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# Proposed UX Model for Children Educational Mobile Application

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**Abstract.** The evolution of mobile learning is robustly popular among children these days since the engagement is portable and owns unique interactive specialties that tends to attract more users. User experience (UX) is one of the potential approaches in designing mobile applications to deliver a complete experience for utilizing a technology. However, this concept of UX has not been adopted while designing educational mobile application for children even when researchers have claimed that children's experience differs from adults. Therefore, the inadequate experience of mobile learning leads in affecting children's cognitive skills in learning perspective. The problem statement argued in this paper is children's cognitive skills on solving educational critical thinking problems are diminishing due to lacking of adequate elements while designing educational mobile application. To support the problem this paper aims to develop EduMobile UX Model for children when designers are developing educational mobile application for them. This study conducted a literature review to develop EduMobile UX Model. This model will be referred by designers when designing children educational mobile application.

**Keywords:** User Experience, Children Educational Application, Cognitive skills.

## 1 Introduction

Mobile devices are trending in the current technological era among the modern generation [1] as it advances in interactivity as well as promotes friendly features. Mobile devices are easily portable, educational contents can be accessed anytime and anywhere, and material presentation would be beyond the traditional classroom settings learning. Several researchers believe that mobile learning gives the opportunity to the students and teachers to facilitate an interactive plus innovative teaching and learning process. Furthermore, learning is easy through mobile devices like mobile phones, handheld computers and tablets. The usage of mobile while learning is becoming a part of the children life but their cognitive skill on the other hand is getting affected [1]. This is due to the poorly designed interface as well as neglecting children's experience while using a mobile application when learning. Technological development has introduced latest resources but at the end the user is who that decides to accept or reject the service.

Thus, UX plays the core concepts in mobile application even though the consent is uncertain. UX converges information, visual, web and content design, application architecture, visual rhetoric (image and branding), content creation and writing, and analysis (business, web, and “big data” analytics), among others [2]. Several ventures of defining, understanding and scoping UX has been done yet, there is no specific consensus which reached this concept [3]. The manner which perceive the surrounding of a user and adapts the usability into the application delivers a complete experience. Hence, it is important to understand children’s experience in using a mobile application while learning because of their divergent perception compared to adults. Problem supporting this research content is children’s cognitive skills on solving educational critical thinking problems are diminishing due to lacking of adequate elements while designing educational mobile application. Hence, this paper aims to develop and validate EduMobile UX model for children educational mobile application which could be adopted as well adapted by designers while designing the application. This objective considers to answer the research question, “what are the identified elements of UX in designing children educational mobile application?”.

## **2 Literature Review**

### **2.1 User Experience**

#### **Introduction to UX**

UX is a well-defined consequence of presentation, functionality, system performance, interactive behavior, and assistive capabilities of an interactive system for hardware as well as software [4]. UX has evolved into one of the core concepts of HCI where wide range of disciplines’ researchers and practitioners daily work on these concepts. According to ISO 9241-210 [5] UX is a person’s perceptions and responses resulting from the use and/or anticipated use of a product, system or service. Furthermore, UX is also a consequence of brand image, presentation, functionality, system performance, interactive behavior and assistive capabilities of the interactive system, the user’s internal and physical state resulting from prior experiences, attitudes, skills and personality, and the context of use. Despite several attempts of understanding, defining and scoping UX, no secured consensus has been reached on this concept [2]. Donald Norman was the first author who used the term “User Experience” to describe all the person’s experience aspects with a system and he claims his introduction to the term UX as he believed “usability” to be narrowed deeply for representing a holistic vision of HCI [2]. According to Jacob Nielsen and Don Norman, UX encompasses “all aspects of the end-user’s interaction with company, its services and its products” [3] yet not all associated with UX have agreed on this definition [6].

Generally, developers who are interested in UX design, not only focuses on what the product does but on how the users tend to interact with it. Thus, a positive experience requires substantial benefits to users and a negative experience entails frustration and failure [7]. Section below describes the existing designs when designing mobile application.

### **Theories Involving Software Design for Children**

According to [1], there are many theories which concerns designing software for children which are: (1) user-centered design (UCD), (2) contextual design, (3) participatory design, (4) cooperative inquiry, (5) informant design, (6) learner-centered design, (7) constructional design, and (8) interaction design. UCD involves user indirectly in the software design but only the designer is allowed to control the design process. Contextual design refers on the required information, users daily activities and software goals. This model is suitable to design child-centered context [1]. Participatory design was not used for children because designers think children cannot deliver useful ideas and opinion when designing [8]. Cooperative inquiry refers to the methodologies carried out which are observation, questionnaires and children involvement in the design but it is best to be applied with students aged 7-10 years old [1]. Informant design appreciates the involvement of children in the design because designers believe that it leads to a funny and intuitive design [1]. Constructional design allows users to build their own preferred design based on the allocation of the application. Thus, this model is also controlled by the designer at the end. Interaction design defines the behavior of certain products and systems in response with the users [1].

Fadel had developed a model called Experienced-Centered Web Design Model [9], where he has done a comparative study on UX's axes then, associated with the similarities between categories and dimensions and finalized it into three dimensions which are emotional, aesthetic and functional. The emotional dimension defines the emotional responses and interaction which occurs when a user is using the system [10]. The functional dimension defines the interface role (features) in the general context of the system [11]. Aesthetic dimension defines about the visual and interaction design principles, where the interface planning, creation, evaluation, and communication takes place [12]. Even though the model name represents web but it is easily adaptable in mobile application designs. International Organization for Standardization (ISO) has produced many usability models but none covers all the aspects of usability [13]. Thus, all these above models discussed above does not include and utilize all the required elements which are needed to provide best user experience for children while using educational mobile application. Next session discusses on the importance of including all the user experience aspects.

### **Elements of UX**

This study compares the elements of UX discussed by several authors to address the importance of including cognitive dimension in designing mobile application. Each of the elements play an unique role in their respective fields. The user interface design or aesthetic plays a role of best interaction of beauty [14] for users in order for them to accept the application because their dislikes could lead to anxiety or discomfort [15]. A fun as well as engaging interface design has motivated more students in learning [16]. The importance of functional dimension has been claimed as the clients' needs in relation towards the interface [9]. It is necessary to anticipate the use of a product or a system through a user's perception and responses [17] towards engaging as well as fun experience [16]. Functional elements are able to compare and contrast the users'

convenience, features and design of product [18] to attract targeted group of users for sustaining their loyalty [19].

On the other hand, the emotional elements creates its importance in UX by character interactivity users towards an interface and to what extend they can react to a user's interventions [9]. It is crucial to stress on this element due to users' complex and mixed feelings of emotions [17] during the interaction with the system or product [20]. The interaction between a user and the system may lead to unique experience in different context of use [21] which includes users perceptual and emotional aspects [4]. Cognitive defines level of ability which demands to master a specific information and technology literacy creatively as well as using innovative skills [22]. The representation of cognitive element in designing a system is important because it portrays a paradigmatic shifts of how a user anticipates about the interface [6] and the results will then represent usability of a system, product or service [17]. Nevertheless, cognitive helps to reduce complexity of an experience [4] by directing them to a right path of using the system [23]. Nevertheless, cognitive inclusive enhances users imagination and improves their behavior [24]. A systematic literature review was conducted to identify the UX elements required to be included in designing educational mobile application for children aged 10 – 12 years old. **Table 1** describes the researchers who have highlighted the elements and its importance to be included in designing mobile application.

**Table 1.** UX elements supported by researchers

Elements	Researcher
Effectiveness	[15], [17], [21], [24], [25], [26].
Efficiency	[15], [17], [21], [19], [27], [26], [28].
Satisfaction	[15], [21], [19], [18], [29], [26], [30], [31], [32], [33], [28].
Gesture Interaction	[34], [35], [11], [26], [30], [36].
Learnability	[21], [37], [22], [26], [31], [32], [38].
Memorability	[34], [21], [19], [26].
Convenience	[6], [19], [18], [24], [26].
Responsive	[6].
Animation	[6], [17], [27], [24], [39], [35], [40], [26], [33].
Discoverability	[34], [6], [19], [35], [26], [38].
Colours	[6], [17], [16], [27], [39], [35], [40], [41], [36], [33].
Enjoyment	[17], [21], [19], [18], [42], [26], [28].
Attractiveness	[17], [24], [26], [28].
Text	[17], [16], [27], [39], [40], [26], [30], [41].
Audio	[17], [16], [27], [39], [35], [42], [40], [26], [41], [33].
Complexity	[17], [21], [27], [24], [37], [39], [22], [26], [38], [33], [28].
Engaging	[16], [21],
Motivation	[16], [21], [18], [37], [39], [25], [26], [41].
Usefulness	[16], [18].

Comfortable	[19].
Technology Fit	[19], [18], [24], [39], [11], [26], [30].
Pleasure	[19], [23], [36], [28].
Simplicity	[27].
Collaborative	[24].
Interactive	[2], [24].
Innovative	[37].
Conceptual	[39].
Flexibility	[11].

The elements were chosen based on number of researchers highlighted it in their study and which could be adopted while designing a standard educational mobile application for upper primary school children. The elements chosen are later discussed in the next chapter.

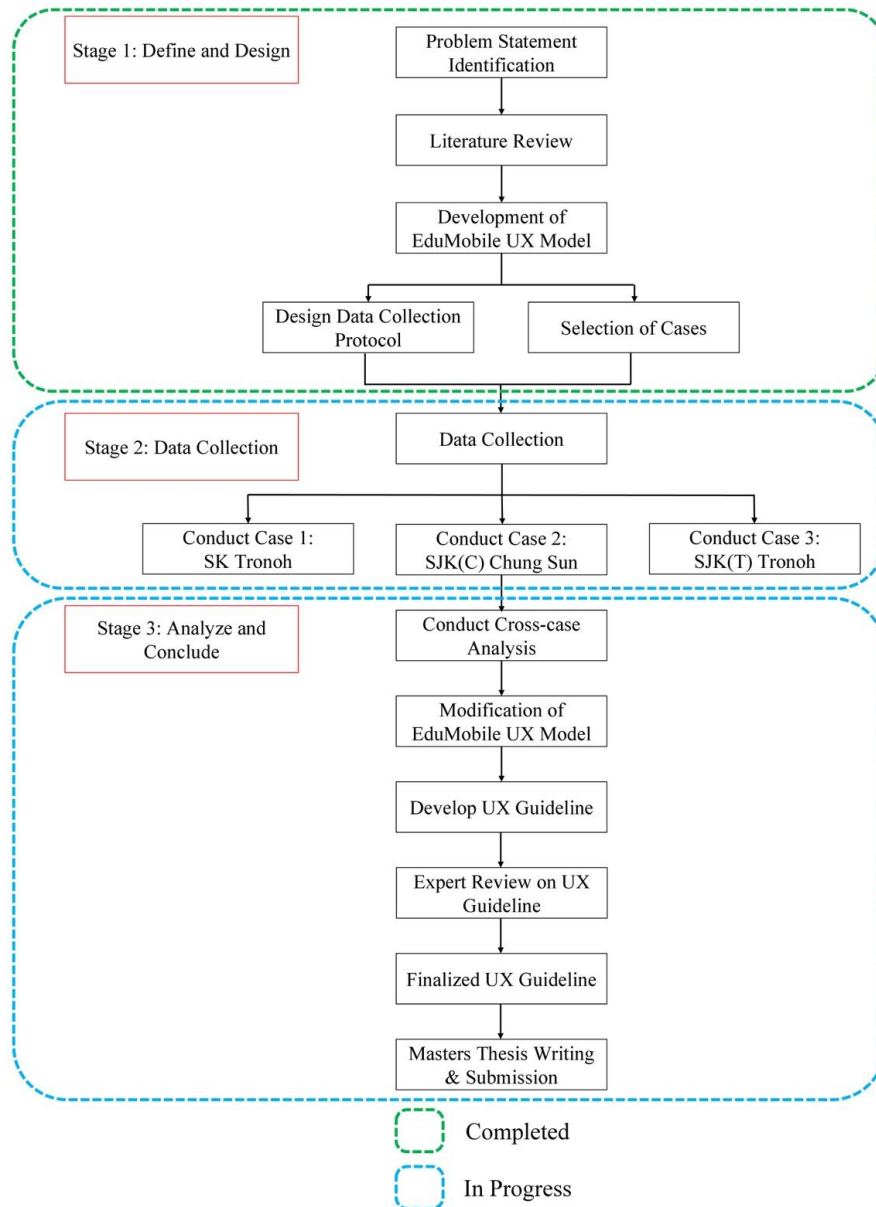
## 2.2 Children of Children Mental Development

Cognitive development initially was introduced by Jean Piaget, developmental psychologist. He explains that there are four basic concepts to elaborate the individual's cognitive structure activity process which are schema, assimilation, adaption and balance [43]. Cognitive development refers to the lifespan development of thinking. Thinking has unclear boundaries which differs from other mental activities yet it involves higher mental processes such as problem solving, reasoning, creating, conceptualizing, categorizing, remembering and planning [44]. One of the most influential theory of cognitive development are Piaget's Theory of Cognitive Development.

Piaget's theory often focuses on the children's progress by referring to the development stages qualitatively [44]. According to Ellin Kotsky, Piaget's Theory occupied middle ground of two-level psychological function explanation. However, many researchers claim that Piaget and his challengers deliver different, pending perspective of the similar issues which has to be incorporated into cognitive development model [45]. In cognitive development, Jean Piaget's theory describes that children undergo through four mental development stages [46]. This theory not only focuses on understanding the way children obtain knowledge yet understanding the nature of intelligence. The stages in Jean Piaget's theory are sensorimotor stage (birth – 2 years), preoperational stage (2 – 7 years), concrete operational stage (7 – 11 years) and formal operational stage (12 years - adult). This research focuses on children ages 10-12 years old thus, concrete operational stage is discussed in this paper. This stage goes through logical thought of development [46]. It is discussed that children at this stage are concrete, their thinking involves logical and sophisticated in their thinking in this stage. Normally, children practice solving logical problems in their mind. Hence, the feedback from the application is the key that indicates performance changes in children and provides more interest in using it.

### 3 Methodology

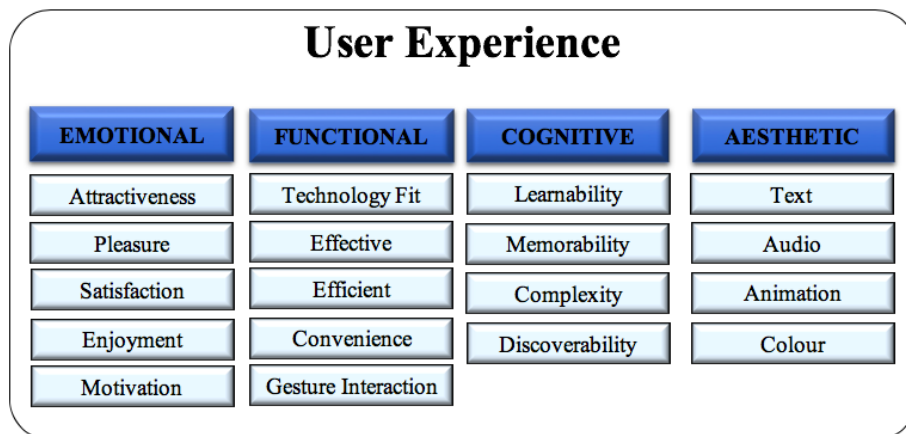
The methodology will be implementing in three sequential stages. The **Fig. 1** illustrates the stages with the following outcome.



**Fig. 1.** Research Activity

### Stage 1: Define and Design

Several research papers have been reviewed for developing UX model. This research has looked into the importance of UX elements and dimensions (functional, aesthetic, emotional and cognitive) which needs to be considered while designing an educational mobile application for children. After reviewing all the studies in previous chapter, this research develops EduMobile UX Model which incorporates all the relevant aspects of usability, user experience and ISO9241-210. This model has all the necessary elements which needs to be incorporated when designing educational mobile application especially for children aged 10-12 years old. **Fig. 2** describes the elements and dimensions included to complete the experience of a user.



**Fig. 2.** EduMobile UX Model

### Stage 2: Data Collection

The research will be using a qualitative exploratory case study method by Robert Yin [47] to conduct the research. The research adopts purposive sampling where some criteria has been developed in order to select the sample or cases. The criteria are (a) similarity in Science syllabus, (b) government funded schools (sekolah kebangsaan), (c) each schools should teach lessons in different language since, Malaysia is a multi-national country and, (d) school population should be less than 30. Thus, the schools (cases) chosen for this research are SK Tronoh, SJK(C) Chung Sun and SJK(T) Tamil. This study's unit of analysis will be the mobile application used in schools during observation session. The mobile application version used is Android and the mobile application is "Environment Current Affairs 2018 (offline)". The application used in this research is selected accordingly where the content in the app contributes with the "*Kementerian Pendidikan Malaysia*" syllabus, English language settings, Google Play ratings and this app is poor in user experience design. The data collection method will be conducted through semi-structured interviews based on the model developed and observation. Students will be the respondents of the interview as well as the observation session since, they are the audience who will be engaging to the mobile application.



Since, children participate fully in designing the technology, they have the most privileges as design partners. Furthermore, children have many positive ideas that can support the process of the application design. The result from the data collection will be validating the EduMobile UX Model.

#### Stage 3: Analyze and Conclude

This session will be analyzing the respondents results through Atlas.ti. The outcome from the analysis will be used to develop the UX guideline by adapting the final version of EduMobile UX Model. The guideline will then be evaluated by mobile application expert. Later, the guideline will be presented to the designers for referral purpose while designing educational mobile application for children. The guideline will be contributing in researchers master's thesis.

## 4 Conclusion and Future Work

Mobile learning practice is growing tremendously among children but similarly children's cognitive skills tends to be unpleasant. Therefore, designing an appropriate mobile application for children while improving and maintaining their thinking skills is crucial. User Experience of a child differs from an adult experience thus, providing the accurate elements for designers as a guide to design educational mobile application is important for them to understand children's thinking ability and produce sufficient mobile learning experience. This paper focuses on developing and validating EduMobile UX Model for children educational mobile application which tends to focus on solving the problem statement above.

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