Multimedia Application to Improve the Cognitive Skills of Preschool and Kindergarten Children

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Abstract

Multimedia provides different alternative methods to give lessons especially for children who like more playing, and children with concentration problem. The purpose of this research was to design a framework and an interactive multimedia application for Ethiopian preschool and kindergarten children education system so that small kids can easily learn lower level cognitive skills (identifying, recalling, arranging, sorting, etc.) with a sense of play and fun. As a result of this, children can build strong positive attitude towards learning from their early age. In doing this research, first existing multimedia applications to children education were studied and determinant factors of children in multimedia learning were identified. A multimedia system called PKLS (Preschool and Kindergarten Learning System) was developed and observational list, questionnaire and interview were prepared. Then the PKLS system functionality was tested and its effectiveness evaluated.

In the PKLS system English letters, Amharic letters and human body parts were included and the system interface was built using different colors and shapes in Amharic and English languages. Six preschool and kindergarten aged children who did not join any preschool or kindergarten before were selected and they have been divided into two groups purposively. Our evaluation result shows that monotonous learning materials reduce the children's willingness to stay on learning while the developed PKLS improves the children attention, focus duration, learning performance and sense of play when it is compared to the traditional learning.

Keywords: Cognitive Skills; Determinant Factor; Kindergarten; Multimedia Learning; Preschool

1. Introduction

Education is one of the fundamental factors of development. It improves humans' understanding and the quality of their lives. Learning begins from the moment a child is born and continues when the kid joins kindergarten. The kind of early children education that we give plays a fundamental role for higher educational success [1]. Active engagement in learning is an important factor towards improving learning process [2]. Researches demonstrate that the earliest years of a child's life are crucial period of biological, neurological, psychological, social and emotional growth and change. Well-planned early education can have long term positive outcomes for children [3].

During the preparation of learning resource; characteristics of children, learning capacities and cognitive thinking abilities of children should be considered [4]. Studies show that children enrolled in high quality early childhood education are subsequently more likely to complete higher levels of education, have higher earnings, be in better health and relationships, and are less likely to commit a crime or be in prison [1].

The quality of the education depends on the availability of resources in the school, and the performance of children lies on the teachers' knowledge, skill and attitude. Schools which can have qualified teachers, interactive teaching and learning materials, comfortable school compounds and playing grounds can provide quality education for kids [5].

The quality of children's preschool experience, the preschool and kindergarten readiness to teach kids, quality of early education environments, family resource and support affect the children's future

study and life [6]. The cognitive theory of multimedia learning dual channels (humans possess separate channels for processing visual and auditory information) has limited capacity (humans are limited in the amount of information that can be processed in each channel at one time). Humans engage in active learning by attending to relevant incoming information, organizing selected information into coherent mental representations and integrating mental representations with other knowledge [7]. Students' attention is guided towards relevant ideas or concepts through the inclusion of signals or cues, such as when a student views an animation based tutorial describing airplane flight with concurrent narration that emphasizes important ideas by using a slower and deeper intonation of voice, learning and performance improves [8].

The current Ethiopian children education providing techniques lack multimedia interactivities. Due to this, children become bored and hateful towards learning [5]. As different findings show, children cannot focus for a long time in mono type learning resource; instead they like playing & fun [7, 8]. In addition different researchers concluded that educational achievement is strongly influenced by the attitude of children towards learning, and these attitudes start developing from an early age [9]. Taking this into account, the objective of this research was to design a framework and an interactive multimedia application for Ethiopian preschool and kindergarten children education system. The main focus of the research is improving children's cognitive skill learning related problems by avoiding monotonous learning resources. It helps the children visual and auditory focuses through different mental stimulations such as creating colorful and attractive user interface.

2. Method

Different literatures were reviewed to understand the application of multimedia system, to know basic principles and determinant factors of multimedia learning before developing the multimedia system. Different literatures in the domain area were seen to identify the existing multimedia technologies. Ministry of Education in Ethiopia, preschools and kindergarten schools, teachers, parents and kindergarten and preschool aged children were the main sources of data. Non-probability purposive sampling was used to select schools and teachers to collect the system requirements and to gather learning outcomes.

During the experiment, a total of six children were from Addis Ababa were taken with the age range of 4-5 years. All samples did not start school when the experiment was conducted.

Both qualitative and quantitative data were gathered through interview, questionnaire and direct observation. An interview with the concerned body from the Ministry of Education was conducted, but unfortunately we were unable to get the surrounding education curriculum and its contents. An interview was also conducted with four teachers, and they were asked about the learning resources they have been using for teaching. So the requirement for the prepared system had been taken from those teachers and from other countries' curriculum. As surrounding education is one of the subjects the preschool children are expected to learn [9] learning resources prepared on the PKLS application is for the surrounding education using Amharic and English languages.

The desired system was developed on Macromedia Authorware because it provides a cross platform application. After developing the Authorware system six preschool aged children who didn't go to school before were selected to participate during the system effectiveness evaluation. As there were only a few participants, the researcher administered the whole study. Interactive multimedia application was designed and implemented to cover one of the main topics (human body parts) in surrounding education for preschool and kindergarten children that are usually covered in the curricula of other countries.

Subject contents were adopted from the UNECCO curriculum [10]. Parallel to the PKLS system 15 minutes lesson for human body parts and English letters each were prepared separately to avoid achievability difference. The traditional lesson materials contained the same content as of in the PKLS teaching learning system. Children's prior knowledge was controlled by selecting children who did not go to any preschool or kindergarten before. In addition to this pretest was conducted to check the children prior knowledge that will be a cause for wrong results in our evaluation. Before both traditional and computerized lesson and quiz were conducted, children were taught the basic English and Amharic letters and then the human body parts lesson were followed.

Preschool and kindergarten aged children were chosen and two groups were formed because children prefer working in groups [10]. And then the first groups of children were taught using the paper based lesson contents and the second groups were taught using the PKLS system. We taught them in two rounds about 15 minutes in each round. In the second round we changed the way of teaching; meaning children from the first group went to the PKLS system and vice versa. Effectiveness of the developed system was evaluated based on related literature [7]. Interface attractiveness and level of enjoyment were the usability indicators that have been used during the evaluation whereas focus duration and learning performance were the system performance indicators.

Direct observation was employed to see the level of enjoyment, duration of focus and interface attractiveness. Duration of focus was analyzed based on the children starting time of a given multimedia learning element and based on the time a child started losing his/her attention or started talking or disturbing. Three different multimedia system interfaces were created to evaluate the children preferences. Children focus duration on the text, audio, dynamic text, image combined with text and audio, animation, and video materials were tested separately.

3. Result and Discussions

In the implementation of this project we used Macromedia Authorware. We experimented a variety of shapes and colors to make the user interface more attractive to children's visual attention, with same approach as previous studies [11]. The PKLS system, implemented in Windows environment, was tested in both standalone and local area network. We used the free tight VNC (Virtual Network Computing) software to make collaborative learning, to facilitate file sharing and to handle security issue. After installing the tight VNC software into our two laptop computers, we tested the functionality of the preschool and kindergarten learning system. The major functional requirement of the PKLS system is providing variety of multimedia lessons to users, so its functionality was tested properly in both standalone and local area network environment. Before testing we packaged and made the application executable file, and then we tried to install the executable application file on desktop and laptop computers. Finally we opened each learning element and all worked properly. The system was also tested in Local Area Network. To do this first we put the application on a remote computer and then we tried to access the learning resource remotely and all system elements were working properly. To prevent unauthorized learning resources access in the classroom, we assigned password during the installation process of the free tight VNC remote desktop software. As a result of this the learning resources can only be accessible by authenticated users.

3.1 Comparisons between Traditional teaching learning and the PKLS system

In the first round, three of the children were taught using the traditional paper based learning materials. Four minutes later, the children started talking and looked tired during the traditional learning. Three of the children from the second group

were taught using the PKLS system and the children were attracted by the different learning contents and learning continued until the end of the 15 minutes, and we have taken 5 minutes for evaluating the group performance using the method they were taught in. Table 1 presents the details.

Table 1: Comparison between Traditional Teaching and the PKLS System (Human Body Parts) in Acquiring Lower Cognitive Skills in the First Round

	Way of teaching	*Focus interrupted (out of 15 minutes)*	*Learning performance (out of 7 questions)*
Group 1	Traditional	4 minutes	4
Group 2	PKLS	15 minutes	7

During the second round teaching-learning, groups in the first round learned by traditional method came in to the PKLS system and the second group went to the traditional. The lesson prepared to the second round focused on identifying English letters using related sounds combining with different item names. Table 2 presents the detail analysis.

Table 2: Comparison between Traditional Teaching and the PKLS System (English Letter) in Acquiring Lower Cognitive Skills in the Second Round

	Way of teaching	*Focus interrupted (out of 15 minutes)*	*Learning performance (out of 5 questions)*
Group 1	PKLS	15 minutes	5
Group 2	Traditional	7 minutes	4

When we compared the average focus duration out of 15 minutes as shown in Tables 1 and 2 the PKLS system the children focus duration, learning performance, sense of play were better recorded and observed than the traditional one.

3.2 User Interface Preference by Children

For the interface preference evaluation we prepared three different interfaces. The interface which contains different colors and shapes was selected more than the interfaces which were made up of only three colors and rectangular shaped icons. Mean of interface 1, interface 2 and interface 3 were 0.33, 0.16 and 0.5 respectively. Table 3 presents the detail.

Table 3: User Interface Preference by Children

Children	*Child 1*	*Child 2*	*Child 3*	*Child 4*	*Child 5*	*Child 6*
Interface preference	Interface 3	Interface 2	Interface 3	Interface 3	Interface 1	Interface 1

Figure 1: Interfaces made of different shapes and colors.

In addition to the children observational list analysis, we also tried to present here the questionnaire analysis that was taken from kindergarten teachers. Table 4 presents the detail.

Table 4: Questionnaire Filled by Kindergarten Teachers

Question	*I agree*		*Neutral*		*I disagree*	
	Number	*%*	*Number*	*%*	*Number*	*%*
Q1. PKLS (Preschool and kindergarten Learning System) makes children to entertain during learning	3	75%	1	25%	0	0%
Q2. PKLS (Preschool and kindergarten learning system) application reduces supervision time	4	100%	0	0%	0	0%
Q3. User interface colors (children's book cover pages, worksheet cover pages) should be attractive to children	3	75%	1	25%	0	0%
Q4. Colors and shapes motivate children's visual attention	3	75%	1	25%	0	0%
Q5. The PKLS reduces the supervision time during learning	4	100%	0	0%	0	0%

4. Conclusion and Future Work

4.1 Conclusion

Children are expected to acquire the lower level skills such as recalling, identifying, arranging and sorting at preschool and kindergarten grades. In children education the hardest challenge is holding their attention and keeping them concentrated until the end of a lesson. To reduce the concentration related problem during children learning and to teach lower skills in a fun and enjoyable way multimedia plays great role. The different multimedia elements go to the children's mind through their visual and auditory channels.

In addition to text, audio, video and animation, colors and shapes are important in children learning resources preparations because colors and shapes create variations and these variations provide motivational stimuli to the children's attention. From this experimental study, it is possible to conclude that colors and shapes improve the children's focus duration, learning performance and level of enjoyment when it is compared to the traditional one.

For the purpose of the system evaluation, traditional ways of teaching materials were prepared which contained the same contents as of the developed PKLS system. Two groups were created. Moreover, the evaluation was conducted in two rounds. Each group was taught in both the PKLS system and in the traditional material. In both rounds, the PKLS system result was found to be better.

4.2 Future Work

The overall result of the study was found to be promising in terms of holding children's attention and learning performance. But to get best result in evaluating the system's effectiveness, large sample data is required.

Children's learning performances in each of the multimedia elements should be evaluated separately. Moreover developing backend database and web interface to enable the application users to get dynamic learning contents and updated quizzes is recommended. This is because unless the user has installed the remote desktop application in all of the children's desktops, the teacher is unable to see and unable to control children's activities during class. Future work may also integrate lessons using game to enhance children's higher level cognitive skill.

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