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Examining the Educational User Interface, Technology and Pedagogy for Arabic Speaking Children in Kuwait

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Abstract: The emergence of educational technology has resulted in a widespread popularity of different forms of education technologies among various multidisciplinary researchers. This is evident based on the high number of empirical, theoretical, and conceptual studies that are published on educational technology-related research. However, many open research questions and challenges remain unresolved. In this study, we are going to: 1) present an educational technology research agenda underpinned by extensive research and studies; 2) highlight the missing interconnections between empirical findings of published studies and the pedagogical theories; 3) discover if educational technology research is overly dominated by studies conducted in developed countries, while developing countries, for example, Arabic speaking populations in the Middle-East in general and the Gulf states, in particular, are overlooked by researchers. Based on our in-depth review of the existing literature, we will discuss the challenges of designing educational user interface, technology, and pedagogy-related research, and finally propose guidelines and recommendations for future research to overcome some of the existing challenges.

Keywords: Arabic, Arab child, child-computer interaction, educational user interface (EUI), educational technology, learning, pedagogy
Categories: H.5.0, H.5.2, L.2.1, L.3.1, L.3.4, L.3.6, L.3.8

1 Introduction

Educational technology has truly revolutionized education by replacing the traditional forms of teaching using blackboard and chalks (Albirini, 2007). Educational User Interfaces (EUI), in the form of tablets, whiteboards, mobile, and handheld devices, are increasingly used for enhancing classrooms and learning in general. Educational tools demonstrate their effectiveness by engaging children in learning activities (Timmermann, 2010).

Educational technology aimed at young children is an interesting market for product-making companies, due to their increasing headcount and large existing user base. In July 2011, 26.3% of the total world population's age was below 15 years old (Fact Book, 2012) and it has been predicted that world's adolescent population will remain 1.2 billion until the end of 2050 (Trends, 2012). These statistics reveal the motivations of different service and product companies behind developing new educational technologies targeting the youth market.

Teachers are widely making use of educational technologies to present old and new concepts on different subjects to children in the right format (Dunlap, 2009). Typically, educational tools involve concept presentation through interactive images and visual instructions, instead of plain text format. Scientific concepts are presented in an entertaining fashion through the use of exercises, examples, illustrations, images, feedback, and reinforcement. Educational tools such as instructional software and educational games have been accepted as supporters for active learning process among students (Plowman, 2005). Moreover, instructional programs and educational games are effective in motivating young children to learn and achieve new skills (Plowman, 2005).

Educational technology supported tools have one common objective, which is to motivate children to learn and to increase their confidence (Earle, 2002; Chester, 1998). Therefore, all forms of educational instruction and pedagogy should take advantage of the new forms of educational technology, e.g. novel interactive media and learning supporting tools. It has often been observed that educators are early adopters of any new educational technology (Culén, 2011) and there could be several reasons behind this zeal for novel interactive technology, e.g. motivation for improving learning outcomes, experimentation with novel technology and so forth (Dunlap, 2009). This same reason could also be attributed for the widespread popularity of iPads in schools, even though there is no scientific pedagogical study that proves the use of iPads improves student-learning outcomes (Churchill, 2012). Different interactive devices such as the iPad are now popular among very young children especially at kindergarten age. This kind of pattern and rapid adoption is not only visible in western countries, but also in other parts of the world such as the Gulf States- Kuwait, UAE, Saudi Arabia, and Qatar. For example, Al-Mousawi, 2012 found that the iPad is the preferred device by four to five year old children in Kuwait. The next most preferred devices are iPhones, PlayStations, and PSPs.

Pervasive systems, in the form of mobile phones and handheld devices like the iPad, PSP, Nintendo, and Xbox, have not only transformed the daily routine and lifestyle of adults but also of young children around the world. It is safe to argue that teddy bears and fiction magazines are no longer the sole companions of children (Druin, 2011; Shuler, 2009; Lenhart, 1999; Druin; 2009), as the daily routine for young children consists of leisure, learning, and play, where the role of technology is central in this whole stage. This results in overlapping, integrated and interacting technology, and physical spaces around children. These interacting spaces beg the need to develop new approaches for the design of products aimed at children (Shuler, 2009).

Interactive design plays an important role, as it involves understanding the needs and expectations of students, examining fundamental theories, governing potential implementations, and performing design and evaluation. Interaction Design with Children (IDC) is governed by the Child-Computer Interaction (CCI) discipline. Although CCI embraces traditional Human-Computer Interaction (HCI), it also specializes in the areas of child psychology, learning, and play (Druin, 2011; Read, 2008; Read, 2005). Figure 1 presents the relationship between IDC, CCI, and HCI disciplines. The emergence of CCI and educational technology has changed the access patterns of today's children (Druin, 2011; Read, 2008) and it needs to be

clarified that it is important to examine the role of CCI and interaction design in the context of EUI, technology, and pedagogy (Dhir, 12b).

Arab children's culture is different from western culture (Al-Mousawi, 2012); moreover, Arabic is a bi-directional language in which the text is presented to the user from right to left, but numbers are presented from left to right (Alsumait, 2009). In addition, Arabic letters occupy different spaces to English and the same letter can occupy different spaces; this depends on whether the letter is joined to other letters or not (Alsumait, 2009). All these factors greatly influence the needs and expectations of Arab children for any EUI and educational technology. Furthermore, these factors are the main reasons behind the differences in Arab children's culture and their western-world counterparts.

Lately, research examining the needs and expectations of Arabic speaking children, has received attention from both researchers and practitioners e.g. Al-Mousawi in 2012; however, studies published on the design and evaluation of EUI, in general and CCI, in particular, are scarce in the context of the Arabic speaking user group. This affirmation is based on present research carried out by the authors of this research. In this study, systematic literature review methodology was adopted with existing published work on CCI, EUI, HCI, and children were rigorously studied and analyzed. It was found that the present research agenda covering CCI and EUI is overly dominated by studies planned and organized in the western world, and this fact has led to poor understanding of the needs of young Arabic speakers. Therefore, bearing in mind the urgent nature of this subject, we are interested in understanding the design, use, and evaluation of educational technology by Arabic speaking children in Kuwait.

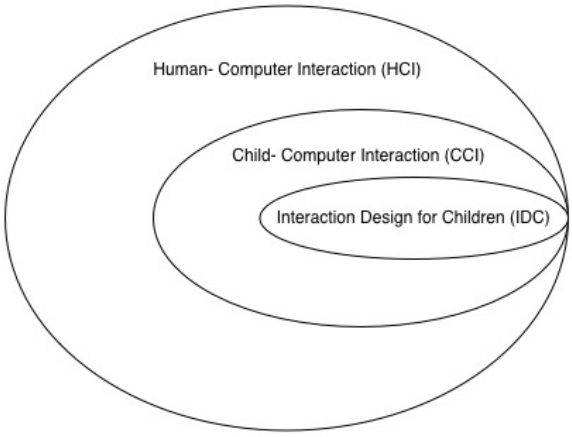

Figure 1: Relationship between HCI, CCI, and IDC

The primary aim of this study is to examine the emergence of EUI, technology, and pedagogy in the context of Arabic speakers in general, and of Kuwaiti youth in particular. Our contributions can be summarized as follows: firstly, we discuss the possible relationships between learning and pedagogy theories, CCI, and educational technology literature; secondly, we examine EUI and technology research in the

context of the Arabic speaking population; thirdly, we highlight the various design challenges offered by the field of EUI, technology, and pedagogy; finally, we propose future trends and directions for researchers and practitioners in the field of educational technology and pedagogy. This study also complements our ongoing work on developing appropriate EUI and technology for Arabic speaking students in Kuwait.

The rest of the paper is organized as follows: section two presents the relationship between CCI literature and educational technology research agenda; section three discusses educational technology background research, by presenting a detailed outline of previous works on educational technology and pedagogy, educational technology and learning, and educational technology acceptance research; section four presents design challenges, and suggests solutions, in the field of EUI and technology, namely designing EUI for children, designing EUI for all, gender-culture-demographics related research dimensions, and evaluating EUI in educational settings; section five describes emerging future trends and research directions in the field of educational technology research; and finally, section six gives conclusions and suggestions for future work.

2 Educational Technology and Child-Computer Interaction

The last two decades have witnessed the genesis of the Child-Computer Interaction (CCI) research agenda. The emergence of CCI dates back to Papert in 1980, when he first combined the two words, “children and computers”. Later, Russman, in 1997, coined the term “child-computer interaction” in his dissertation where he explored the relationship between children and computers, and how this relationship affect the experiences and reactions of children towards the use of computers. On the other hand, Russman argued that the CCI research agenda should examine the children’s needs, perceptions, autonomy, competence, and enjoyment of interacting with computers.

Educational technology has gained great popularity due to its affordability to the mass users and this has resulted in the creation of new opportunities for HCI and CCI researchers and practitioners, educators, and other related policy makers (Markopoulos, 2008; Read, 2005). The role of CCI in educational technology and pedagogy becomes even more important, because children are different to adults in terms of developing cognitive, social, and motor skills (Piaget, 1970; Leontjev, 1978). For this reason, children have different interactional needs from any EUI and technology; therefore, the design and evaluation process for any educational technology should also be different when compared to assessing adult needs. The increasing interest in CCI has also led to the emergence of various international conferences and workshops (International IDC, 2012; Workshop UI, 2011; Workshop child, 2012); moreover, there are also well-known textbooks published on evaluating interfaces and interactive technology with children (Markopoulos, 2008; Druin, 1999; Druin, 2009).

The HCI community has strongly advocated that the next generation of HCI research methods and techniques will play a central role in the development of learning process and learning outcomes (Markopoulos, 2008); however, we believe that the evaluation of the pedagogic suitability of these different educational

technologies is also required. The existing work published in CCI forums is scattered, without any initiative to organize, and does not present a clear research agenda and future goals. It lacks understanding of theories, frameworks and conceptual models for design, and evaluation of EUI and technology. Therefore, we argue in favor of this urgent need to address this emerging area, by investigating the opportunities and challenges provided by CCI. This issue becomes even more critical if we look at deprived communities, for example, Arabic speaking students who have been overlooked by the CCI research agenda at the moment. This kind of information can prove highly useful, for practitioners and researchers who are interested in developing educational technology and related products, targeting Arabic speaker students.

3 Educational Technologies: Related Research

3.1 Educational Technology and Pedagogy

Educators are increasingly adopting different modes of digital technology in order to meet the pedagogical needs of their learners (Sugar, 2004). Novel educational technologies, such as augmented reality (Dhir, 12b) and multi-touch interfaces have enhanced the students' learning and are considered better than the traditional pedagogy (Stone, 1990; Gibbons, 1997). They are also known for promoting inquisitiveness among learners, encouraging students to experiment by trying to solve problems. They also provide real-time feedback to learners in a collaborative environment, as feedback is essential to reach a consensus when learners do not agree. Furthermore, feedback is also vital for constructive learning (Rendon, 1994). Active involvement in different forms of learning is advocated in the new form of educational pedagogy (Montessori, 2012; Astin, 1984); therefore, any education technology should support this fundamental principle of active involvement.

Educational technology supports both didactic and discursive pedagogy, as it can provide access to educational content in the form of e-books and Web pages (Serrano-Santoyo, 2010). Didactic pedagogy-based learning takes the main stage in any traditional classroom environment where the teacher is defined as the expert, supreme authority, jury, and knowledge source (Kansanen, 1999). However, contrary to this, discursive learning is based on the discursive practices of interaction being followed in the community of teachers, students, and peers (Fisher, 1993).

Educational pedagogy and instruction has witnessed a shift from a teacher-centric approach to a learner-centric pedagogy (Johnson, 1998; Astin, 1984). This very change has been clearly reflected in educational technology, too. For example, more and more educational technology solutions have been developed or are being developed in order to support the learning of individual and small group of students. In other words, lesser focus is now given to support the activities of a single teacher. This argument has been further strengthened by the student—student negotiation over student—teacher interaction (Vygotsky, 1978).

Educational technologies are meant for teachers and students; thus, designers, researchers, and practitioners must understand the different styles of pedagogy instruction and teaching environment in general, e.g. teaching style varies from strict and rigid command style to self-teaching and coaching style, where students learn

based on their own learning experiences. The three broad classifications of pedagogy and instruction are as follows:

1. **Constructivist Approach -** Teacher believes that learning is a continuous process that starts at birth while student gains knowledge through experiences, teaching, and self-teaching. This new knowledge is built upon previous knowledge that student has gained from prior learning (Vygotsky, 1978; Montessori, 2012).

2. **Behavioral Approach -** Behaviorist teacher puts emphasis on providing students with stimulus of a particular lesson and in return, expects the response of success as an outcome for a test. Usually, this form of instruction includes a scripted or well-documented approach of instruction. Past studies have shown that this style of teaching tends to motivate even the marginalized learners towards education and instruction (Engelmann, 1988).

3. **Cognitive science Approach** - Cognitive science and educational technology share a common relationship that has been tied around the learners or users of educational technology. This includes some of the well-known terms in cognitive science, namely cognitive load, information seeking and processing, memory models, and frameworks (Sweller, 1998). Cognitive factors are much discussed in the usability of educational interfaces (Tse, 2010; O'Shea, 1997); however, there is a difference between the conventional usability requirements and usability requirements for an educational interface. In the former case, the emphasis is on reducing the cognitive load to facilitate its use for any user, but the latter case suggests that optimum cognitive load is deliberately added so that cognitive processes go beyond recall of the learning curriculum (Sweller, 1998; Zurita, 2004). This optimum cognitive load is considered to be beneficial for learning outcomes (Sweller, 1998) as this involves interpretation, exemplification, classification, inference, differentiation, and organization of the concepts (Zurita, 2004).

3.2 Educational Technology and Learning

Educational technology must take note of the learner's interest and deliver educational content to support essential learning; for example, grabbing the attention of users is considered an important feature of any educational technology (Evans, 1999). Therefore, understanding fundamental theories on pedagogy and instruction are essential for the development of educational technology. Existing empirical studies on this subject have found that EUI should support the following characteristics namely: simple, passive, intuitive, consistent, meets user expectations, ergonomically and contextually aware, reduces cognitive load, makes use of appropriate color schemes and icons, easy in and easy out, user-friendly, and error recovery (Evans, 1999; Goldes, 1983; McFarland, 1995). EUI is intended for student learning and improving the quality of learning support; therefore, due consideration must be given to the student audience, navigation, cognitive cost, constructive support, and learning value (O'Shea, 1997). These are explained as follows:

1. **Student audience:** Students differ according to their previous knowledge, social status, gender, economical position, information technology skills, and learning

capabilities. Students with different skills will make use of EUI in different ways; for example, certain interfaces might not be suitable for children below a certain age due to the use of too much text and small widgets.

2. **Constructive Functionality:** Educational interfaces that are heavily decorated often make the actual representation obscure and hidden. Students often find it difficult to focus on such interfaces and determine what is being presented.

3. **Navigation Support**: Often, learners find the information space confusing due to bad navigational support provided by the EUI. Learners want easy tracking of their navigation history so they can easily visit the information that is required.

4. **Cognitive Cost:** Every EUI is designed keeping in mind the mechanical, representational, and physical metaphors. Students have to pay certain cognitive costs before they become proficient in using a particular interface.

5. **Added learning value:** EUI and technology are developed in order to support learning and educational pedagogy. Apart from the learning goal, EUI must also consider added value or inclination learning value, which might be supported by this technology. For example, if any EUI supports visualizations and multiple representations of the same abstract concept, then it will result in higher order learning skills.

O'Shea, 1997 argued that the need for placing the use of any EUI based on the constraints in learning, such as different learning styles, cognitive abilities, gender, culture, personal knowledge about information technology, and motivation, as these are essential for the proper utilization of the pedagogic needs of any EUI. We also agree with this position because learning and other cognitive difficulties should be considered while developing any advanced EUI that aims to support learning and development among young children.

3.3 Educational Technology Acceptance Research

Studies investigating different parameters that affect technology acceptance and adoption are popular in the field of information systems and so far, there are several theories that have dominated the majority of the research carried out on technology acceptance. This includes motivation theory (Deci, 1985), Theory of Reasoned Action (TRA) (Fishbein, 1975), Theory of Planned Behavior (TPB) (Azjen, 1985) and the Technology Acceptance Model (TAM). Among all of these, the TAM is used to understand the key aspects related to technology acceptance in any learning environment by involving teachers and students (Zhang, 2010). Majority of the TAM related research is focused on the following aspects, namely: technology characteristics (Tornatzky, 1982), user's perception (Davis, 1989), user's beliefs, and other miscellaneous factors involving user training and implementation-related issues. (Zhang, 2010) examined technology acceptance in educational settings through a qualitative study involving classroom students, and discovered that the usefulness, ease of use, accessibility, performance, quality, likeability, and other factors can influence the adoption and sustained use of any technology (Zhang, 2010).

We have found that technology acceptance research in the context of educational technology is heavily concentrated on students, their choices, attitudes, and perceptions. Since students are deemed the end users, they have been the focus of educational technology research studies. However, we believe that research dealing with this subject must also involve other stakeholders; for example, teachers, organizational set up, classrooms, pedagogy, and finally individual factors related to personality traits, learning and so on.

4 Design Challenges in EUI and Technology

4.1 Designing EUI and Technology for Children

Adapting technology for children has both advantages and disadvantages, as technology can provide children with a meaningful source of learning experiences, and this source of information is huge and has unlimited content, leading children to absorb both useful and harmful knowledge and behaviors. Despite the fact that technology may harm children, its role as a new and effective method of learning encourages researchers to focus on improving children's technological skills. Al-Mousawi, 2012 attempts to measure children's technological interactions by using an observation and a survey method that includes general user guidelines, which helps technology designers understand the basic child's skills required to interact with technology.

Children are different from their adult counterparts due to existing differences in cognitive abilities. Children possess underdeveloped cognitive and social skills (Piaget, 1970; Leontjev, 1978), limited reach and exposure to the real world, different activities and personalities (Leontjev, 1978), developing motor skills, and weak maturity towards society and individuals (Piaget, 1970). These fundamental differences between children and adults have resulted in the need for developing newer HCI research methods and techniques to serve the needs of product designers and practitioners mainly working with children. For example, Read, in 2006 argued that traditional survey methods are not fit for doing research with children; thus, a new form of survey was proposed that is based on fun.

Designing for children is both challenging and complex, as it involves several challenging issues; for example, ensuring personal space and privacy in educational technology, potential online security and privacy risks, and tedious ethical requirements in any user research involving children as participants (Livingstone, 2008). These set of potential risks and challenges become even more alarming when children are involved (either as participants or potential users), as they are always at a disadvantage compared to their adult counterparts when any technology use comes into picture. This could be credited to the lack of awareness about privacy, security, safe use of educational technology, age, and underdeveloped cognitive abilities (Livingstone, 2008; Faisal, 2011).

The above discussion has revealed that a child's cognitive abilities have great impact on different HCI research methods and techniques; for example, memory load defines response time against any interactive educational technology. It is important to mention that memory load and other cognitive abilities vary from very young to older age groups among children. Similarly, due to developing motor skills, young

children might face problems in precise object positioning. Other notable design considerations are as follows: children are always keen to explore the world around them; children possess strong desire to feel in control of the technology they are using (Siraj-Blatchford, 2003); children enjoy those technologies that support multiple forms of interaction (Druin, 1999), and lastly, technologies aimed at children should support elements of engagement, motivation, fun, and enjoyment; moreover, these should deepen their existing learning on any given subject (Falcão, 2010). Therefore, we can agree that there are several design considerations for interaction designers; for example, EUI should include easy drag and drop functionalities, easy target selection facility, and make use of large widgets in order to ease the recognition (Tse, 2010). CCI and HCI practitioners and researchers should take such parameters and device appropriate interaction sequences into account. EUI and technology aimed at children must be intuitive, simple and must use appropriate icons and less cognitive load (Tse, 2010). Additionally, the educational interfaces for young children should support and develop literacy skills through the use of appropriate icons and lesser use of text (Tse, 2010).

4.2 Designing EUI for All

Children can be different when it comes to comparing their learning, cognitive, and social abilities. Some children have Learning Difficulties (LDs), i.e., cognitive disabilities they inherit biologically (Vera, 2005). Students with LDs face significant problems in learning and gaining instruction; therefore, they often score below average in their academic tests. LDs among young children lead to poor concentration, weak memorization, poor recall capacities, cognitive disabilities, and most importantly reduced social, practical, and academic development (Falcão, 2010).

Over the past few years, developing educational interfaces for people with disabilities or special needs has attracted the attention of many multidisciplinary researchers (Al-Wabil, 2012). There is a growing movement among both developing and developed countries towards supporting educational needs of individuals with developmental disorders. In this direction, many international legislations and acts were passed in order to ensure that classrooms provide necessary support for people with special needs. Some of the prominent initiatives include United Nations Rights of Persons with Disabilities (UNRPD) Act, which gives equal possible opportunities for everyone including people with special needs. UNRPD advocates that people with special needs (i.e., people with disabilities) should be given equal access to any education system in order to integrate them in the society (UNRPD, 2008). Several countries have increased their yearly budget to facilitate those with special needs; for example, UAE, Kuwait, Qatar, Oman and Saudi Arabia have called for the urgent need to develop assisting technologies for their citizens with special needs. Assisting people with special needs is part of their strategic priorities for 2010-2014 (Strategic Plan, 2010).

Lately, there has been growing interest towards developing appropriate EUI and technology for children suffering from learning or other cognitive disabilities such as dyslexia. On average, about 8-9% of students in every class suffer from LDs of different severity levels and this statistic shows that there is an urgent need for addressing EUI needs of the children with LDs. This situation is alarming in the case of Arabic speaking children, where studies examining EUI and technology needs for

children with LDs are scarce e.g. Al-Osaimi, (2009) is the only published research so far (to the best of our knowledge) that studied the requirements for designing an e-learning program for deaf Arab children at elementary schools.

This research topic requires urgent attention from educators and interaction designers, because very little has been done to support and enhance the learning experience among children with LDs. Falcão, (2010) argued that this open research topic requires systematic research design, so that informed research can be carried through novel interactive educational technology.

We have reviewed pertinent issues and have proposed guidelines based on extensive review of the literature, as well as our experience in this field e.g. Alsumait, 2008; Alsumait, 2009; Al-Mousawi, 2012. The set of guidelines should accommodate individual differences among Arab children such as gender, disabilities, literacy, culture, family income, and so forth. The goal is to build a set of guidelines that can complete and enhance the existing guidelines in order to be capable of handling children's needs. Additionally, these guidelines can be used to develop EUI and technology that can essentially make the learning experience more engaging. It should also provide new ways of teaching complex concepts and support critical thinking.

1. **Text**: Allow user settings to define base text size, colour, and contrast with the background. Additionally, simple language should be used.

2. **Icon**: Each icon used should be presented with a label, a tooltip, and an audio. This feature allows children, regardless of their disability, to know what to expect when clicking on that icon.

3. **New Concept Representation**: Use text, image, video/audio, and sign language representation to explain new concept.

4. **Help**: Since most children have poor reading skills, therefore it is recommended to use video-based help that shows children how to interact with the interface. This type of help eliminates the possibility of not understanding a concept used in the text-based help.

5. **Show Site Map**: If the program is large and includes multiple levels, then a map of the program should be shown. Design the structure of the map in a way that is simple and easy to understand. Furthermore, text and images should be used to describe each section in the map.

6. **Interface Design**: Children lose their interest toward educational programs very quickly. Colourful interfaces should be designed for them to gain more interest.

7. **Use Real Image Representations**: It is easier for a child to map a real image representation than a cartoon representation.

8. **Provide Instant Feedback**: Children must receive instant feedback after every activity or action. The feedback needs to inform children whether their actions were correct and motivate them to continue interacting with the interface. In the

same manner, the feedback should inform children that their actions were incorrect and explicitly direct them to the correct behaviour.

9. **Use Sounds**: Use audios wisely to enrich the interacting experience of children. Sound needs to be clear and the speaking speed needs to be suitable for those children.

10. **Sign Language** Actors: For deaf children, use child actors for the videos of the sign language. Allow them to control the size of the video screen.

11. **Physical effort**: Design for children with fine motor skills, so that the interface can be used efficiently and comfortably and with minimum fatigue.

12. **Mobile Universal Usability**: It is important to support universal usability for mobile e-learning software, as mobile applications are becoming increasingly pervasive and complex, involving sophisticated EUI and touchscreen-based interaction designs.

4.2 Cultural Dimensions, Demographics, and Gender in Educational Technology

Examination of cultural dimensions and attitudes towards the adoption of educational technology has generated increasing interest among different researchers throughout the world (Hofstede, 2001). This area of research has led to the emergence of various cross-cultural studies that have brought various interesting facts related to gender, ethnicity, culture, and other demographic factors into the field of educational technology (Hofstede, 2001).

Culture is defined as a set pattern of thinking, feeling, and potential acting; something that one learns throughout a lifetime (Hofstede, 2001). Therefore, culture dominates our day-to-day actions, is likely to be used repeatedly and is also difficult to be changed by the individual himself. Cultural differences lead to different attitudes, behaviors, and value orientations among people (Hofstede, 2001) and these differences are not limited to ethnicity but also include different academic disciplines (e.g., humanities versus natural science) and professional groups (for example, technical versus non-technical) that constitute any culture. Hofstede in 2001, carried a large study involving IBM staff from over 72 countries and discovered five main cultural dimensions namely: power distance, collectivism vs. individualism, femininity vs. masculinity, uncertainty avoidance, and long-term vs. short-term orientation. (Weinberger, 2010) examined the effect of culture, profession, and attitude towards the use of different educational technology among German and Romanian users. The study comprises a large-scale sample (N=2834) involving participants from technical and non-technical backgrounds. It has been scientifically proven that cultural differences do affect the use, adoption, and acceptance of educational technology. Additionally, these attitudes are socially shared patterns of thinking, feeling, and behavior towards technology and may change on the basis of new experiences and learning (Weinberger, 2007).

Fundamental theories related to adoption-diffusion govern the process of spreading newer technologies over time (Straub, 2009). These theories can also

explain the adoption of educational technology if examined and practically used through an empirical study. By adoption, we refer to the individual's personal decision to use any technology; for example, due to personal choices, willingness and attitudes (Ajzen, 2000), while diffusion is a collective process of technology use over a time span. Research dealing with technology adoption is very wide and it has been a popular theme of research at the beginning of the new millennium.

Gulluoglu, in 2012 examined gender differentiated communication patterns and other educational characteristics in online educational technology and instruction. Based on gender differences and related educational characteristics, instructional design, delivery, and support strategies have been proposed. The study argued that teacher-learner dynamics should be studied before designing any educational tool aimed at supporting the teacher-learner relationship. Additionally, such initiative helps in promoting social equity among instructors and learners. Gulluoglu, in 2012, argued that during the time of educational technology development, most emphasis was given to the technical implementation, while instructional models were often ignored. Furthermore, the effect of gender differences between students and teachers is less focused and psychologists have agreed that males and females have different styles of learning and preferences. These differences also affect the relational and group dynamics along with the academic achievement.

Several studies have examined the effect of gender, culture, and other demographic parameters in the use and adoption of educational technology. However, there is a need to propose design considerations for interaction designers and software specialists, based on the gender, culture, and demographic related differences, which exist in the context of educational technology usage. These design considerations will enhance the educational technology development process and will best serve its users.

4.3 Evaluating of EUI under Educational Settings

As noted before, children have different cognitive and social skills, when compared to adults, due to developing memory and motor skills (Piaget, 1970; Leontjev, 1978). Given this reason, traditional HCI evaluation techniques, if practiced with children, require proper adaptation so as to make evaluation more appropriate for children (Rounding, 2012). These adaptations are essential for the validity and reliability of the study results. Review of the existing literature has shown that only a number of traditional HCI methods have been modified and transformed as per the needs of the young children (Read, 2006). This includes organizing observations in classrooms, adjusting Fitt's Law so as to make it more engaging, usability evaluation with stations, and activity pairs (Markopoulos, 2008). However, at the same time, different usability evaluation methods (UEMs), such as expert heuristic evaluation, survey, observational, and experimental methods are not yet modified for children (Kesteren, 2003; Edwards, 2007; Benedikte, 2005). Furthermore, only a few studies have been carried out to examine the effectiveness of UEMs to children.

Evaluating any product or service with young children is not an easy task as this involves several challenging issues. For example, children might find it difficult to understand the common written and spoken vocabulary of adult researchers (Isomursu, 2002); children often feel too shy to express their genuine opinions in front of adult researchers (Isomursu, 2002); evaluation of EUI and technology in the classroom environment by external adults (i.e., researchers) might make children

uncomfortable (Isomursu, 2002). One recent study has examined the effectiveness of five survey techniques in evaluating the usability of e-learning programs dictated to five and six-year old children (Alsumait, 2008). Results indicated that "Smileyometer", "Best/Worst Activity Table" and "Again/Again Table" survey techniques were more reliable than "Word Box" and the "Remembering" (Alsumait, 2008).

Evaluating any EUI with children essentially means taking a few steps to customize the environment to the child's developmental level. Evaluators are required to set up the appropriate environment for EUI testing, whether in a classroom or in a lab, and make it child-friendly. Before starting the test, the evaluator has to establish a connection with the child and later motivate him. During the test, the evaluator has to use simple instructions to make those children with more limited vocabularies understand better, provide additional comfort levels for those children who are less able to regulate their emotional arousal, and lastly, pace the test to accommodate differing attention spans and energy reserves. After the testing, it is important to show appreciation to the children and to their parents for their contributions (Hanna, 1997).

5 Future Trends in EUI, Technology and Pedagogy

This section presents nine emerging future trends and research directions for fellow researchers and practitioners who are interested in the field of EUI, technology, associated pedagogy, and instruction. We believe that these trends will dominate the future research agenda pertaining to this kind of research:

1. **Relationship between new media and learning** –New forms of interactive media devices such as iPad and other multi-touch devices are very popular among very young and late primary children. Educators are also increasingly accepting the iPad as part of their day-to-day instruction; however, there is no scientific assessment of the learning and instruction benefits of the iPad for young children. Researchers must examine new forms of interactive media from the point of view of pedagogy, instruction, and learning. This research theme addresses broader research dealing with the evaluation of pedagogic suitability of interactive educational technologies.

2. **CCI for Arab** – CCI research agenda has been so far exceptionally dominated by studies conducted in western countries. Arabic speaking users are ignored by the CCI research agenda; therefore, we call for the emergence of a newer research discipline, i.e., CCI for Arab. This new research discipline should focus on Arab child psychology, learning, and play. Due emphasis should be given to developing newer research methods and design considerations for Arabic speaking communities.

3. **Foundations of CCI** - Existing studies on CCI lack understanding of theories, frameworks, and conceptual models for design and evaluation of EUI and technology. Researchers should investigate the theoretical foundations of CCI research by examining published CCI studies, in order to find relationships between theory and empirical facts.

4. **Interrelation between educational technology, pedagogy, and learning** - Solid understanding of fundamental theories on pedagogy, instruction, and learning is essential for developing educational technology. Therefore, researchers should further examine and understand the various relationships that exist between technology, pedagogy, and instruction.

5. **Evaluating technology under Educational settings** – Researchers should try to answer several open research questions pertaining to the evaluation of educational technology, e.g. how should we evaluate interactive products such as EUI with children? What kinds of evaluation techniques are fit for testing with young children? What is the important or essential information to be considered before evaluating any EUI with young children? What are the challenges and complexities in evaluating EUI under classroom environments?

6. **Educational technology acceptance research –** Future educational technology acceptance research should involve different stakeholders, including teachers, students, classroom environment, organizational set-up, and pedagogy, instead of only focusing on students alone.

7. **Educational technology versus Demographics** – Researchers should look into proposing an extensive set of design considerations for interface designers and specialists based on gender, culture, and other demographics related to learner differences.

8. **Educational Technology for Special needs** – This subject includes developing appropriate educational technology for people with special needs, including cognitive disabilities and disabilities due to other reasons. Design consideration for developing any educational technology aiming at special needs is still a young field of research.

9. **Systematic review**- Systematic literature review methodology is commonly practiced in the health and medicine disciplines; however, the last decade has witnessed the emergence of systematic reviews in the software engineering discipline. The educational technology research domain is expanding at a very fast rate in terms of published studies and newly emerging conferences, workshops, and other academic forums. The need, at this moment, is to organize this vast amount of scientific knowledge so that both young and experienced researchers can make use of this knowledge to the fullest. Examining the value possessed by the educational technology scientific community can potentially deliver insights on research design decisions and future opportunities.

6 Conclusions and Future Work

In this paper, we have presented a detailed review of the EUI, technology, and pedagogy research agenda, by reviewing literature from CCI and empirical studies on EUI implementations. This study also offers five contributions. Firstly, it presents an

educational technology research agenda underpinned by extensive research and studies. Secondly, it highlights the missing interconnections between empirical findings of the published studies and the pedagogical theories. Thirdly, it points out that educational technology research is overly dominated by studies conducted in developed countries, while developing countries, for example, Arabic speaking populations in the Middle-East in general and the Gulf states in particular, are rarely studied. Fourthly, it presents major challenges in designing EUI, technology, and pedagogy. Lastly, it proposes guidelines and recommendations for future research to overcome some of the existing challenges.

We have also discovered that Arabic speaking students are currently not the focus of any EUI, technology design, and evaluation; hence, this has resulted in poor understanding of their educational needs and requirements. In order to bridge this gap, we are currently conducting user studies in Kuwait. Our research is mainly focused on Arabic-speaking children, for whom we intend to examine, understand, and develop EUI and pedagogy. We will examine and investigate the issue of providing appropriate educational technology and EUI services to Kuwaiti students based on their needs and expectations.

The results of this research could serve as a reference for designing EUI for Arabic students. Our goal is to prepare a framework that will act as a guiding source for educationalists, teachers, and policy makers in developing better educational technology and pedagogy services aimed at young children. This potential framework will not only provide necessary guidelines to design EUI, but it will also provide methods to evaluate these technologies in classroom environments. Our research is also linked with Kuwait's foremost strategic goal, i.e., to increase the competitiveness and attractiveness of Kuwaiti education. Furthermore, this research is highly relevant to Kuwait society, keeping in mind the current focus of the Kuwaiti state in improving education, ICT infrastructure, learning, and educational pedagogy. The research questions behind this study will be achieved through a multi- method research methodology that consists of series of large-scale questionnaire surveys, face-to-face interviews, focus group discussions, and participatory design workshops involving students and teachers.

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