DLMA_NEU: Digital Literacy Mobile Application for Children

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Abstract—This paper presented the design and implementation of DLMA_NEU, a digital literacy mobile application for Android that targets children between ages 7 and 18. It is a developmental study aimed at designing a digital literacy mobile application. The study was conducted in three phases: (1) literature review, mobile application store search, and interviewing experts in children's digital literacy; (2) smartphones app development; and (3) accessing the functionality and usability of the app. Thirty students from Near East College and five experts on mobile app development and e-learning provided qualitative and quantitative data used throughout the research process. The app is the first digital literacy mobile application to support the Turkish language, considers children's opinions during the design phase, and is interactive. For application use, a child is required to register first. Furthermore, the application currently supports two languages (English and Turkish) to provide representation. The application supports chatting with friends and educates children (via videos, text, cartoons, and jokes) on interacting online. The application also serves as an avenue for children to report cyberbullying and other online issues and acquire internet usage habits.

Keywords—children, digital children's rights, digital literacy, mobile application, e-learning, internet mediation

1 Introduction

Mobile applications (mobile apps) are designed to run on mobile operating systems [1]. These applications are made available through the application stores and have provided a significant opportunity for developers and designers. Depending on the type of mobile app, users can download the application via a specific platform for free or at a low cost. These applications are becoming an essential part of human life, particularly for children, and are now becoming the most convenient and effective means of communication [2]. However, smartphone owners face a dilemma: among the millions of mobile apps to choose from, mobile applications are now offered by various outlets,

from local stores to large corporations. Unsurprisingly, this phenomenon has given rise to a significant shift in our day-to-day activities, including social interactions.

According to statista.com, over 11 million mobile applications are shared across the application stores, with over 197 billion downloads. Techcrush.com reported that customers use an average of 9 apps daily and 30 apps monthly. The progressive growth of these mobile apps and the number of children using them highlight the importance of developing a child-friendly mobile application considering that adults and children differ in multiple areas. Hence, there is the need for developers to pay special attention when designing the applications. For instance, children's cognitive ability needs to be considered while designing interfaces to ensure that children are not forced to make complicated navigation [3]. At the same time, studies have shown that children are very concerned with customization and visualization [4]

A growing number of online communities exist for children. Despite the challenges faced by both designers and policymakers regarding safe online interaction for children, most of them only promote one-way posting, such as www.cartoonnetwork.com, www.backyardjungle.com, www.habbohotel.com [5]. Therefore, this research aims to design and develop DLMA_NEU, a digital literacy mobile app for children to interact, chat, share ideas, and learn how to stay protected online.

This research is classified into seven sections: the introduction, which presents and gives preface of the work; the objectives of the study; the problem description; methodology; literature review; the system under which the phases, as well as the procedure for the design, were described; implementation and testing; the result were the app is presented; and finally, conclusion and recommendations.

2 Objectives

This section states the intended outcome, which comprises the component goals to achieve at the end of the research. As technological acceptance keeps rising [6], it comes with the need to investigate the kind of support leaders and policymakers provide to assist children in managing and adapting to these global trends and learn internet usage habits to make them more resilient online. The main objective of this research is to design, develop and assess both usability and functionality of DLMA_NEU, which, if implemented judiciously, will help researchers, educators, and policymakers in understanding internet usage habits as well as risks encountered by children online and in the same vein make the children more resilient and conscious of their internet usage habits. The specific objectives of the research are:

1. To develop the DLMA_NEU application
2. To assess the usability of the DLMA_NEU application
3. To evaluate the functionality of the DLMA_NEU application
4. To appraise the potency of the DLMA_NEU application in influencing children's internet usage habits.

3 Literature review

The following paragraphs present the review done on literature regarding smartphones and mobile apps. A smart device or mobile device is any ubiquitous, autonomous, and portable device like smartphones, tablets, iPad [6]. It also refers to any device that is small, easy to carry, and can be used for some form of learning. Therefore, mobile learning refers to mobile devices that ease learning [12], reducing formal and informal education [13]. The unique properties of these smart devices as catalysts provide an excellent and convenient avenue for teaching and learning processes [6]. Large bodies of research show that smart mobile devices, particularly tablets, are being used by both educators and learners around the globe to facilitate learning and access information in new and innovative ways [14]. Various multinational organizations like UNESCO believe that these technologies can improve learners' educational opportunities in multiple settings [15].

Traditionally, formal education has been restricted within the classroom walls, but today, smart mobile devices can foster learning in environments that maximize understanding [13]. Enormous advantages have been linked to children's use of these mobile devices for learning [16]. Among them are student-oriented teaching and learning context and the progressive use of mobile devices among children [17]. Smart devices were introduced to primary schools and colleges to encourage more participation in cooperative learning activities and stimulate children's interest in the learning process [18]. The massive increase in the ownership of phones, tablets, and laptops and the increased access to the internet by children indicate the remarkable role digital technologies now play in the lives of children [19]. Children are now developing in a world where digital communication is often regarded as face-to-face interaction. While contemporary parents see a clear distinction between offline and online environments, the two environments are seamless or merged from children's perspectives. Things that only previously happened in the physical world are now increasingly happening online through blogs, websites, chats, etc. Children are now redefining friendships and methods to access friends, which has resulted in a considerable increase in the number of institutions employing digital technologies for both teaching and learning [20], which keeps motivating various actors (NGOs, companies & governments) to donate PCs and tablets to schools, with the expectation that they will play a vital role in connecting children with their mentors and also develop new digital skills in the process [21].

The evolution of wireless technology like smartphones has brought about massive lifestyle changes, including but not limited to learning, by providing instant, flexible and ubiquitous access to knowledge. This accessibility and ease of use of smartphones make it easier for children to explore the world and expose them to wide-ranging risks [12]. Despite the enormous advantages of educational applications, the adoption of smart devices or digital applications as instructional mediums largely depends on whether mediators consider the app to meet their children's peculiar needs [22]. According to multiple kinds of research, another reason for adopting an application is previous ICT experience and the level of ICT exposure [17].

3.1 What do children want, and what do they not want?

Children are significantly different from the majority of the designers who are adults [4], and therefore their needs also differ when it comes to mobile applications. These needs have often been overlooked in developing new technologies [23], which has failed many programs like mobile4girls in South Africa [24]. According to Komlodi et al. [25], Callaghan [26], and Papadakis [27], children need the following in their mobile applications:

- Customization and visualization of tools and materials; for example, children search (either by type or clicking visual icons) to modify colours and graphic interface.
- Special provision to share images and questions template where the need may arise
- Design in local language with images which they are familiar.
- Children find applications that are playful often appealing.
- Children find pop-ups that are pornographic upsetting online, although nothing was said concerning pop-ups that are non-pornographic.

4 Problem description

Under this heading, the problem that calls for addressing through this research is stated descriptively. Social interaction is an integral part of human life, children inclusive; it is an important phase in children's overall development. Children start developing their senses and learning through social interaction. Today, social interaction is undertaken digitally, where children can now associate and collaborate with the entire world with one click. While this gives a massive opportunity for the children to network, expand their views and increase their knowledge of the world, it also comes with considerable risks.

The blind nature of the internet [7] and the lack of local content and representation have made children of the Global South engage in riskier and less-productive use of the internet. As soon as they have access to the internet and a browser or other digital devices, these children log in to Facebook, YouTube, or other social networks [8] without considering that these mediums might not target them, especially those under 13 [9]. This makes designing policies for applications that will improve children's resilience to risk of harm and promote the productive use of the internet among children in the Global South necessary. This research sought to answer the following questions:

1. Is the DLMA-NEU usable?
2. Is the DLMA-NEU functional?
3. How does engaging with the DLMA-NEU influence children's internet usage habits?

5 Methodology

This section describes the design procedure, the instruments used, the procedure for data collection, and the research limitations.

5.1 Method

This research is a developmental study in which the result would be DLMA_NEU. This digital literacy mobile application aims to increase children's digital literacy by posting videos, images, cartoons, and notes on children's online behaviour (the do's and don'ts) while allowing the children to interact among themselves. It also presents an avenue for mediation where children can report abuse and risky behaviours and seek advice.

5.2 Procedure

Before commencing the planning and design process, the following steps were taken:

- Market survey: the researchers searched all the mobile application stores using keywords, such as Turkish app, educational app, digital literacy app, and children's app. This process was undertaken to determine the existence of similar mobile applications to avoid duplication.
- Experts' and Users Opinions: the opinions of experts in the field of mobile application development, particularly teachers (at universities and colleges) and children, were sought before, during, and after the design process to ensure that children's needs are met using a simple, user-friendly and attractive design since children are known to prefer visualization and customization [4];[2].
- Also, Teachers play a vital role in classroom implementation of new technologies [10], playing a significant role in its success or failure. This, therefore, justifies teachers' involvement in both the design and trial phases of this application.

The following procedure was repeated multiple times during the application development to ensure user specifications were met.

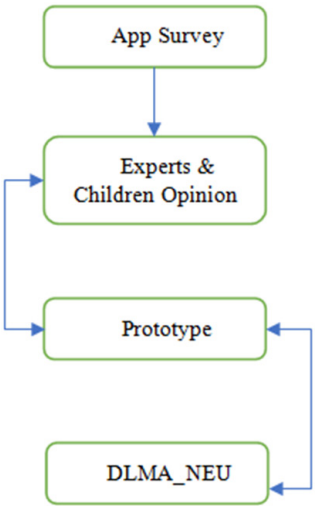

Fig. 1. Showing the search criteria

5.3 Measurement

Although this research aimed to develop DMLA_NEU, specific measures were employed before reaching the desired goal. Among which are:

- A mix of qualitative and quantitative research instruments (interview and questionnaire) were designed and administered by the researchers to generate data on the needs of children with regards to mobile applications and digital literacy and assess the system functionality.
- The instruments were subjected to validation by experts from computer education to establish validity.
- In order to measure usability, the researchers adopted a usability scale by Meccawy et al. [11].
- The responses were coded and analyzed using IBM SPSS version 21, and a 0.05 significance level was adopted in all cases.

5.4 Samples

The sample was collected in Turkey, where thirty (30) children from Near East College took part in the study after the research ethics committee of TRCN approval was obtained. All participants have owned an android phone for at least a year and have been using social media platforms.

6 Limitation

Despite the rigorous procedure employed while conducting this research, the authors are aware of certain limitations. The findings were based on a specific target group in the same school, and the sample size used in testing the app was also small. Another limitation to this research is that not all students are capable of individualistic learning, and, as rightly pointed out, the dropout rate is high when it comes to online learning. App Survey Experts & Children Opinion Prototype DLMA_NEU.

7 The proposed system

The authors considered some factors during the design process, the app's organization, and the implementation and testing phases. The aim is to develop DLMA_NEU, a digital literacy mobile application for children. The purpose of the app is to increase the online resilience of the Turkish Republic of North Cyprus children to enable them to make use of the online opportunities at minimum risk. Security is the primary target of this app, so designing a native mobile application on Android is preferred (Android being the most used mobile operating system used in North Cyprus [28]).

7.1 Design consideration

Before describing the design and implementation processes of DLMA_NEU, it is of paramount importance to state the limitations and challenges faced when developing the

application. These challenges and limitations have impacted the design, development, and implementation of DLMA_NEU. For any online community to succeed, special attention needs to be given to usability (effectiveness and efficiency of the interaction) and sociability (quality or meaningfulness of interaction between members) [29]. The children's critical thinking and technical skills were taken into cognizance. For instance, how effective are they with a keyboard and mouse, their level of exposure to technology and technical vocabulary, and their ability to navigate complex instructions?

While designing the interface, significant consideration was placed on children's cognitive abilities [30]; [1], where icons and names were used to guide navigation across the app, and the content included many videos and images for children with low reading skills. Due to the needs of children, special consideration was also placed on visualization and customization of the application [31]; [32], such as the images used and the application displayed. Emphasis was also given to member-to-member and member-to-admin interactions and vice versa by providing prompt replies (where necessary) to children's inquiries. Perhaps, the most important consideration was children's data and information safety.

7.2 Planning

The ever-progressive nature of the mobile application market and the complexity of digital devices work together to make the mobile application development industry with significant potential, which is now becoming the mobile communication support system [33]. Users of mobile applications now expect quality applications in terms of content delivery and design, which can be challenging as people are now highly dependent on these applications. Ensuring an application meets all its requirements with high-quality formal reviews and intense testing is needed before delivering it to users. The main objective of planning is to guarantee that innovative design requirements, mobile technology, and product creation objectives are addressed accurately and conveyed to each team member [34]. For this reason, the planning started with the application layout, which incorporates user experience design, strategy planning, and estimate planning.

7.3 System design and development

Mobile Application Development is a complex process that requires multiple developmental stages and testing and implementation. According to Flora, Wang, and Chande [34], for the designers to provide an excellent solution, they should create simple design consuming as little resource as possible with associated appropriate basic architecture for the mobile app". According to some designers, the best method to achieve this is to build a layered application, in which there would be consistent functionality across platforms while at the same time the feelings and look requirements of each platform are satisfied. This stage creates the look and feels for application users, mockup screens, and visual design view. It also helps save time for the implementation stage. As Flora, Wang, and Chande [34] proposed, this stage contains architecture, including creating initial mockups and prototypes, creating the security and step models of the user interface, and design specifications, including model-level design.

Flora, Wang, and Chande [34] emphasized that "to create a phenomenal mobile application, one needs to begin by identifying the initiatives, goal, purpose, problem as well as the audience the application targets." To present the conceptual idea, the idea was sketched on a piece of paper as recommended by Wong et al. [1], with particular consideration given to display and screen layout, icons, and menus. Ensuring that pages do not contain too much information is vital as excessive information may make the pages cluttered with redundant information making it hard to focus or read considering the screen size of smartphones [35]. Chats functionality is also added to provide interaction in any mobile application that targets children [36] and improved response time [37].

7.4 System organization

Below is a summary of the organization of the system, the kind of input the system will accept, the process, and the expected output, as suggested by Nawaila, Ozamli, and Kanbul [38]. The user registers his/her information after downloading the application, which immediately creates a profile for them. This provides the user with access to the home page. If the user is above 18 years of age, he/she will automatically be rejected. Those under 18 years of age will have access to videos, text and can report abuse or potential abuse. The developed DLMA_NEU architectural design is described in Figure 2, and the system flow chart is shown in Figure 3.

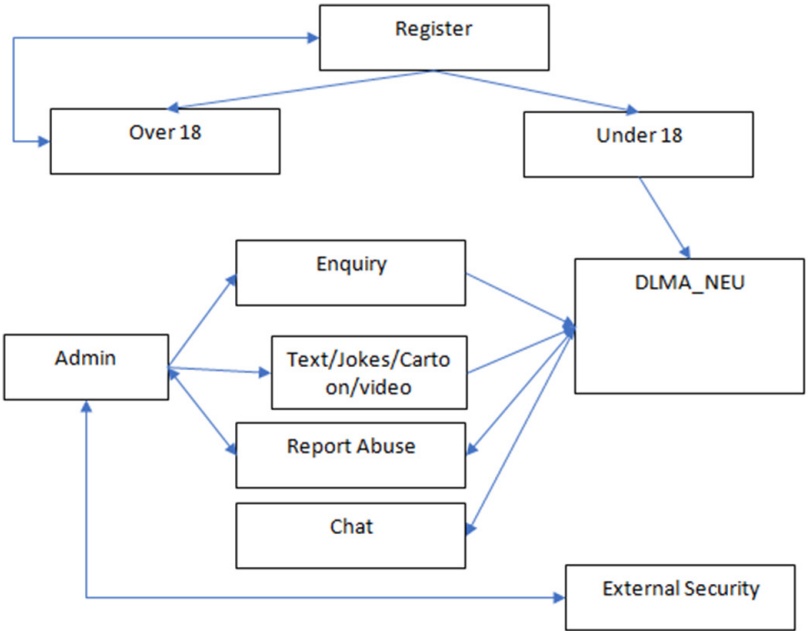

Fig. 2. Showing DMLA_NEU architecture

The system is divided into four (4) stages in conformity with Ilgen, Hollenbeck, Johnson, and Jundt [39], where the system has input, process, output, and feedback stages.

7.5 Development

In conformity with Flora, Wang, & Chande [32], the development stage commenced by breaking the project into units and writing the codes, while unit level testing was followed. A child must register first and provide representation; the application currently supports two languages (English and Turkish). The application supports chatting with friends and training children (via videos, text, cartoons, and jokes) to behave online. The application also serves as an avenue for children to report cyberbullying and other issues they are facing online and, at the same time, make inquiries on online usage habits.

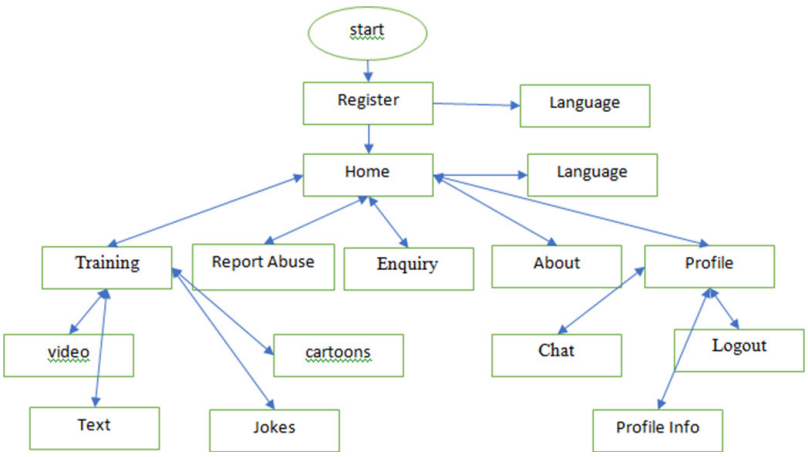

Fig. 3. Showing DMLA_NEU flow chart

8 Result

This section presents the app, the interfaces, the windows and how the app operates, unit testing, and the outcomes.

8.1 DLMA_NEU

The application is divided into two (2) parts: the administrative dashboard and the client window.

8.2 Initial design based on researchers perspectives

Client window (Initial design). A user first encounters the registration window where he/she can either signup (for new users) or sign in for returning users. This will take them to the default page, where he/she can either select his/her profile (which will automatically take him/her to the profile page, chats, logout or back to the default page), Home (which transfers him/her to the page where he/she can view videos, cartoons, jokes or text about digital literacy), Report Abuse (where he/she can report problems he/she has encountered online), Enquiry (where he/she can ask questions and make enquires about digital literacy) or About (where he/she can read about the developers, Near East University or TRNC). start Register Language Report Abuse About Profile Chat Inquiry Logout Training Home Language Text Jokes Profile Info video cartoons. Note that the administrator will send all videos, cartoons, and jokes via the admin page, and reports and inquiries will also be sent to him.

8.3 Result after expert opinion/suggestions

Client window (Final design). The initial interface of the client window was later changed after multiple consultations with children and leading authorities in the field of educational technology, computers, human interaction, and mobile application development. All those consulted unanimously disapproved of the first interface as they believed it was too complex for children. One of the experts stated: "I think children will find this complicated; for instance, I do not think there is any need for a home key." Another expert stated: "I think it is OK for research purposes, but to put it into practice, the interface of the client window needs serious adjustment."

The administrator goes direct to the default page from which he/she can either go to the Home page (where he/she can send videos, texts, cartoons, plain text to the clients or go back to the default page), profile (where he/she can view the users' list), Report abuse (where he/she can view all complaints sent by the clients for further action) or Enquiry (where she/he can see all the question asked by the client and if possible send answers). It is worth noting that the DLMA_NEU employs the services of firebase live chat, firebase cloud (formally known as Google Cloud Storage) for storage, and firebase real-time database DLMA_NEU was designed for children aged between 9 and18 years old. One of the limitations of DLMA_NEU is that although only children aged 18 or below can register, it cannot be guaranteed that only those age brackets do indeed register as anyone older than that can easily register by faking his/her date of birth.

8.4 Design phase

Since the application is an e-learning application, there is a need to pay more attention to interactive features. Hence, the application incorporates a user interface and admin interface. Database Design to store and encourage instructiveness, firebase services were employed. Firebase assists software developers in building real-time, collaborative applications being an API that synchronizes application data across iOS, Android, and Web devices and stores it on firebase's cloud. Since the application is an e-learning application, there is a need to pay more attention to interactive features. Hence, the application incorporates a user interface and admin interface.

8.5 Data base design

To store and encourage instructiveness, the services of firebase were employed. Firebase assists software developers in building real-time, collaborative applications being an API that synchronizes application data across iOS, Android, and Web devices and stores it on firebase's cloud.

8.6 Implementation phase

The implementation or coding phase is where all the back-end development is carried out. To develop this application, the researchers used java programming language, while the android studio was used as a designing tool and firebase was used as the database.

8.7 Testing

Both virtual and actual testing mechanisms were employed for the application, where functionality, specifications, and requirements were tested using experts on both mobile applications and the children themselves. Special consideration was given to testing real devices, especially for usability and functionality with real users in the project.

After uploading the DLMA_NEU prototype onto the platform (Android), a functionality and usability assessment was conducted to ensure the desired target was met.

To make DLMA_NEU successful and attract children's patronage, an appealing user visual interface was designed (since visualization is an essential mobile application requirement for children [5]), and chats were also added (since enhanced functionality and usability makes mobile applications more successful [1].

8.8 Usability testing adopted from Meccawy et al. [10]

The application was tested on genuine users to test usability and functionality by assigning tasks. Usability was helpful in the error discovery, whereas functionality helped assess application validity and users' needs.

8.9 Results of the usability test

Table 1. The usability test results

Measures	Percentage
Clear Application	85%
Users like to use the application again	71%
Buttons were well organized and easy to find	71%
Users like the colour of the application	57%
Design for data entry is flexible	86%
Application is simple to use	100%
It is easy to learn how to use the application	86%
The application gives error messages that clarify how to fix the problem	86%

8.10 Functionality of the app

The standard functionality of the application comprises of Sign up, log in, Homepage, User profile, Report Abuse, Enquiry, My Chat, Language, Training, Videos, Cartoons, Jokes, and I want to read.

9 Conclusion

Digital technologies like smartphones are gaining more acceptance due to their internet connectivity, size, solid computational capabilities, and mobile applications [40]. These mobile applications change users' smartphone utilization and experiences [41]. They are vital tools in children's lives regarding inclusion, expression, socialization, and education. Nevertheless, their usage can bring about the risk of harm [42]. This progressive increase of low-cost mobile devices and the associated infrastructures such as the internet and mobile applications presents both risk and opportunities. These technologies have significantly changed how individuals access and process information, and multiple studies have shown that access to services has improved. Although, most of these studies focused on the needs of adults [25].

Hermes [43] stated that the information age had brought forward different citizens with distributed responsibilities and different perspectives. Applying restriction to time spent online to prevent cyber victimization and cyberbullying is practically infeasible because of the digital nature of children. This makes the development of means that attract the children's interest very importantly.

This study presented the development of DLMA_NEU, a smartphone application, to enhance digital literacy among children. DLMA_NEU is a mobile application that makes digital literacy fun and enjoyable by providing videos, audio, cartoons, and texts on how to behave online while incorporating chats. It also serves as an avenue for children to complain about unwanted or questionable activities they encounter online. Children can also ask questions about online behaviours as DLMA_NEU mentors and guides Turkish children. This research work builds on Nawaila et al. [12] to design and develop DLMA_NEU, a mobile application that will enhance children's digital literacy to reduce their online risk. DLMA_NEU came into existence based on the need for securing and enhancing children's safety online and was found to be usable and functional and positively impact the user internet usage habit as reported by the users.

As application developers, the aim is always to produce applications that provide valuable user experiences, reliability, efficiency, and effectiveness. Therefore, the researchers ensure that the application addresses societal and parental needs in terms of digital literacy. Therefore, it is recommended that teachers, parents/guardians, and policymakers encourage children to frequently use DLMA_NEU as digital literacy to reduce the risk [44]. This mobile application can be enhanced in several ways. For instance, audio and video calls and group chats could be added, while an iOS version or an adult version could also be developed. The effectiveness and efficiency of the application will be left for further research.

Smart devices as the preferred communication tool for children have caused the development of various applications for children. Nevertheless, despite the explosive

adaptation of the apps, research to assess whether they are attuned to the target children's needs [45] is limited. Applications that target children will continuously be released, with the majority claiming to be educational, and many of these claims are unsubstantiated [46].

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