهج الحاسب الآلي مرتبطة على عدم إمكانية المعلومات ونصوص التدريب والتأهيل المقدم لهم. لذا فإنه يتوجب على وزارة التربية والتعليم تقديم برامج تدريبية وتأهيلية للمعلمين وخصوصاً معلمان الحاسب الآلي.

٢. استخدام تقنية المعلومات في التدريس (التعليم الإلكتروني)

هناك حاجة لوجود قسم في وزارة التربية والتعليم مخصص بدعم تقنية المعلومات واستخداماتها في العملية التعليمية وتدريس الحاسب الآلي كمادة أساسية. يمكن الاستفادة من خبرات وتجارب الجهة المسؤولة عن ذلك في بريطانيا والذي تدعى BECTA
ومن ناحية أخرى فإن غالبية المدارس الأهلية المتقدمة تسعى لتطبيق نظام تعليمي إلكتروني في تدريس جميع المواد دون دراسة جدوى ذلك، ونظرًا لأن غالبية الدراسات البريطانية أشارت إلى أن الدعم الجذري لتقنية المعلومات فمن الضروري عمل دراسة تجريبية قبل تطبيق نظام التعليم الإلكتروني.

3. تدريب المعلمة

كما تم الإشارة أعلاه فإن الضروري تدريب المعلمات وخصوصا معلمي الحاسب الآلي للتقليل من مشكلات تدريس الحاسب الآلي كمادة وتعميق دمج تقنية المعلومات في تدريس مختلف المواد.

وحيث أن تدريب المعلمات إجباري في بريطانيا والذي يشمل تدريب المعلمات على ما يلي:

- طرق تدريس مادة الحاسب الآلي
- توعية حول ضرورة دمج تقنية المعلومات في التعليم.
- طرق استخدام الحاسب الآلي في التعليم

4. تصميم التعليم الإلكتروني

أشارت الدراسة إلى عدم وجود أي تعاون بين وزارة التربية والتعليم والشركات المنتجة للتعليم الإلكتروني ولا تزال المواد الإلكترونية التي تنتجها الشركات غير خاضعة لأي اختبارات جودة من قبل وزارة التربية والتعليم.

يوجب على الوزارة أن تتعاون مع الشركات المنتجة تقوم بمراقبة الإنتاج، إضافة لضرورة وضع لوائح تضمن إنتاج مواد تعليمية كترونية على مستوى عالي من الجودة والفاعلية.

أمل منكم النظر في التوصيات المقدمة أعلاه وفي حال وجود أي استفسار فلا تترددوا بالاتصال معي على البريد الإلكتروني أو الهاتف ال الجوال.

عليم بأن التوصيات أعلاه مختصرة وحلول قبولكم لها سيتم إرسال دراسة مفصلة حول تطبيقها.

شكرًا ومقدرة لكم شكركم وأمانيكم ولله يحفظكم.

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Characteristics of Computer Education in Saudi Arabia

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Keywords E-learning, Blended learning, computer curriculum, educational software, computer teacher.

Abstract There is a distinction in the usage of computers in education, where they can form either a tool embedded in the curricula or a subject taught in its own right. This paper discusses the status of computer education in Saudi Arabia, with reference to these two competing objectives.

If educational curricula and material are to be devised to support learning, it is necessary to understand both the use of ICT as a teaching tool, and how computing is taught a subject in its own right in terms of the characteristics of the computer curriculum, its content, difficulties of teaching, teaching practices and technologies. To determine how ICT is currently used in schools, and the curriculum being followed in Saudi Arabia, semi structured interviews were conducted with computer teachers in ten public and private schools and three managers of educational software companies. Additionally 10 IT lessons were observed.

The results indicate a divergence between private and public schools in the use of computers as an educational tool across curriculum and in the nature of the curriculum. Public schools are behind the private schools in the content of the computer curriculum, teaching methods and techniques used to teach computer and the age at which they start to teach computers. However, the Ministry of Education is struggling to unify the computer curriculum and to provide higher resources to public schools.

Introduction

For the last few decades, technology has been revolutionizing every aspect of life. Saudi Arabia has responded to the technological expansion in most areas, including education, which is in a transitional stage in its movement towards e-learning. The optimum combination of traditional and e-learning (learning supported in some way by computers) for any subject, and for any learner is still to be established, with some researchers such as Hennik (2003) suggesting that blended learning, “an integration of e-learning and traditional learning” is a way of maximising the advantages of both approaches and reducing the disadvantages associated with an over reliance on just one approach. Clearly, teachers should be provided with training and assistance in developing material best suited to the needs of their subject domain and class.

General terms

Prior to discussing this research, it is necessary to clarify the way in which certain terms have been used in this paper:

‘Traditional learning’ refers to the learning which occurs during face-to-face teaching. The teacher conveys information (written and oral) to the student directly.
‘e-learning’ (as defined by Pollard and Hillage, 2001) is "the delivery and administration of learning opportunities and support via computer, networked and web-based technology to help individual performance and development." In some cases the teacher will not provide a series of facts to the students, but ask them to locate information from on-line sources. The teacher becomes a facilitator, as opposed to the keeper and transmitter of information. This approach is favoured by the action learning community;’ Blended learning’ merges traditional classroom teaching with e-learning activities; ICT indicates the use of computers in the teaching process itself or in school management and administration; IT comprises the knowledge, skills and understanding to make appropriate, productive use of ICT. This should form the basis of the computer curriculum

Research Aims and Objectives
The overall aim of the research was to analyse the current status of computer education in Saudi Arabia as a starting point to an investigation of the benefits of blended learning in comparison with traditional and e-learning in the teaching of computer studies, with a view to informing the development of more effective approaches to the teaching of IT. This can be broken down into the following objectives:

1. To investigate the influence of ICT on education in Saudi Arabia, the benefits and the obstructions.
2. To explore the divergence between public and private schools in relation to computer education in terms of content, the age at which schools start to teach computer studies, teacher qualifications, training, methods and techniques.
3. To evaluate strengths and weaknesses of the computer curriculum.

Background
The Saudi Arabian government has realized that human resources are the most important factor in the development of the country; as a result the Ministry of Education is committing huge resources to developing the country's education system, under the slogan "Education for all". In the case of computer studies, in assessing the relevance of Saudi education to the needs of the society, three characteristics have been identified: government regulation, the emphasis on rote memorization, and the method of teaching.

Firstly, in public (government) schools, textbooks and other classroom material are currently controlled by the government. Committees in the Ministry of Education and Higher Education determine the content of textbooks and basic courses. With the permission of the Ministry of Education, individuals and private institutions have been allowed to establish private schools if they agree to use the basic curriculum approved by the government authorities. Private school directors can therefore only add to the government-approved curriculum, not subtract from it. Such schools consider English and Computer Studies as the main two additional subjects they can offer.

Secondly, "the pedagogical approach that stresses rote memorization and heavy dependence on one or few text books has traditionally characterized Saudi education practice" (Rugh, 2002) However, memorization may not be suited to computer education which requires practice.

Thirdly, "Traditional oral lectures have been the basis of education in Saudi for many generations." (Abdulgader, 2001) This approach tends not to develop creativity or
independent thinking; the emphasis needs to shift towards increasing action learning and computer literacy (achieved through doing). Therefore, as indicate by Abdulgader (2001) "Nowadays, most of the educational institutions have started to witness the attempt of many schools to venture into the world of electronically supported learning."

The use of the Internet is one of the main examples that showed this. The Internet service started in the Kingdom in accordance with the Council of Ministers' Decree No.163, dated 4-3-1997. Figure 1 shows the increase in the number of Internet users as indicated by the International Business Strategies accessed 2005.

Figure1: Internet Users in Saudi Arabia

However, there is an overall reluctance to use the Internet in the Saudi culture, as mentioned by Al-Dawalij manager, Al-Rashed (2005) "the number of the internet users does not exceed 6% of the Saudi population, and most of the schools are not convinced to have internet."

Generally, most schools are not satisfied with traditional learning. They are now in the transitional stage, blending ICT with traditional teaching methods and have the ambition to move towards e-learning. However, this may not be the most appropriate strategy for all subjects and all students, research indicates that there are not always clear benefits, and sometimes, unforeseen costs associated with e-learning.

The problem is that e-learning may not be universally appropriate. "It is particularly suited to cognitive learning, to presenting new information, stable course content, learning that requires practice and review, for those with reflective or theorist learning styles, where situations need to be simulated, and the where the media requirements are fairly simple" (Epic, 1999). In addition, "e-learning provide a limited flexibility and interactivity to learners" (Zhang and Zhou, 2003). In some cases it is simply post learning material that is offered without content-based structural support to increase learner engagement and interactivity.

Therefore, many commentators believe there is still a place for traditional learning in classrooms with the e-learning. As Fallon and Brown (2003) mentioned "people have begun to recognize that in many instances blended learning is the perfect solution to a given learning need." This research seeks to find the most effective way in which IT can be taught to young students and teaching material produced, with the expectation being that blended learning may be the approach needed. This paper describes the first part of
the research which was to identify current practice in the teaching and general use of ICT in schools in Saudi Arabia.

Methodology
To determine current practice 30 secondary and high, public and private schools were contacted in Riyadh. Using information provided by the headteacher or educational consultation company 'e-learning solutions', 10 of these were selected as providing a representative sample in terms of the catchments’ area, provision of ICT facilities in the school and usage level. In total, 14 computer teachers and 5 IT coordinators were interviewed to accompany classroom observations of 10 IT lessons. Additionally 3 managers of national software companies were interviewed to define the company's role in educational software utilization in schools.

Semi structured interviews were conducted with the teachers, coordinators and the managers. For the teachers and coordinators questions were related to firstly the use of ICT as an educational tool in the school including software packages, CD-ROMs, websites, and technological tools such as projector; secondly the IT curriculum, its content, difficulties and obstacles of teaching; and thirdly, the use of e-learning in the school. The focus of the interviews with the software providers was on the relationship between the company and the school in supporting e-learning, and embedding their products in the school.

Results
ICT as an educational tool
As "ICT has the potential to transform the way that education is delivered". (Fisher, 2001) a wide range of technological options are available to support the learning process. However in this sample, only 50% of the private schools used ICT to support other parts of the curriculum (ie not computer studies/IT itself) and 20% of the public school teachers were not in favour of using ICT. Reasons for this included: 1. Lack of technological competence, confidence and experience was felt to be an issue by 80% of the sample as evidence in comments such as “the computer always goes wrong when one most needs it to work”, “It would seem that the computer has a mind of its own! It knows how we feel, and plays on us and will always works for other people”. Thus the computer can become a real threat, undermining the authority to teachers. This is especially problematic when the pupils have more expertise than the teachers and can make the machine work. 2. The computer is considered as a time-consumer more than a time saver. 3. Decisions regarding the use of ICT are made by the school and not the teachers. For example, 20% of the private schools require all teachers to embed ICT in their subjects.

From the schools that are embedding ICT in their teaching process, 98% are using blended learning without recognizing that they are doing this and 90% are convinced that this increases computer literacy of the students. However, as mentioned earlier, the blended learning approach currently being adopted is just seen as a transitional stage on the way to full e-learning.
Commercial educational software packages are responsible for most ICT usage in schools. This is provided by five national software companies; Sakhr, Al Dawalij Technologies, Al-Mareefa Al-Saudia Company, Obaikan Home Interactive, and Al-maalim and international Arabic software companies (such as Ariss and Turath) that markets and produces their products in Saudi Arabia. Software produced by Al-Dawalij Technology and Al-Mareefa are intended specifically to match the Saudi curriculum. Other educational software companies produce software that is merely supportive.

All the national companies seem to concentrate on producing multimedia CD-ROMs in science studies because of customer demand. However, at present no company produces the Saudi Ministry computer curricula on an educational CD. All the CDs which are related to the computer field are for teaching specific applications such as Microsoft Word, Excel, PowerPoint and Photoshop.

The managers claim that they do not produce the computer curriculum for commercial reasons, notably because of the divergence in content between the public and the private schools, that the exam results of the computer subject is not counted in the total gross performance average, and it is still not an approved subject in most of the public schools.

However, there are two drawbacks with the existing educational CD-ROMs. Firstly, from the interviews it became apparent that material produced to conform to the curriculum content suffered from a general lack of copyright control and superintendence and more importantly, its effectiveness was not evaluated. Secondly, most programs simply re-present the content of the books on the computer screen without any significant treatment to assist or enhance usage. Even the same pictures and questions are used. So opportunities for engaging and motivating children to learn, have fun, and experience the wider potential of computers is lost.

**Divergence between public and private schools**
Differences were found in the two types of schools in the following ways:

1. **Usage of ICT as a tool across curriculum**
95% of the public schools teachers were not using educational CDs, in any subject. This means that private schools and individual students represent the major clients of commercially produced software in Saudi Arabia. The selection of which educational software is used in the in private schools is made by the teacher and the IT coordinator based on ease of use, educational value, level of entertainment, cost, and correlation to the curriculum. 90% use the educational CDs to support the curriculum content while the remaining 10% use it for fun and entertainment.

20% of private schools are moving towards e-learning, with 70% of the private schools using e-mail as one of the main correspondence tools between the student and teacher and between the students themselves. 75% of the private schools tend to have a website that either includes information about the school, or that can be used as an interaction tool between the students and teachers and between the parents and the school. Only
20% of public schools use e-mail as the only form of internet support, and in some cases this is the only form of internet support used.

2. The teaching practices and tools used to teach IT
All public and private schools use ICT as a tool in teaching computing. Microsoft PowerPoint is the most common application used by 70% of the computer teachers in private schools and 20% of the ones in public schools. This is because PowerPoint's presentations can be easily created, updated, and readily accessible for presentation to the whole class by means of a projection device or the intranet if available. All the computer teachers still use a black or white board.

In both types of school, the computer lesson was divided into two parts; in the first part the theoretical issues involved in carrying out the task on the application being taught in the lesson are explained. In the second part, the students have the opportunity to apply what they have learned on their PCs.

3. Computer teachers
Given the vital role that computer teachers play in improving computer education and general ICT awareness, studying their education level, technology utilization and the difficulties they encounter are important steps in leading to education improvement.

The Bachelor degree is the standard qualification required to be a computer teacher; however, there is a divergence between the public and the private schools in the qualification of their computer teachers.

Private schools started to teach computing before public schools at a time when there was a shortage in suitably qualified computer teachers; hence they tended to employ non-Saudi computer teachers and those with just a Diploma.

Additionally, the majority of the teachers are qualified as engineers or specialists in computer science and not educators. This confirms Al-Moneea’s (2001) finding that majority of the computer teachers in private schools are non education specialists. This may cause “difficulties in information delivery, weakness in students gaining skills, and weakness in utilizing modern teaching methods.”

Where such cases are identified there may be a need for programmes of CPD (continual professional development) either to enhance the computer skills of the teachers who have no computer qualification, or to develop pedagogic skills of those from a non-educational background.

However, this is changing slowly with the establishment of a Computer Teacher Department in the College of Education at King Saud University established that will provide appropriately trained teachers in the future. However, a further impediment to the integration of ICT across the curriculum, and in its teaching as a lesson in its own right, is a restriction on the number of computer teachers that can be employed in each school (one per school) and the demands made on that person.
The lack of teachers qualified to teach IT and their failure to deliver the computer curriculum once employed, may be further attributed to the fact that many graduates with degrees in computing prefer to work in the commercial sector (for monetary or other advantages). Additionally, once a competent computer teacher is recruited they may well be called upon to provide general IT support in the school, especially if computer studies itself is not seen as part of the core curriculum. At present, the need for an IT coordinator in schools is not formally recognised. However, 40% of the private schools have an IT coordinator who is responsible for organizing the use of ICT in the school.

Although computer teachers should be trained continually to update their knowledge, no such training is offered by the Ministry of Education. 70% of the private schools require teachers to train themselves. Usually this is through the personal interest of the teacher who likes to keep up to date in technology advances. In some schools the computer teacher may provide training for the rest of the staff.

4. Computer curriculum
Evaluating the curriculum reveals a large divergence between the public and private schools and between the private schools themselves in terms of the content and age at which they start to teach computers.

Computer literacy is relatively new subject, Doheash and Aloreani (2001) noted that "computer just started to be taught formally in Saudi public schools in 2000". However, most private schools started to teach aspects of computer studies in 1995.

Computing is taught in public high schools to students aged between 15-16 years old. However, 60% of private schools start to teach computing from Kindergarten, 30% starts from Primary or Secondary level and only 10% start to teach computing in high school. Although in 2005 the Ministry of Education formally approved it in all public primary and secondary schools, this has not yet been implemented.

Learning about computers at an early stage can increase IT skills that can be built on in later grades. Almoneea (2001), the Councillor of the Arabic Open University supported the idea saying that "the computer subject is significant (enough) to be taught to all levels in public education." It does not have to be limited to high school only; it has to include both secondary and primary school.

Therefore, there is a need to concentrate on the integration of computing at all educational levels and the need to formally teach IT skills as part of the curriculum in the same way as other core and foundation subjects.

Regarding the content of the curriculum, public high schools teach the unified curriculum as specified by the Ministry of Education. Currently two computer courses (one course a year – 2 classes a week) are required of all students at grades 10-12. However, schools in remote areas have not introduced computers as a subject yet.

The following table provides an overview of the content, as specified by the Ministry in 1999.
The Ministry curriculum concentrates on the theoretical aspects. 70% of the private high schools teach this curriculum. However, primary and secondary private schools teach a different curriculum from public schools, leading to variation within the private school sector. This again confirms the finding of Almoneea (2001) that "in primary and secondary private schools, computer curriculum varied from one school to another. Since it is not created by specialist, it depends on personal diligence more than educative groundwork."

Teachers create the curriculum in all the private schools and 80% of them consider it as a 'fun' class. As a result the curriculum may concentrate on entertainment such as games, colouring and story telling for amusement purposes. Although computer applications such as Microsoft Office, Flash, Photoshop, 3D Studio Max were taught, there is not any form of standardization. It may be concluded that the Ministry of Education has not managed to unify the computer curriculum across private and public schools. Additionally as the grades from computer subjects are not included in the students GPA, teachers may strategically concentrate more on subjects that are examined. This means that the computer class timetable may be reduced when extra time is needed for other subjects.

Obstructions to the development of the computer curriculum in private schools may be related to the over influence of the preferences and ability of the teacher in course design; competition between private schools – competitive advantage and differentiation is achieved through the extra curricula subjects offered (usually English and Computing); and lastly, through the inability of schools to keep up with technological advances, leading to reliance on machines that are not able to run the latest software. In such cases the authority of the school and the teachers is further undermined, as the pupils may be familiar with higher specification machines and more recent software.

Triangulating the results from all parts of the study with the teachers, students and the classroom observations, it became apparent that not only did the students have a better understanding of practical content than the theoretical parts of the curriculum, but that inmost cases (80%) the teachers felt that the material was beyond the ability of the students. To achieve understanding of the theoretical content required high capability, tolerance and a good level of attention and concentration. It could be argued that this theoretical understanding will later differentiate a system developer from a merely highly proficient user; that the teaching of the theoretical part may be so confusing and
uninspiring that students are not motivated to engage with the material at this level (especially if it is not examined) and that if a theoretical level understanding is required then resources need to be developed which will enable children to learn and enjoy learning about the theoretical aspects.

**Conclusion**

Saudi Arabia is undeniably trying to cope with the IT revolution. This research considers the way in which computer studies and ICT are taught in schools. IT will have a major impact on all levels of society. Education is important in two respects, in preparing future generations to use and understand IT effectively, and in shaping the future of IT development in Saudi Arabia. Firstly: The use of ICT as a tool in education is advancing. The Saudi Ministry of Education has been investing in infrastructure to connect its schools and classrooms with the right learning tools. During 2003, the Ministry of provided an additional 850 IT labs in elementary and secondary schools. To increase the advancement more rapidly schools should buy PCs; train teachers and enlighten the Directors about the importance of IT and ICT in education. Most schools are in a transitional stage in which they are using a combination of traditional and e-learning tools, without understanding the benefits of the different methods. Because there has been little research in this area in the Saudi Arabian culture, there may be an inappropriate haste to adopt technological, educational solutions which may lead to sub optimum teaching and learning experiences.

Therefore, a further investigation and innovation plan should be conducted in order to examine the student's success rates using blended learning in comparison with traditional and e-learning in teaching computer studies.

Secondly: There is a large divergence between private and public schools in terms of ICT usage as a teaching tool, the usage of internet, content of computer curriculum, age at which they start to teach computers, underlying pedagogies, and computer teachers' qualification. This divergence is one that needs to be corrected through standardisation and quality control if all students are to receive a good grounding in IT. There are indications that the Saudi authorities will look at the unification of computer curriculum between private and public schools and try to catch up with the more advanced countries in the use of ICT in education.

Thirdly: Teachers and students are facing difficulties in the theoretical part of the curriculum. The computer curriculum has to accommodate wider technology developments. As Sanger (2001) discussed, this may require reappraising the structure of schooling to meet the needs of individual learners.
References


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[2] Internet service Unit, International Business Strategies & Saudi Business machines
Appendix H.2 : ICT as a learning tool to assist teaching ICT in Primary Schools

ICT as a learning tool to assist teaching ICT in Primary Schools
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Abstract
A distinction should be made in the usage of information and communication technology (ICT) in education, i.e. whether ICT is a tool supporting the overall curriculum or a subject to be taught in its own right. Recent school inspection reports, at the, in both Scottish and English primary schools, clearly identify the use of ICT as the weakest aspect of professional practice and that the ICT curriculum is the least well taught. This paper describes classroom observations of ICT lessons and interviews with ICT coordinators, teachers and children about current teaching practices with respect to the use of ICT as a tool in teaching the subject of ICT, with the aim of developing a set of guidelines for the development of teaching ICT using ICT tools.

Keywords: ICT, ICT curriculum, e-learning, primary school.

General terms
Prior to discussing this research, it is necessary to clarify the way in which certain terms have been used in this paper:

- ‘Traditional learning’ refers to the learning which occurs during face-to-face teaching. The teacher conveys information (written and oral) to the student directly.
- ‘e-learning’ (as defined by Pollard and Hillage, 2001) is "the delivery and administration of learning opportunities and support via computer, networked and web-based technology to help individual performance and development." In some cases the teacher will not provide a series of facts to the students, but ask them to locate information from on-line sources. The teacher becomes a facilitator, as opposed to the keeper and transmitter of information. This approach is favoured by the action learning community;
- 'ICT' information and communication technology;
- Edutainment or infotainment refers to products that are educational but that also have some entertainment value, the term typically applies to games, stories, children’s software in which the entertainment elements are obvious.

Introduction
ICT has turned from being a technology of communication and information to a curriculum creation and delivery system. However, there is an unresolved tension around the issue of ICT as a subject in its own right that comprises the knowledge, skills and understanding to make appropriate, productive use of ICT, or as a set of tools with which to deliver and absorb other subjects in the curriculum. Smith (1999) mentioned "the focus is on the subject being taught or studied rather than developing pupils' skills with, and knowledge of, the technologies themselves.'
This argument shows no sign of coming to a resolution. As Dale, Robertson, and Shortis (2002) predict that "the qualitative and quantitative gaps between the pupils' and the teacher's understanding of the affordances of ICT as a technology of teaching are much greater than has heretofore been the case with any other teaching technology.”

As a tool, "ICT has the potential to transform the way that education is delivered" (Fisher 2001). ICT can facilitate differentiation and individualization in education: it makes it possible to tailor both the content and the presentation of the subject matter to the individual’s background, experience and needs. In addition, as Schiller and Tillet (2004) said “ICT enhances what is possible by amplifying what teachers are able to do, by providing an entry point to content and enquiries that were not possible without the use of ICT, by extending what students are able to produce as a result of their investigations, and finally by providing teachers with the opportunity to become learners again.”

According to the possibilities of utilizing ICT as a tool in education, its usage has spread with “92% of primary schools teachers making regular use of ICT for teaching and learning" (BECTA 2004) However, as indicated by Ofsted (2005) “In primary schools ICT was used mainly to support English and mathematics; there was some use of ICT in other subjects but application across the curriculum was still largely undeveloped.”

In addition to the current concern of raising standards of ICT usage across curriculum, “the National Curriculum for ICT in England has been considered to provide a useful framework for ‘ICT capability’ or ‘information literacy’. Such capability enables children to demonstrate the development of their knowledge, understanding, and skill in making ‘informed judgments about when and where to use ICT to best effect, and to consider its implications for home and work both now and in future” (DFEE 1999:96). ICT capability is not limited to a facility with a range of techniques and skills with particular technologies and software applications.

The National Curriculum in England identifies the ‘programmes of study’ and ‘attainment targets’ from which schools can develop their planning and organization of the curriculum. The framework for the knowledge, skills and understanding in ICT curriculum is presented in four aspects: Finding things out; developing ideas and making things happen; exchanging and sharing information; reviewing, modifying and evaluating work as it progresses.

However, the inspection report (1999) revealed ICT to be the “least well taught” of National Curriculum subjects and subject to a “substantial underachievement in about two fifths of primary schools.”

Two years later, Scottish school inspectors continued to report “few examples of ICT usage consistently and effectively” and important weaknesses in the majority of schools” (Scottish Executive, 2000) and school inspectors in England reported “some improvement” (Ofsted, 2002). But as indicated by QCA annual report (2004) “In Key Stages 1 and 2 there has been a general improvement in ICT provision, in 90% of primary schools inspected by Ofsted since their last inspection. The pupils' achievements have continued to improve in ICT more than in any other subject.
However, in a significant minority of schools ICT is still unsatisfactory. Lately Ofsted (2005) “most schools made satisfactory curriculum provision for ICT, including some balance between teaching ICT capability and its application across subject”

Though, most of the obtainable literature regards the integration of ICT across curriculum. As indicated by Heemskerk et al. (2005) there is a general lacuna in research on ICT and education concerning the relationship between learning outcomes in ICT curriculum and the use of ICT as a teaching tool.

This study focuses on the use of ICT as a tool in ICT curriculum itself, by answering the following questions:
1) What is the pedagogy used in teaching the ICT curriculum?
2) What are the ICT tools that are being used in teaching the ICT curriculum?
3) What are the obstructions that face teachers in teaching ICT?
Answering these questions may identify what is needed to improve the quality of teaching ICT curriculum.

Research Method
This research explores the use of ICT in teaching ICT, based on an analysis of the strength and weakness of the pedagogies and technologies currently used in teaching ICT in primary schools. To determine current practice, 60 primary schools were contacted in the West Midlands with 18 of them approving the visit. 10 of these were selected as providing a representative sample in terms of the catchment area (to ensure that the students are from different social environments), provision of ICT facilities in the school, its usage level, and the school standards as recorded in the most recent Ofsted report of each school.

All the schools were in Coventry and visited during the autumn term of 2005. In total, 10 ICT coordinators and 7 teachers were interviewed to accompany classroom observations of 18 ICT lessons. ICT lessons were observed in years 3 and 6 to look at teaching methods and technology.

Semi-structured interviews were conducted with the teachers of the observed lesson whether s/he was the ICT coordinator or not. The interviews reflected the teacher’s wider perspective of the methods and techniques used in the observed lesson, and the questions were divided into two main sections; firstly, concerning the ICT resources being used in teaching ICT skills including software packages, CD-ROMs, websites, technological tools such as projector, and edutainment materials including stories and games. The purpose of use, target audience, selection criteria and student’s motivation were considered; secondly, focusing on the ICT curriculum, its content, difficulties and obstacles of teaching.

Since most of the studies about embedding ICT in practice and the ICT curriculum refer to inconsistencies between schools, in conducting the interviews and the observations, the focus was on similarities between schools that weren’t considered in previous studies.
Results

1. Teaching Practices in ICT
Traditional teaching methods were used by all teachers’ in the first part of the ICT lesson, while in the second part; students practice what was shown to them. 20% of the teachers’ used prompt sheets from the LEA, 30% created their own sheets, and 50% asked the students verbally to perform a particular task.
70% of the teachers allowed pupils to explore new things if there was available time at the end of the lesson. Whereas 30% of them signified that their teaching principle is not to teach pupils every thing but to let them discover by themselves.

2. ICT in teaching ICT Curriculum
Commercial educational software packages are responsible for most ICT usage in schools. However, such packages were not used in teaching ICT curriculum. 60% of the teachers claimed that this might be due to the unavailability of an educational CD-ROMs that teach ICT skills. In addition, 10% of the teachers indicated that, "A teacher may not have time to develop the skills to build a learning application from scratch. But if s/he receive a template today into which s/he can put educational materials they have readily to hand, and this then becomes both more motivating and more accessible to their students, they can probably find the time to do this minimal task. While, 40% of the ICT coordinators believed that they would not find an educational CD-ROM that would satisfy their needs and fit in the curriculum.

30% of the teachers said that if there were available educational CD-ROMs that teach the ICT curriculum they would use it with the weaker students. However, 80% of the teachers supported the idea of using CD-ROMs for revision purposes in a group collaborative context. 90% presented the ICT lesson using a projected screen with 40% using a PowerPoint to present the aims and objectives of the lesson.

In 90% of the schools, the selection of the educational software is completely up to the ICT coordinator; the teachers rarely get involved in that decision and pupils are never involved. 70% of the ICT coordinators prioritize the entertainment value above the curriculum.

Although 40% of the students suggest the use of online resources, 90% of the teachers were not convinced of its value in teaching the ICT curriculum. They felt that students would not be motivated to use the computer as learning medium; nor by reading a tutorial or watching a recorded video. In addition, edutainment materials such as stories or games were not used in the ICT curriculum.

3. ICT Curriculum
30% of the primary schools strictly follow the ICT National Curriculum. However, 70% use it as a guidance to develop a curriculum that suits their needs. Whatever the ICT curriculum of the school, computer applications (Microsoft Office) represent the main part of it. In all the schools visited Microsoft Word is taught from year 3 and PowerPoint in year 6.

This divergence between the schools in their ICT curriculum content is mainly due to the obstructions that the teachers face. This can relate to
1. Teachers ICT knowledge: 70% of the primary school teacher's knowledge is limited to the techniques of using computer applications, mainly Microsoft office.

2. Class management: 60% of the teachers face some difficulties in sustaining students attention when teaching in the ICT suite. Teachers attribute this to the layout of the ICT suite where pupils work with their backs to the teacher.

3. Lack of assessment: students ICT capability is not being assessed during the ICT lesson. 80% of the teachers were assessing the subject that ICT is being integrated in and not the ICT skills themselves.

4. Gap between school and home use of ICT: all ICT coordinators and teachers mentioned that the divergence between the students in their home access to computers is an obstruction in teaching ICT skills. 70% believed that equal access to information technology and learning through ICT is vital if we are to have equal opportunities.

5. Computational thinking: 30% of the teachers are facing problems with the students understanding of abstract computational concepts. For example, they commented that most students forget the sequence of executing a command.

Discussion
In the division of the ICT lesson into teacher-centred and learner-centred parts we have an application of Dewey’s theory: “learning by doing”. Although children learn to use ICT by copying from competent users such as teachers, parents, and colleagues, many children described learning to use the computer and its software through trial and error, fiddling, just picking it up, practicing, reading the help files and working it out for themselves. One child explained that ‘you mess around and find out how it works’.

Allowing children to explore by themselves in the free time at the end of the lesson can be considered as an individualization of learning experience according to the learner’s ability. Leask and Pachler (1999) supported the idea of exploration when they discussed the need of pupils to have time to explore freely any new software on their own before being asked to engage in the set task.

In the teacher-centered part of the lesson, teachers are relying on traditional teaching methods, with out the use of any supportive educational CD-ROMs that teaches the ICT curriculum itself. However, the teachers would support the collaborative use of educational CD-ROMs for revision purposes.

In addition, e-learning has been applied in most curriculum areas in primary schools, except for ICT. 60% or more of the time spent by students in the ICT lesson is in practicing, and e-learning "is particularly suited to cognitive learning, learning that requires practice and review, for those with reflective or theorist learning styles" (Epic, 1999).

It is believed that e-learning will help to improve the ICT skills as supported by the National Education Centre (2000) and this is one of the aims of the ICT curriculum. The use of e-learning will affect the role of the teacher dramatically. Since there is a new presence in classroom providing a supply of knowledge and information, thus reducing the dependency of pupils on teacher. Most of the teachers acknowledged that they are learning from their students most of the time and their role is as a guider or a
facilitator. However sometimes the teacher has to be an expert and purveyor of knowledge.

The biggest encumbrance in using ICT in the educational process is on the teachers, As Griffin and Bash (1995) discussed "the acceptance of computer in primary classroom may be dependent upon assumed cultural norms of behaviour, both of teachers and children." Teachers have to develop their own personal and professional applications and adapt their teaching strategies for different learning environments, such as the ICT suite, portable computers in class, and home –school links. Yet, technological determinism in education leaves largely invisible the work that teachers must undertake in order to realize the improvements that technology offers, if education is transformed, as Fisher (2005) mentioned "it will be because teachers - no doubt making use of particular technologies - have made it happen." If the teacher develops their personal applications as indicated by Bennett (1997) "they will feel more confident and more effective as teachers of ICT." However, they may resist applying the change even if the resources are available. As one of the primary school teachers said "although I have been trained to use ICT and we have good resources at school, I didn’t start to use it yet, I feel that it is waste of time and a new duty that has been added to my list of tasks."

Against the application of e-learning, most of the teachers recommended the use of edutainment materials in teaching to motivate children. However, they are not using it in teaching ICT curriculum. One problem is that ICT is one of the main subjects students experience outside the school that is associated with fun and entertainment. This leads to a need to develop ICT teaching practices that are enjoyable and provide opportunities for fun, exploration and entertainment.

The use of edutainment might help to obviate the obstructions of teaching ICT, such as holding the students attention when teaching takes place in the ICT suite. Such lessons can be very productive in introducing pupils to new packages and allowing them to gain familiarity with computers and software. However, as Leask and Pashler (1999) discussed "classroom dynamics alter considerably with ICT, especially when teaching takes place in an ICT suite." This might be because the workstations are arranged along the sides of the room with the screens facing inwards so pupils work with their backs to the teacher. This increases noise levels, and makes it difficult for the teacher to hold the attention of the whole class. However, the teacher can see every screen from the centre of the room.

Since computers distract pupils from the teacher, the teachers prefer to teach the theoretical part of the lesson and then ask the pupils to log in to the computers to avoid distraction. This requires duplicated effort in controlling the pupils to ensure that they have an opportunity of preparing and discussing work away from computer. Not all computer suites have sufficient space for pupils to work away from their computers. One school solved this problem by having ICT lessons timetabled alternately in classrooms and computer suites.

In addition to the obstruction in teaching in the ICT suite, the gap in school – home interaction represents a vital obstacle in teaching ICT since the home use of ICT influences the content of the ICT curriculum and the methods used to teach that content. As one of the primary school teachers said "the increment in the usage of
computers at students' home lead to the enhancement of student's ICT capability compared to 3 or 4 years ago. This led me to develop the curriculum to include more advanced skills."

While access to ICT in home is generally improving, it is clear that this picture is not consistent across society as a whole. Still, as reported by QCA (2004) "the impact of e-learning and ICT capability developed by learners outside school hours is not yet fully appreciated." There is a mismatch between children and young people’s experience of digital technologies in their social and cultural lives and in school classrooms. Robinson argued what was claimed by Professor David Buckingham; Head of the Centre for the Study of Children, Youth and Media at the Institute of Education (2005) "schools are becoming increasingly irrelevant to the modern child as a result of their failure to embrace the digital media." He explains that outside school, children are engaged in a constant whirl of media and yet in many schools they are taught little more than the rudiments of information retrieval.

Conversely, the home experience complemented computer school experience, some children commented that what they learned at home they used at school and others said that what they learned at school they used at home. Groundwater-Smith et al. (2000) discussed that “transferring skills between environments appears to create a potential for greater learning.” As it has been suggested that "children learn better when there is congruence between the learning environments in their homes and in their schools." (Toomey 1989) Therefore, schools should make a positive use of the range of the ways in which children use ICT at home.

Most teachers agreed that the existence of computers at home has a positive influence on the educational process. Dale, Robertson, and Shortis (2002) said, "Children who use a computer at home are more enthusiastic, competent and confident when using one in school." Parents support this positive impact of accessing home computer, they appreciate that bringing computers to home may benefit their children's education and future. Although children are not gaining access to and are not developing skills in the use of ICT for authentic tasks, but are mainly using computers for fun.

Other researchers such as Downes (1997) and Sutherland et al (2001) highlighted the gap between children’s preferred use of computers at home and their restricted or boring use at school, while proposing that home use is neither simple nor uniform phenomenon, but has the potential for a variety of appropriations, uses and constructions that are not always reflected in school experiences.

At home children learn to use ICT by having a variety of meaningful tasks available to them and having lots of time for engaging in the process of playing, doing, exploring, experimenting, discovering and modeling, which is hugely beneficial, whereas at school, there are restrictions of resources, time and rules about playing. ICT school use is heavily teacher directed in order to achieve syllabus outcomes in the key learning areas. So the pupils are told ‘not to fiddle’ with the school computers and if you have a problem ask, don’t try to fix it yourself and they don't have a lot of time for practicing the skills which are taught. Those who don’t have computers at home miss out on being able to try things out for themselves and transferring skills between home and school computing environment. The practice of using software only once at school is contradicting the way in which children learn at home through playing a
game or using the software over and over again and so their learning will be fairly directed.

Teachers need to distinguish students according to their home use of ICT. When they are introduced to students at the beginning of the year, they tend to assess the ICT capability of the students to identify the students who are using computers at home. This consideration will influence their lessons especially during the practical part. A teacher's expectation that students are skilful computer users may disadvantage those who haven't had the chance to acquire these skills.

As a result, the ICT curriculum has to accommodate the technology development in the outside school, and as Sanger (2001) discussed "the need for the reappraisal of the structure of schooling to meet the needs of individual learners". Indeed the recognition by schools, of skills and knowledge acquired outside of the classroom will be an important factor in ensuring that pupils remain motivated to learn. For example, an increasingly rich experience of technologies at home is likely to lead to many pupils entering school with a variety of ICT skills. To prevent such pupils from becoming frustrated and disaffected, these skills will need to be recognized and developed in appropriate programmes of study.

In addition to the potentiality of edutainment in controlling the ICT suite, closing the gap between the ICT home use and school use, edutainment can enhance computational thinking in children; especially remembering the sequence of commands of performing a specific task in computer applications. Although teachers refer to the difficulty in understanding computationally abstract concepts to the material being taught and not the teaching method, enhancing the teaching methods with edutainment may overcome this problem. More so if children are engaged in the process of designing the edutainment material. Although children showed pleasure and enthusiasm in providing their own feedback about resources related to the ICT lesson, results showed children are not involved in selecting learning tools and teachers were not concerned about this.

Conclusion

Children are required to apply their ICT know-how in other lessons, but little emphasis has been placed on how they are taught ICT. This paper discusses the current teaching practices and techniques used in teaching ICT curriculum in primary schools and the main obstacles in teaching it.

Semi-structured interviews with teachers and ICT coordinators in addition to classroom observations were the main research methods availed through visiting ten primary schools in Coventry during the autumn term of 2005.

The main results were as follows; Firstly, ICT is being taught either through supporting other curriculums or using the traditional teaching methods, accordingly there is a need to investigate new pedagogies of teaching ICT.

Secondly, most of the teachers claimed that the unavailability in the market of an interactive multimedia educational CD-ROMs, edutainment or e-learning materials is the reason behind not using them in the teaching or learning of the ICT curriculum. So
such material needs to be produced and evaluated in terms of their influence on teaching and learning ICT curriculum.

In addition, some teachers were not convinced about using on-line materials in teaching and assumed that children will not like it, without any evaluation study of the effect of such material on children. Therefore, research is needed on a participatory design approach to the development of such material and its evaluation.

Thirdly, the obstructions of teaching ICT in primary schools such as the limitation of teachers ICT knowledge, difficulties in class management, lack of assessment, and the gap in the children's ICT usage in school versus home are factors that should be considered when studying the effect e-learning on teaching ICT in primary schools. Moreover, the gap between home and school ICT usage is one that needs to be corrected through standardisation and quality control if all students are to receive a good grounding in ICT.

References
Appendix H.3: Developing e-learning material for children, with children

Developing e-learning material for children, with children
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Abstract: Although much e-learning material has been produced to support the National Curriculum, little of this has been developed for the ICT (Information and Communication Technology) curriculum. Since ICT knowledge in many cases is ‘picked up’ when children are required to use IT in other lessons. With the overall aim of developing e-learning material to support the teaching of ICT to primary school children, an investigation was made into how e-learning materials are currently designed for the ICT (Information and Communication Technology) curriculum. Several limitations were identified which pointed to the need for a more child centered design approach. This paper discusses the child centered design techniques which will be used to involve children as design partners, informants, testers and users in the development of interactive multimedia teaching material to teach 9-11 year olds ICT skills. The proposed material is under progress and will be implemented in three primary schools in Coventry during the summer term 2006 to evaluate its effectiveness.

Keywords: e-learning, child centered design, participatory design, ICT.

Introduction
E-learning in the present paper to refers to the application of ICT -computer hardware and software- as a tool in the learning process; particularly, if used by the learner rather than the teacher. E-learning is now a key priority for education and training policy in the UK. Indeed, it is considered that e-learning has the potential to revolutionize teaching and learning. Many schools and colleges have embedded e-learning into the curriculum, and demonstrate high levels of effective and appropriate ICT (Information and Communication Technology) use to support teaching and learning across a wide range of subject areas. BECTA (2005) researched the effectiveness of e-learning in the curriculum, but didn’t consider its influence in the
ICT curriculum itself. This paper focuses on the use of child centered design in developing an e-learning material that teaches ICT for children aged 9-11 years old.

**Research objectives and methodology**

The main aim of the research is to propose a child centred design method that is being used currently to develop an e-learning material that teaches ICT to students aged between 9-11 years old. The material should be ready for school implementation in the summer term of 2006.

Underpinning this overall aim, the specific objectives of the research are to:

- Identify the problems of the teaching practices of ICT curriculum in primary schools
- Investigate the current design practices associated with ICT e-learning materials.
- Understand the need for a child centered design approach to develop an e-learning material.

With a view to addressing the key research objectives, the following stages were undertaken:

- Literature review /benchmarking study to understand the application of e-learning, in primary education.
- Observation of the teaching of ICT in primary schools through visits to 25 primary schools in UK to understand current teaching practices in the ICT curriculum and the use of e-learning in the school.

Schools in the West Midlands have been targeted as a convenience sample. Using the Ofsted reports, 120 schools that met the required criteria (different socio-economic groups, different levels of IT experience, resourcing, and quality of educational provision -as measured by Ofsted) were contacted either by post or e-mail letters.
explaining the purpose of the research, asking whether they would like to participate in the research. Additional letters were sent until the required sample size of 25 primary schools had been reached.

All the schools were in Coventry and visited during the autumn term of 2005. ICT lessons were observed in years 3 and 6 to look at teaching methods and technology usage.

* Review of design issues relevant to the development of e-learning material through a review of current material gathered from trade publications; industry reports; publishers and retailer’s websites, catalogues, shop displays and corporate publicity. This was augmented by interviews with designers at 5 educational software; and e-learning materials publishing companies to understand the design process.

**Results**

1. **Teaching Practices associated with the ICT curriculum**

Several problems have been identified in the current teaching practices associated with teaching ICT curriculum in primary schools such as;

1. Poor teaching practices and technologies used in ICT curriculum. Mainly due to the lack of teacher's ICT knowledge;
   The lack of teachers' ICT knowledge and skills is because of the limitation of their ICT training to:
   - Technical competence: understanding and practical competence in hardware and software.
   - Applications: understanding and competence in using ICT for specific purposes (including personal and professional information gathering).

2. The limitation of assessment: students ICT capability is not being assessed during the ICT lesson. 80% of the teachers were assessing the subject that ICT is being integrated in and not the ICT skills themselves.
3. Divergence between the schools in the content of their ICT curriculum, 30% of the primary schools strictly follows the ICT National Curriculum. However, 70% use it as a guidance to develop a curriculum that suits their needs.

4. Children's ICT usage in school versus at home contributed two issues; firstly: children consider their ICT experience at home as fun while at school it was restricting. This created a gap between the two experiences (with learning centred experiences perceived worse). Secondly, differences in the extent of children's ICT exposure at home may reinforce socio economic inequalities.

2. Current design practices of electronic materials
A review of current e-learning material and interviews with representatives of publishing houses has shown the following problems:

1. Poor overall design. This may be due to lack of graphic design skill or the knowledge of how to apply this to teaching material or e-learning formats.

2. Material may be designed by those who have no prior knowledge or in depth understanding of the subject. This may lead to problems of imprecision, misconception and confusion. Furthermore, authors who produce the concept tend to focus on the content rather than the interfaces design. i.e. there is a lack of communication between the content author and the designers.

3. Designers may not appreciate the level of student understanding or the concept they need to emphasis in order to promote scaffolding. Hence, their productions do not help learning and may cause confusion.

4. The initial specification may not been evaluated with users. Interviews with designers’ show the current design process is author and marketing led rather than having teacher or end user involvement. 90% of the designers pointed that student and teacher involvement in limited to the summative evaluation of the product during the final stages of the design.
5. 80% of the designers indicates that students and teachers are not being involved in the design process, while 20% mentioned that they have little involvement with students and teachers (the end users) or the author (i.e. expert, teacher) during the design process. This means that designers may not have in depth knowledge of the curriculum they are supporting and may not have the correct requirements to inform their practice. Furthermore, designers rely on personal experience, editor and the author's opinions to evaluate the design without students' involvement.

Discussion

E-learning has several disadvantages which support its spread, such as the positive effect that it has on learner's participation, retention and attainment (Harris et al., 2003). Moreover, e-learning can minimize forgetting by interspersing the original retention interval with additional learning events (Thalheimer, 2003). In respect of the learning process in general, e-learning is faster due to compression (Epic, 1999) and provides a large audience of possible learners with access to teaching material (Hennik, 2003).

However, one of the areas of concern with respect to e-learning is that it may not be universally appropriate and that in the rush to use technology this is sometimes forgotten, or technology is not used as well as it could be. E-learning is particularly suited to cognitive learning, to presenting new information, stable course content, and learning that requires practice and review (Epic, 1999). Although not all material can or should be delivered electronically, currently the corporate e-learning market is dominated by IT training, i.e. in the use of applications and infrastructure software. Epic (1999) found that most favored subject addressed online is IT user training. This is particularly suited to online delivery because it is largely cognitive in nature; it is easy to simulate tasks and content can be regularly updated. McCrea et al. (2000) noted that e-learning is particularly suited to training in new IT systems and IT certification, which they cite as the traditional use of e-learning. Also e-learning, by its very nature increases IT skills (National Education Centre, 2000). Although ICT curriculum is an appropriate content to be taught electronically, until recently educational organizations focuses on the use of e-learning across curriculum and not
in the ICT curriculum itself (BECTA, 2005). Therefore, there is a need to consider the application of e-learning in teaching ICT curriculum.

In addition, the use of e-learning may help to solve problems associated with the teaching practices of the ICT curriculum in primary schools. With regard to the lack of teachers' ICT knowledge, the use of e-learning material developed by experts in the pedagogy of teaching ICT skills to children with an assessment tool for each session could overcome the teacher's lack of ICT expertise. Moreover, such material developed by experts can be standardized as an ICT curriculum material for primary schools.

Moreover, adding an entertainment value to the educational content when developing e-material for children should make the restricted school experience an entertaining, exciting and motivating experience. Particularly, when delivering e-material in a game context. Integrating educational content with appropriate game design and use of interactive multimedia may maximize the learner's motivation and minimize misunderstandings.

Although some e-learning scenarios have limited flexibility and interactivity – just allowing the presentation of learning material, without offering content based structural support to increase engagement and interactivity (Zhang, and Zhou, 2003), Interactive multimedia (defined as the use of computer to present and combine text, graphics, audio and video with links and tools that let users navigate, interact, create and communicate) can increase interactivity and flexibility in an e-learning environment thereby reducing the lack of motivation which can be caused by isolation when working on a computer. Multimedia courseware can entice learners to pay full attention to a task, through the vividness of presentation. It can also enhance individuals' problem solving skills and improve learning effectiveness (Zhang and Zhou, 2003). Recently, interactive multimedia technology has been widely adopted in e-learning to enhance learners' perception of live interaction with virtual instructors. It is widely used in many companies, such as CISCO e-learning, and Microsoft learning resource.

Thus, the use of e-learning is recommended as a solution to the problems of the teaching practices associated with the ICT curriculum. However, there are known
difficulties to overcome when providing material using e-learning formats. Though, most of these can be avoided if the material is designed carefully.

Most of the educational software producing companies indicates that they are applying the ADDIE model which stands for Analysis, Design, Development, Implementation, and Evaluation, as illustrated in the figure 1.

![The ADDIE Instructional Design Model](image)

Figure 1: The ADDIE Model

Each step has an outcome that feeds the subsequent step. During analysis, the designer develops a clear understanding of the "gaps" between the desired outcomes or behaviors, and the end user’s existing knowledge and skills. The design phase determines specific learning objectives, assessment instruments, exercises, and content. In the development process the actual creation of learning materials is completed. During implementation, the produced materials are delivered or distributed to the final users. After delivery, the effectiveness of the training materials is evaluated.

Having identified several problems in the current design practices followed by the producing companies, the most important factor to solve these problems is the reconsideration of the communication between the author, end user and designer during the design process.

Thus, the current research follows a participatory design approach with four phases: understand, propose, realize, and evaluate (Figure 2). Understanding is gained prior to any design work by analyzing the needs of the students and the teachers, the requirements of the educational content, and the deconstruction of existing e-learning
material either that teaches ICT curriculum, or the materials targeted to the audience about other curriculums. Propose is the stage where the designer takes the information obtained from previous stages and produces a set of concepts as sketches or a storyboard which are discussed with stakeholders (teachers, students) before realization. At the end of the realization phase, a full piece of working e-learning material will be produced which is then evaluated with children in the final phase.

Figure 2: Phases of participatory design approach

The review of the literature provided evidence that participatory design approach can give designers greater insight into user perspective and preferences, allowing designers to rethink design goals and solutions (see for example Laurel, 1990; Norman, 1988; Raskin, 2000) and traditional user-centered design may be applied to any design process. Users can be described as active partners, inspectors, testers or research participants to be observed and/or interviewed. Through user involvement, technology can be shaped and changed in ways that may be meaningful and useful for future technology users.

Numerous methods have been developed that bring users into the development process - from brainstorming methods that ask users and designers to sketch out ideas; participatory design (Greenbaum and Kyng, 1991; Schuler and Namioka, 1993), or cooperative design (Bjerknes et al., 1987), to interviewing methods that can capture user tasks, roles, and design ideas and contextual design (Beyer and Holtzblatt, 1998).
Puphaiboon (2005) has applied an iterative design research model to the design of educational material to teach mathematics. In order to overcome the insufficiency of current design methods associated with mathematical diagrams. However, Puphaiboon collaborates with the teachers in order to specify the children’s development requirements. This was not satisfactory in most cases as after evaluation with children the produced material does not satisfy the children requirements in terms of font size and animation timing. Thus, children should be involved directly at earlier stages of the design process. This is the main consideration of the researchers proposed design method.

Since user involvement is well understood as important to the technology research and development process, users that are children are less commonly involved than adults. Moreover, it is common for developers of new technologies to ask parents and teachers what they think their children or students may need, rather than ask children directly. (Druin et al., 1999; Druin, 1996). However, children play games, chat with friends, tell stories, study history or mathematics, and this can all be supported by new technologies. From the Internet to multimedia authoring tools, technology is changing the way children live and learn. As these new technologies become ever more critical, we need to be sure that they support children in ways that make sense for them as young learners, explorers, and avid technology users. Designers of new technologies for children should consider that children are an entirely different population from adults, with their own culture, norms, and complexities (Berman, 1977). They have their own likes, dislikes, and needs that are not the same as adults’ (Druin et al., 1997).

9-11 year old children can participate in the design process effectively. Druin et. al (1999) found that children of 7-10 years old make the most effective prototyping partners, due to their ability to develop ideas from abstract concepts and openness to exploring new ideas. Children younger than this have a more difficult time partnering with adults to develop new design ideas.

According to classroom observations, 9-11 year olds are verbal and self-reflective enough to discuss what they are thinking. They can understand the idea of designing something with low-tech prototyping tools that will be turned into future technologies.
Children at this age, however, don’t seem to be too heavily burdened with pre-conceived notions of the way things “are supposed to be”, something typically seen in children older than 10 years.

Moreover, as indicated by Guha et. al. (2005), children can become visibly upset, withdraw from design experience, or disrupt design activities if they feel they are not being listened to, or the team is modifying their idea. In addition, children like to tell stories, make up games, and build things. Children enjoy many different forms of expression: sound, visuals, movement, and physical appearance. As such, when participating in the design process, children suggest that new technologies should enable them to tell stories, design games, and build futuristic machines. Children are part of teams that have proposed "the story-monster machine", "the eye-ball building computer", or "the brain-game" (Druin, et al., 1997; Druin & Solomon, 1996).

Children want to be in control of their world as quickly as possible--and that means learning something quickly. If it is a struggle, they have little patience. If it is easy to learn they will quickly become immersed in the experience. Contrary to what most adults imagine, children have long attention spans, when there is something to do that is meaningful and makes sense. If a tool offers them little control, they will lose interest quickly. Children are sensitive to what they see, much more so than adults would imagine. They care what something looks like just as much as how it works or what it does. They don’t want the visual look of things to "talk down to them" or question their intelligence. They want what adults want—things that look good and respect who they are as users. Furthermore, children have become accustomed to "having it all." It used to be that technology did not have to have sound--but due to video games, TV, movies, multimedia, etc. children want a multi-sensory experience. Not only do they find it more entertaining, but more engaging an environment to explore.

According to the understanding of the target age group characteristics; children 9-11 years old, cooperative inquiry approach will be used as a method for involving the children in the design process. Cooperative inquiry describes the design approach proposed. It is based upon the belief that partnering with users is an important way to understand what is needed in developing new technologies (Druin, 1999).
The main techniques of cooperative inquiry are:

1. Contextual Inquiry
   Here a team of researchers observe and analyze the users’ environment for patterns of activity, communication, artifacts, and cultural relationships (Beyer and Holtzblatt, 1998). From these observations, notes are taken on children's activities and conversations. These are analyzed and coded for frequency.

2. Design Journals
   Participants are asked to write down /draw their ideas and thoughts and reflections from design sessions and other project activities.

3. Low technology Prototype
   Prototyping techniques suit children because they can visualize their ideas. Since children face difficulties in communicating to adults about their imagination. Moreover, there is never a need to teach people how to prototype, since using basic art supplies comes naturally to the youngest and oldest design partners. Using paper, crayons, clay, string etc is inexpensive, yet quite effective in quickly brainstorming new ideas or directions (Druin et. al., 1999). It is from these low-tech prototypes that high-tech prototypes emerge.

5. Design and development workshops at laboratories
   Here participants are brought in to technical development environments for seeing that earlier co-operative design ideas are technically feasible and for joint testing of early prototypes, and based on that experience can develop further design ideas.

Conclusion
This paper discuses the use of child centered design in developing e-learning material for children aged 9-11 years old.

The use of e-learning is spreading in education. However, the literature indicates a lack of studies that consider the ICT curriculum as content for e-learning material particularly for children. Although, e-learning can help to overcome the problems identified in relation to teaching ICT curriculum. In addition, several studies have pointed to the appropriateness of e-learning to teach ICT skills.

Conversely, several problems have been identified in relation to the design of e-learning material. Such as, poor design, materials designed by people who have no prior knowledge of the subject, designers not appreciating the level of student
understanding or the concept they need to emphasise in order to promote scaffolding. Also, the designer has little or no involvement with students and teachers (the end users) or the author (i.e. expert, teacher) during the design process. Accordingly, a more user centered design was proposed. Puphaiboon (2003) applied User-Centered Design approach in developing mathematical diagrams. However, his method showed unsatisfactory results when evaluated with the children, since his limited the stakeholders involvement to the teachers. Thus, children involvement must be considered at early stages during the participatory design approach. According to Druin and the research results of classroom observations the characteristics of the target age group has been identified. Understanding characteristics of children when participating as a design partners led to the proposal of several techniques which can be used during the design process phases. A brief description was indicated for each of them.

Therefore, researchers should involve users in their design by choosing the most appropriate techniques to the context ,time and financial limitations, pupils and teacher's needs achieve a most efficient e-learning material that suit the children needs and their characteristics.

References
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Appendix H.4 E-learning and ICT Curriculum in Primary Schools: Differences and Similarities between UK and Saudi Arabia

E-LEARNING AND ICT CURRICULUM IN PRIMARY SCHOOLS: DIFFERENCES AND SIMILARITIES BETWEEN UK AND SAUDI ARABIA

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Abstract
Given that the use of e-learning depends on context specificity, students from cultures different from that in which the material is developed are likely to experience difficulties in using that product. A child centred design approach was used to develop e-learning material for primary school children relating to the development of ICT skills, in collaboration with UK primary schools. It was hoped that this material and the processes used to develop it could be transferred to the Saudi Arabian educational system. This paper investigates the educational, technological and design differences between Saudi Arabia and UK with regards to the ICT curriculum current teaching practices, the use of ICT as a tool in schools, and e-learning design practice.

Keywords
ICT curriculum, e-learning, child centred design approach, ICT as a tool.

1. INTRODUCTION
The use of Information and Communication Technology (ICT) in education is increasing. However, e-learning has not always been applied appropriately or ICT taught effectively as a subject in Saudi Arabia.

Given that UK schools are more advanced than Saudi Arabian ones in the quality and the quantity of using ICT as a tool in education and in teaching ICT as a subject, a study was undertaken of UK schools to observe best practice and problems which still occurred in teaching ICT in UK. It was hoped that the lessons learnt in the UK with regard to e-learning in general, and the use of e-learning to teach ICT in particular could be transferred to the Saudi Arabian context – leading to an improvement in standards and a plan for the effective use of e-learning and the teaching of ICT. In the last part of the research e-learning material was developed and evaluated in schools to test out the usefulness of a user centred design approach to the creation of such material and to assess whether companies that develop e-learning material (both in Saudi and the UK) might be persuaded to adopt a more user centred design approach

Two studies were undertaken to investigate the current teaching practices of ICT and the use of ICT as a tool in Saudi Arabia [1] and UK schools [2] through school visits. 10 representative schools varying in terms of catchments areas, provision of ICT facilities in the school and usage level were visited in Riyadh (the capital of Saudi Arabia) and 15 primary schools in the West Midlands in UK. ICT lessons were observed and semi-structured interviews conducted with the ICT teachers and/or ICT coordinators in each visited school.
Another two studies investigated the current design practices in the development of e-learning material in UK [3] and Saudi Arabia. 6 educational designers responsible for the development of e-learning material in their respective companies were interviewed in each country.

This paper compares the results of the studies undertaken in UK and Saudi Arabia to identify the similarities and differences between the two countries in the teaching practices of the ICT curriculum, the use of ICT as a tool in the school, and e-learning design practices. In doing so it was hoped to assess the transferability of both the material and the design method to the Saudi context.

2. RESULTS

Comparing the results conducted from the previous studies undertaken in UK and Saudi Arabia, revealed the following:

1. Regarding the use of ICT as a tool

   a) UK schools are more developed than Saudi private schools in terms of the quality and the quantity of the use of ICT across the curriculum. Saudi private schools are, in turn, more advanced than Saudi public schools. This difference can be attributed to the following factors:

      1) There is a wide range of supportive material and teaching resources available for teachers wishing to teach or implement IT in UK schools. Such material is not provided in Saudi Arabia either by the Ministry of Education or private independent companies. Such investment would lead to improvements in standards, the generation of shareable resources, and encourage best practice and communities of practice.

      2) Teachers in UK now receive in-house training on the integration of ICT across curriculum and teaching ICT skills. This has taken a few years to emerge. However, in Saudi Arabia teachers are only provided training in technical skills.

      3) The educational system in the UK is more mature. There is both a history of technological innovation, and a willingness to embrace new ideas and technology.

   b) In both countries teachers believed that the integration of ICT in teaching and learning could improve pupils’ learning, however, their lack of detailed knowledge about ICT and ways of using e-learning represented an obstacle to such integration.

   c) In both countries e-learning is used particularly to support the teaching of core subjects such as math, literacy and science.

   d) In UK, e-learning is used as a supportive tool to enhance more traditional teaching methods. The plan in Saudi Arabia is to apply a full e-learning system in schools. This is problematic as it may be argued that e-learning is not always the most effective method of tuition for all students, and all subjects. The current transitional stage – in which a blended learning approach is used (featuring both e-learning and traditional teaching methods), may be more effective.

   f) In both countries there is diversity in schools in both the quality and quantity of the ICT integration across the curriculum. This diversity is greater in Saudi Arabia.

   g) In both countries the extent to which IT is used and its integration across the curriculum is dependent on the teacher’s attitudes and abilities, unless specified by school policy.

2. The ICT curriculum

   a) The ICT curriculum is relatively new in Saudi Arabia, thus, it is not being considered as a formal subject in most schools. The Ministry of Education has not been able to unify curriculum content or the age from which ICT should be taught. There is a wide divergence between public and private schools.
b) ICT as a subject is taught in UK public schools from kindergarten, while in Saudi public schools it is taught in high schools and in some Saudi private schools it is starting to be taught from the primary level.

c) There is no generally available set of guidance or framework that can be used as a reference by Saudi primary school teachers to develop their lesson plans.

d) In Saudi Arabia, the focus is on computer literacy per se. While in UK, the ICT curriculum is not limited to computer literacy, but considers communication using a range of information technology tools. Its importance emerges from its integration across the curriculum.

e) In both countries the focus is on teaching IT techniques (i.e. how to use specific computer applications). This is a quantifiable and noted part of the ICT curriculum attainment gains. As it is a fairly recent innovation, if teachers have had only limited access to computers, and have not received in-house training, they may have a lack of knowledge or confidence in the use of ICT. This may lead to poor teaching practices. These were identified in both the UK [4, 5] and Saudi Arabia [6, 7] in the teaching of ICT curriculum compared to other subjects. 90% of the Saudi teachers expressed the need for e-learning material and particularly materials that support the teaching of the ICT curriculum because:

1) The lacked ICT knowledge, so needed additional material;
2) Most computer teachers were not qualified as educationalists so they need supportive teaching material to understand the nature of learning and enhance their teaching skills;
3) Many teachers believed that the ICT curriculum syllabus was beyond the ability of the students, hence additional material is needed.

Thus, there is a need for teaching resources that support teachers in teaching the ICT curriculum. This is especially important if students are to advance to a stage where they are knowledgeable about ICT, in its own right, and are confident enough to use it as a tool to support investigations and work in other subjects.

f) In both countries, there are limitations in the way in which ICT skills are assessed. Where ICT is used to support other part of the curriculum, the focus might be on the subject area content not the ICT skills itself.

g) In both countries there is a divergence between the home experience of using ICT and the school experience. Typically students from IT literate homes have higher end or different machines from those at schools, and may use more sophisticated applications (especially in leisure time). The e-learning material currently produced may not appear sufficiently sophisticated or intellectually challenging to engage children who are more knowledgeable in this area than their teachers. Additionally, there is a knowledge gap between pupils who have regular access to computers and those who do not. In the UK this gap is being addressed by government initiatives to provide pupils with laptops, while in Saudi Arabia this issue has not been addressed by the Ministry of education yet.

3. Design of e-learning material

Both counties are alike in the following:

a) Users are not widely involved in the design process and the produced materials do not satisfy the children's needs.

b) There is a lack of communication between the companies that produce the material and the schools, and between the designer and the end users (the teachers and the children). Users are not routinely involved in the design process except in the final summative evaluation stages.

c) There is a lack of research addressing how the young learner's needs may be captured, fed into the design process, and met in the e-learning material.
d) There is no policy or framework that can be followed for designing or implementing e-learning in schools.

e) The design of e-learning material is not well understood – some companies merely transfer text based material on to the computer, without looking at the other facilities that computerization can offer. Additionally such material is created by designers who may have little knowledge of educational theory and practice or the content they are dealing with.

f) Publishing companies still do not consider it necessary to request feedback from teachers and students, relying on market forces, trends and sales.

In summary, the research has shown that the UK is more advanced in the teaching of ICT and the incorporation of e-learning into lessons, as such it can provide Saudi Arabia with pointers to the way in which both e-learning and ICT should be incorporated into schools. However, the research has shown that the situation in the UK is not optimum. Specifically

1. Many teachers not fully trained or supported in the use of new technology. This is a barrier for them, and is one that they pass on to their students
2. E-learning material produced to support the teaching of ICT (and other subjects) may be poorly designed.

The steps needed to address these points are discussed in the following sections.

3. DEVELOPMENT OF POLICY FOR THE EFFECTIVE TEACHING OF ICT

Following is a scheme of work that may improve the teaching of ICT of Saudi Arabia, based on the understanding acquired of the UK system:

a) Regarding the ICT curriculum content, Saudi authorities should look at the unification of the ICT curriculum between private and public schools through developing a framework that specifies attainment gains for all key stages.

b) The Ministry of Education should develop a curriculum framework, from the early years upwards, based on those that have already been shown to work. Introducing ICT early in school life ensures children quickly acquire IT literacy which can be built on in later grades.

c) The ICT curriculum should be updated regularly to keep in tandem with technology use outside of school.

d) The ICT curriculum should be taught purposefully, and should not be limited to the development of technical skills and techniques (How to use computer applications, such as cut and past, and copying). It should be underpinned by an understanding of when, where and how to use ICT.

e) The delivery of the ICT curriculum could be enhanced by making use of the affordances of new technology. An equal balance should be given to each of the three elements –information, communication and technology. Therefore, in order to rectify these problems, attention needs to be paid to of the best ways of implementing CAL (Computer Assisted Learning) blended teaching across the curriculum.

f) A further investigation and innovation plan should be conducted in order to examine the student's success rates using blended learning in comparison with traditional and e-learning as blending learning might help to improve the students' success rates more than a full e-learning system.
g) Provide training to the teachers about integrating ICT as a tool across curriculum, as doing so will increase the pupils understanding of the ICT skills, particularly when, where, and why to apply the learned skills.

h) Lesson plans, schemes of work and supporting resources should be provided by the Ministry of Education to help teachers in teaching ICT curriculum.

i) The ICT capability of the pupils should be formally assessed as in other subjects.

j) There should be a quality assurance department in the Ministry of Education to supervise the production of CAL products in the market and ensure their association to the curriculum, effective design standards, and suitability to the user needs.

4. DESIGNING MORE EFFECTIVE E-LEARNING MATERIAL

Discussing the way in which current e-learning material is produced with designers revealed a number of problems in relation to the gap in understanding between the designers of the material, the needs of the end users and the learning they need to acquire. Such problems highlight the need for an effective design process that would provide designers with the information they need to improve their designs and provide opportunities for communication with stakeholders (teachers, children and curriculum designers) at concept, detail design, evaluation stages and knowledge in all relevant domains. A participatory design approach might be useful in this context [9] and particularly with children [10, 11, 12, and 13].

In order to investigate this further a user centred approach was developed and tested in the production of alone e-learning lesson to teach primary school children about the learning outcomes of multimedia presentation unit - UK ICT National Curriculum - Keystage 2, particularly the learning outcomes associated with the communication skills.

The process undertaken involved the following stages: firstly, detailed design specification of the e-learning material determined through interviews with children and teachers. This included consideration of children's ICT interactions, ICT teaching methods, understanding of communication concepts using ICT, and the learning context. Secondly, develop a prototype based on the requirement specification. Thirdly, redesign in which children were asked to comment on the usability and the enjoyment of a prototype, and the teachers to comment on the extent to which the prototype would facilitate achievement of the learning outcomes. This revealed any problems and provided guidance on prototype development. Fourthly, a full working prototype was produced taking into account the information derived from previous stages. Fifthly, a pilot study was undertaken to test the usability of the full working prototype with designers in the Usability Laboratory in the School of Art and Design. Finally the material was evaluated with 30 children and their teachers in a classroom situation. It was shown to be satisfying, meeting the children's requirements and pleasurable to use. The teachers also felt the material was easy to use, and supported the intended learning outcomes. They were also willing to use the material across the curriculum and populate it with their own material.

Following this, the design process was formalized and presented to e-learning manufacturers in Saudi Arabia for their comment. Although the material produced using the method was effective in producing material that satisfied the user needs and was an effective learning aid, the designers were unwilling to adopt the method in their practice because they believed it would increase the workload of all stakeholders, the designers in particular, and therefore require more time and cost.

4. CONCLUSIONS

The rationale for this research was the perceived need to raise the standard of teaching in ICT in Saudi Arabia. This was explored firstly through examining differences in the way in which ICT is taught in the UK and Saudi Arabia; and secondly by investigating whether
producers of e-learning material (in both countries) could be persuaded to adopt a more user centred design approach to the development of e-learning material.

Both countries shared similarities in their ambitions to move towards e-learning, the problems teachers faced in teaching ICT and implementing a strategy for ICT in their schools and the lack of high quality e-learning material that supports the teaching of the ICT curriculum and satisfies the user needs. This indicates a need to better articulate educational policy with respect to ICT, to provide teachers with more support, and a need for a more careful and controlled investigation into the nature of the e-learning material.

Taking best practice in the UK as a starting point, the paper outlines a series of recommendations that could be used to improve the effectiveness of the teaching of ICT in Saudi Arabia. Additionally, a more user centred approach to the development of e-learning material has been provided, which if adopted could enable Saudi manufacturers to develop e-learning material that was fit for purpose.

**References**


