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

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Abstract. Educational technology has revolutionized the traditional forms of classroom teaching and learning. Past few years have witnessed the emergence of the educational User Interface (UI) in the form of tablets, whiteboards, mobile and handheld devices for enhancing the classroom learning and instruction. Interaction design plays a pivotal role in improving the educational UI through a step-by-step approach. This process involves understanding needs and expectations of students, examining the fundamental theories governing potential implementations and performing design and evaluation. Existing literature on educational UI and technology has revealed that its present research agenda is overly dominated by studies conducted in developed world. This has resulted in the poor understanding on educational technology need of Arabic speaking students for example. The aim of this paper is to present the recent emergence of educational technology by performing a thorough review of existing work in this emerging domain. This work also complements our ongoing work on developing appropriate educational UI and technology for Arabic speaking students in Kuwait.

1 Introduction

The emergence of pervasive computing in form of mobile phones and handheld devices has transformed the daily routine and lifestyle of young children around the world. It will be correct to say that teddy bears and fiction magazines are no longer the sole companions of the children anymore [1,2,3,4]. Daily routine for young children consists of morning school, afternoon play, home, evening playtime and spending time with parents and doing homework. In all these phases, technology plays an important role i.e., in leisure, learning and play. These interacting physical and technological spaces have resulted in the need for developing new approaches for design and evaluation of products aimed at children [5, 6, 7]. Interaction design plays an important role in educational UI and technology. Interaction Design is governed by the discipline of Child-Computer Interaction (CCI) that focuses on child psychology, learning and play [8, 9]. The studies published on the design and evaluations of the educational UI in developing world such as Middle East are scarce. Similarly, the CCI research agenda is overly dominated by the studies planned and organized in western world. Therefore, keeping 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. In this paper, we have presented an outline of the design challenges and opportunities in educational UI, technology and pedagogy by performing a thorough review of the published work in CCI forums. At present, we are doing a pilot study at Kuwaiti high schools through an initiative of Kuwait University.

2 Child Computer Interaction

Last two decades have witnessed the emergence of the Child-Computer Interaction (CCI) research agenda. It is also correct to say that this emergence of CCI and educational technology has changed the access patterns of today's child [8, 9]. The role of CCI in educational technology and pedagogy becomes even more important because children are different from that of adults due to their developing cognitive, social and motor skills [10, 11]. This shows that children have different interaction needs from any educational UI and technology so the design and evaluation process should be different compared to adults. The increasing interest in CCI has lead to the emergence of various international conferences and workshops [12, 13, 14, 15]. CCI research agenda is defined to be focused on following broad themes namely the development of new research methods and adapting older ones so as to make them fit for working with children in design, evaluation and research; examining fundamental theories on the child psychology, development and technology design; and developing frameworks and models that can help product designers and practitioners in better understanding the notion of appropriate technology for children [16]. There are some well-known textbooks are published on evaluating interfaces and other interactive technology with children [17, 18, 19]. But, despite the presence of wide category of existing textbooks and research papers the notion of CCI is ill defined. There has been no consensus yet on the exact age of the children considered in CCI research [8, 9]. It is common to refer children from age 1 to 13 as the main user group. However, teenagers between 13-17 years who are considered important technology user are so far ignored from CCI research agenda.

The existing work published in CCI forums is scattered without any initiative to organize it and present a clear research agenda and future goals. It lacks understanding on theories; frameworks and conceptual models for design and evaluation of educational UI and technology. There is an urgent need to address this emerging area by investigating the opportunities and challenges provided by CCI. This issue becomes even more important if we look at deprived communities for example Arabic speaking students who have been ignored so far by the CCI research agenda. This kind of information can prove highly useful for practitioners and researchers who are interested in educational technology and related products aiming at Arabic speaking students.

3 Educational UI and Technology

Educators are increasingly adopting different modes of digital technology for meeting the pedagogical needs of their learners (reference). New educational UI and technologies have enhanced the students’ learning and considered better compared to tradi-
tional pedagogy and learning [20, 21, 22, 23]. Recent empirical evidences have scientifically proved that digital technologies such as multi-touch tables promote inquisitiveness among learners. Educational technologies tend to encourage students towards experimentation, trial and problem solving. They have the capability to provide real-time feedback to learners in a collaborative environment. This feedback is essential to reach at consensus in collaborative learning when learners do not agree. Furthermore this feedback is needed for constructive learning [24, 25]. Active involvement in different forms of learning is advocated in the new form of educational pedagogy [26, 27]. There are various digital technologies for example, augmented reality, multi-touch interfaces and other forms of multimodal interactions that also support this fundamental principle of active involvement. However, role of these digital technologies in the advanced educational pedagogy has been less studied so it requires scientific investigation.

Educational interfaces are intended for student learning and improving the quality of learning support so due consideration must be given to the student audience, navigation, cognitive cost, constructive support and learning value [28]. **Student audience:** Students differ according to their previous knowledge, social status, gender, economical position, information technology skills and learning capabilities. So students with different skills will make use of educational UI in different ways for example, certain interfaces might not be suitable for children below certain age due to the use of too much text and small widgets. **Constructive Functionality:** Educational interfaces that are heavily decorated often make the actual representation obscure and hidden. Student often find it difficult to focus on such interfaces and determine what is being built when they are using the interface. **Navigation Support:** Many time’s learners find it too much confusing information space due to bad navigation support provided by the educational UI. Learners want easy tracking of their navigation history so that they can easily visit the information that is required by them. **Cognitive Cost:** Every educational UI is designed after keeping in mind the mechanical, representational and physical metaphors. Every student has to pay certain cognitive cost before he or she can becomes proficient in using that particular interface. **Added learning value:** Educational UI and technology is developed in order to support learning and educational pedagogy. Apart from the learning goal, educational UI must also consider added value or inclination learning value that might be supported by this technology. For example, if any educational UI supports visualizations and multiple representations of the same abstract concept then it will result in higher order learning skills.

Educational Pedagogy has witnessed a shift from teacher-centric approach to learner-centric pedagogy [29, 27, 30]. This very change in pedagogy has been clearly reflected in the technology too. For example, more and more technological solutions have been developed or are developing in order to support the learning of the individual and small group of students. In other words, less and less focus is now given on supporting the activities of a single teacher. This argument has been further strengthening by the student-student negotiation over student-teacher [31]. There is no doubt that technology support leaning and facets of educational initiatives but we believe that technological solutions provides key reflections that are must to create consensus among the group of students or class when learners do not agree on certain arguments.

Multi-media have the potential for enhancing the educational experience because grasping the attention of users is important characteristics of any educational software
In the past, there have been several real implementations for enhancing the learning experience of students through the means of videos (i.e., multimedia) and customization possibilities [33, 34, 35, 36]. Educational software must take note of learner’s interest and deliver educational content in accordance so as to support essential learning. This goal can be achieved through educational UI and technology, which must be simple, passive, intuitive, consistent, meets user expectations, ergonomically and contextual aware, reduces cognitive load, makes use of appropriate color schemes and icons, easy in and easy out, user control and error recovery [32, 38, 39, 40, 41].

Existing empirical studies have argued the need for situating the use of any educational interface based on the constraints in learning for example, different learning style, cognitive abilities, gender, culture, personal knowledge about information technology and motivation [28, 42]. This will enable the proper utilizing of the pedagogic needs of any educational interface. We also agree with this conclusion because learning and other cognitive difficulties should be consider while developing any advanced educational UI that aims to support learning and development among young children. The existing literature on educational UI and technologies lacks understanding on theories, frameworks and conceptual models that can explain how digital technology can contribute towards educational pedagogy. Furthermore, there is a need to examine the contemporary paradigms of educational pedagogy because these paradigms will also govern the fate of digital technologies likewise, any digital technology may prove failure if it does not comply with the educational pedagogy paradigms.

4 Design Challenges in Educational UI and Technology

4.1 Designing Educational UI for Children

Children are different from their adult counterparts because of their underdeveloped cognitive and social skills [10, 11, 43, 44], limited reach and exposure to real world, activity and personality [11], developing motor and level of maturity towards society and individuals [10]. This fundamental difference between children and adults has resulted in the need for new HCI research methods for CCI practitioners and researchers. Furthermore, new HCI techniques must take into account the physical and cognitive handicaps faced by the children during their development age [45]. For example, comprehensive set of heuristics for child e-learning (HECE) were proposed along with a detailed explanation for the usability experts on how to apply them [46].

Designing for children is both challenging and complex subject because it involves several difficult opens issues into account. Some of the complex issues are ensuring personal space and privacy in the educational technology design, potential online security and privacy risks involved in the use of technology and giving due consideration to the ethical requirements in any user research [47]. All these potential risks and challenges becomes more alarming in case of young children because they are always at disadvantage compared to their adult counterpart when any technology use comes into picture. The possible reasons are lack of awareness about privacy, security and safe use of educational technology, age and underdeveloped cognition and thinking [47, 48, 49].
Developmental cognitive skills i.e., memory load and physical motor skills of children between 4-12 years are having design considerations for new HCI techniques [45]. For example, memory load will vary from very young to older children so the response time against any interactive educational technology will also vary. Similarly child’s motor skills are under development phase so young children might face problems in the precise object positioning. This fact results in a design consideration for interaction designers who should include easy drag and drop functionalities, easy target selection facility and making use of large widgets for easy recognition [45]. Thus CCI practitioners and researchers should take such parameters into account and device appropriate interaction times. Educational UI and technology aimed at children must also possess similar characteristics as that for their adult i.e., intuitiveness, simple, makes use of appropriate icons and less cognitive load [45]. Additionally the educational interfaces for young children should support and develop literacy skills through the use of appropriate icons and less use of text [45].

Social media and social relationships can play an important role at any educational UI and technology because this support collaboration and collective learning among group of students [50]. The role of social relations in mobile and pervasive computing has been widely studied [51] but its role in educational UI and technology is less studied. We argue that educational UI and technology can help students facing challenges in their daily routine due to their underdeveloped social skills. Such students often face the condition of distress and embarrassment, which is also a matter of concern of their parents and educators. To best of our knowledge, there has been no initiative for developing such educational UI and technology that can help Arabic speaking children with social skill disadvantage. In our intended research, we aim to examine and investigate this potential use of educational UI by involving children and educators in Kuwait.

4.2 Designing Educational UI for All

All children are not the same when compared against their learning, cognitive and social skills. Some children possess learning difficulties i.e., cognitive disabilities that they inherit since their biological birth [52]. Children that suffers from learning difficulties often face problems such as clue seeking, poor verbal memory, lack of confidence, reduced academic, social and cognitive performance, underdeveloped logical and critical reasoning due to weak motor skills [53, 54]. Lately, there has been focus on developing appropriate educational UI and technology for children that suffer from learning or other cognitive disabilities. On average, about 8-9% students in every class that suffer from learning difficulties of different severity levels. These statistics shows that there is an urgent need for addressing educational UI needs of the children with learning difficulties. The situation is even further challenging for Arabic speaking children where educational UI and technology for children having learning difficulties is scarce.

4.3 Challenges in Evaluating of UI under Educational Settings

As noted before, children have different cognitive and social skills due to their devel-
oping memory and motor skills. This very difference has resulted in few open re-
search questions namely, how should we evaluate interactive products such as educa-
tional UI with children? ; What kind of evaluation techniques are fit for testing with 
young children? ; What are the important or essential information to be considered 
before evaluating any educational UI with young children? ; What are the challenges 
and complexities in evaluating educational UI under classroom environment? Since 
children have different needs and requirements compared to adults so traditional eval-
uation techniques require some adaptation so as evaluation is more appropriate with 
children [55]. They found several interesting findings related to evaluating interfaces 
with children's, for example organizing in-situ observations in classrooms, adjusting 
fit's law so as to make it more engaging, usability evaluation with stations and activity 
pairs.

The evaluation of e learning should address aspects of pedagogy and learning 
from educational domains, as well as usability factors such as the efficiency, effec-
tiveness and satisfaction of interfaces. Various usability evaluation methods (UEMs) 
exist, e.g. expert heuristic evaluation, survey, and observational and experimental 
methods. In literature numerous studies have compared UEMs for adults [56, 57, 58]. 
However, fewer studies have compared the effectiveness of UEMs with children [59, 
60]. Therefore, researchers must give consideration to several minor but essential 
things that should be considered while evaluating interactive educational technologies 
with children. For example, children might find it difficult to understand the common 
written and spoken vocabulary of adult researchers [61]; children often feel shy to 
express their genuine opinions in front of adult researchers [61]; evaluation of educa-
tional UI and technology in classroom environment by external adults i.e., researchers 
might make children uncomfortable. One recent study has examined the effectiveness 
of five survey techniques in evaluating the usability of e-learning program dictated to 
five- and six-years old children [62]. Results indicated that “Smileyometer”, 
“Best/Worst Activity Table” and “Again/Again Table” survey techniques were more 
reliable than “Word Box” and the “Remembering”.

E-learning can also help disable children to learn new vocabulary, mathematics 
and literacy skills at any time that suites them. Such programs can also increase disa-
ble children independence, confidence, motivation and social contact. However, it is 
important that their e-learning programs be as “disable”-friendly as possible. To do 
so, the developers of those programs need to understand disable users’ capabilities 
and needs. One way to achieve this is by involving disable children in both of the 
design process and the test process of the e-learning program. There are many testing 
methods that are developed to test interfaces with children [56, 57, 58, 59]. In context 
to Arabic speaking students, set of guidelines for designing e-learning programs for 
deaf children were recently studied [63]. These guidelines are suitable for designing 
e-learning programs for deaf children in elementary schools.

5 Opportunities in Educational UI and Technology

Educational UI and 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 was below 15 years of age
India and China account for the world’s largest adolescent population i.e. 243 million and 207 million [65]. Furthermore, it has been predicted that the world's adolescent population will remain 1.2 billion till the end of 2050 [66]. The wide scale popularity of educational UI and related technology and its affordable reach to mass users has created new opportunities for HCI and CCI researchers and practitioners, educators and education related policy makers. There is no doubt that educational UI, technology and pedagogy is a hot topic at present in both academic and industrial circles and its dominance can also be anticipated in the near future. However, this research domain requires urgent attention of the world’s research community especially towards the deprived Arabic speaking students who are so far been ignored from the CCI and educational technology research agenda.

The current literature available in the domain of CCI lacks the basic foundations of psychological and sociological theories. At the moment, there are several such interested studies that have been published in the inter-disciplinary areas such as technology, psychology and sociology on educational UI and technology. However, there has been no initiative to study these existing theories, guidelines and framework. These theories might prove useful in preparing common guidelines for developing enhanced educational UI, aiming at researchers, design practitioners, educationalists and policy makers for government.

6 Conclusions and Future Work

In this paper, we have presented a detailed review of the educational UI, technology and pedagogy research agenda by reviewing literature from CCI and empirical studies on educational UI implementations. Based on our review, design challenges and opportunities in educational UI were outlined. We found that Arabic speaking students are currently not in focus in any educational UI and technology design and evaluation. This has resulted in poor understanding of their educational needs and requirements.

In order to bridge this gap, we are doing users studies in Kuwait from April – June 2012. Our research is mainly focused on the Arabic-speaking children for whom we intend to examine, understand and develop educational UI and pedagogy. We will examine and investigate the issue of providing appropriate educational technology and UI services to Kuwaiti students based on their needs and expectation. The results of this research could serve as a reference for designing educational UI for Arabic students. Our goal is to prepare a framework that will act as a guiding source for educationalists, teachers and policy makers for developing better educational technology and pedagogy services aiming young children. This potential framework will not only provide necessary guidelines to design educational UI but it will also provide methods to and evaluate these technologies in classroom environment. Our research is also linked with the Kuwait’s foremost strategic goal, i.e., to increase the competitiveness and attractiveness of Kuwaiti education. Furthermore, this research is highly relevant to Kuwaiti society, keeping in mind the current focus of Kuwaiti state on 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 discussions and participatory design workshops involving students and teachers.
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