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An Extended Mobile Application Design For Special Education To Teach Numbers

Sayıları Öğretmek Amacıyla Özel Eğitim İçin Genişletilmiş Bir Mobil Uygulama Tasarımı

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Öz

Son yıllarda, mobil teknolojiler (akıllı telefonlar, tabletler…) hayatımızın vazgeçilmez bir parçası haline gelmiştir. Bu teknoloji günlük kullanımının yanı sıra, bilim ve eğitim alanında da sıkça kullanılmaktadır. Akıllı cihazların eğitimde kullanımının artması nedeniyle, bu alan için tasarlanan uygulamalara duyulan ihtiyaç daha da önem kazanmaktadır. Bu alanda yapılan araştırmalar, mobil uygulamaların, öğrencilerin okul, iş ve gayri resmi ortamlar dahil olmak üzere çeşitli ortamlarda öğrenip, araştırma yapmalarına yardımcı olabileceğini göstermektedir. Mobil teknolojiler, öğrencilere tekrar yapabileceği esnek öğrenme fırsatları sağladığından, özel eğitime ihtiyaç duyan öğrencilerin eğitimlerini desteklemek için mobil uygulamalar ve cihazlar da kullanılıyor. Özel eğitime ihtiyaç duyan öğrenciler diğer öğrencilere göre daha yavaş öğrenebilirler. Bu nedenle, öğrenme sırasında zorluklarla karşılaşabilirler. Bu yazıda, daha önce önerilen mobil uygulamaya, özel eğitime ihtiyaç duyan öğrencilere sayıları (0-9) öğretmek için öğretmenlere yardımcı olarak tasarlanmış bir mobil uygulama önerilmişti. Ayrıca bu uygulama, okul öncesi çocuklar tarafından kullanım için uygundur. Uygulama, sayı kavramlarını öğretmek için modüller içermektedir. Her bir kavramı öğretmek için yinelemeli bir algoritma uygulanır. Öğretim bölümünde, uygulama Stepwise Yöntemini kullanarak öğretmeye başlar. Mobil uygulama, Java Programlama Dili'ne

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dayanan ve Android cihazlarda çalışan Android Studio'da olacaktır. Uyumluluk için Android 4.0 (Ice Cream Sandwich) İşletim Sistemi veya diğer sürümlerden biri yüklü olmalıdır.

Anahtar sözcükler: *özel eğitim, mobil uygulama, mobil cihaz, teknoloji, eğitim yazılımı, öğretme-öğrenme süreçleri, adım adım yöntemi*

Abstract

In recent years, mobile technologies (smartphones, tablets…) have become an indispensable part of our lives. Besides the everyday use of this technology, it has also been used frequently in the field of science and education. Due to the increased use of smart devices in education, the need for applications designed for this area has become more significant. Research conducted in this area shows that mobile applications can help students to navigate and manage tasks in a variety of environments including school, work, and informal settings. Because mobile technologies provide repetitive and flexible learning opportunities to the students, mobile applications and devices are also being used to support learners with special needs and disabilities. Students who need special education may learn slower than other students. Therefore, they may encounter difficulties during learning. In this paper, we propose an extension to the previously proposed mobile application that is designed to serve as an assistant to teachers to teach numbers (0-9) to students who need special education. It is also convenient for pre-school children. The application includes teaching modules that teach number concepts. An iterative algorithm is implemented to teach each concept. In the teaching section, the application begins teaching by using Stepwise Method. The mobile application will be on Android Studio, based on Java Programing Language and runs on Android devices. Android 4.0 (Ice Cream Sandwich) Operating System or one of the further versions should be installed for compatibility.

Keywords: special education, mobile application, mobile device, technology, educational software, teaching-learning processes, stepwise method

Introduction

Today, mobile devices are essential for making our lives more sociable more comfortable and more enjoyable. Mobile Technologies are also used for educational purposes which are called Mobile learning or m-learning. Because mobile learning uses mobile devices, it provides access to the training process without time and space limitations

Due to the increased use of smart devices in education, the need for applications to be designed for this area has become more significant. Research carried out in this area shows that mobile applications can help students learn anytime and anywhere. Students who need special education may learn slower than the other students. Consequently, they may face learning difficulties. Because mobile technology provides repetitive and flexible learning abilities of the

students, mobile apps and devices are also being used to support learners with special needs and disabilities. In order to focus on these issues, we proposed a mobile application that is mainly focuses on the education of students who need special education. It is primarily aimed at teaching them the concepts of numbers on smart devices. The application is used with the supervision of the teacher. With this application, it is aimed to improve the abilities of the students in order to understand the basic concepts. Furthermore support the students to study independently, without a teacher. Besides, it assists the learning activity wherever they want, and allows unlimited repetitions of the teaching methods until the concept is learned.

The methodology used is applied on Stepwise Method where there are do-show-say-write phases. This teaching method consists of 16 steps. First, the application provides a demonstration and then the student performs according to the directives. There are four sets of tools in each phase and these sets are used in turn. If the student gives correct responses from presentations, the criterion is met and the application will move on to the next step. The student must answer at least 75% of the questions correctly in order to be able to pass to the next phase. The Stepwise Method is used to design the algorithm of the program because it is a very efficient method to teach mathematical concepts to the students who need special education. The details about the teaching algorithm are presented in the methodology section.

Literature review

From the very beginning of the millennium, the usage areas of mobile devices began to increase rapidly. Over the years, the use of smartphones and tablets have become part of everyday life. In the field of education, similar developments have taken place. Distance education, computerized education concepts became a component of education once mobile devices were widespread. The more mobile devices we have in our lives, the greater the importance of educational software becomes. For this reason, educational applications have been developed in various fields. Special education is a field where less practice is developed compared to the other branches of education. The literature review covers the selected studies in the fields of mobile education development for students who need special education as well as pertinent artificial intelligence studies.

In 2008, Chen, C.M. , and Hsu, S.H. developed an application that aims to provide an effective and flexible learning environment for English Language Learning. In their study, an application is designed to effective English Language Learning, and adopts the advantages of mobile learning, which is called Personalized Intelligent Mobile Learning System (PIMS) (Chen & Hsu, 2008).

Intelligent Mobile Learning Interaction System (IMLIS) is another type of intelligent application developed by Zare in 2010 that provides a mobile learning environment for people with mental disabilities. It is presented as a doctoral thesis with the name "A Personalized Learning System for People with Mental Disabilities". The purpose is to develop personalization view by using a decision engine, which makes conclusions based on the user's skills, learning background and responses to processes (Zare, 2010).

Barendregt, Lindström, Rietz-Leppänen, Holgersson, Ottosson, created an application for iPad devices using multi-touch feature. Fingu is the name of the application which is designed for 4 to 8-year-old children in order to support their development of fundamental arithmetic skills (Barendregt, Lindström, Rietz-Leppänen, Holgersson, Ottosson, 2012).

Picaa is another application which is developed for mobile learning technology based on iOS devices to support students who need special education. The application is designed to create adapted learning activities for students who need special education in 2013 by López, Fórtiz, Rodríguez-Almendros, and Martínez-Segura (Fórtiz, Almendros, Martínez, 2013).

In the same year as the previous application, Campigotto, McEwen, and Epp set forth an application named MyVoice. It is a mobile application designed for special education, which allows users to input vocabulary words and link words with pictures. The purpose of this application is to assess how attention and motivation levels are influenced by the use of MyVoice. It is available on IOS devices and designed for students with special needs (Campigotto, McEwen, Epp, 2013).

In 2017, Karanfiller, Göksu, and Yurtkan developed an application with the title "A Mobile Application Design for Students Who Need Special Education". It is aiming to help the students, especially who need special education to learn basic concepts like less-more, short-long etc. Their application also teaches the students to put the objects into order (Karanfiller, Göksu, Yurtkan, 2017)

One of the most recent studies in this area is put forward by Oyelere in this year with the title “Design and Development of a Mobile Learning System For Computer Science Education in Nigerian Science Education Context”. The name of the application is MobileEdu which is a mobile learning system that support teaching and learning of computer science courses in the Nigerian University context. The study stimulates the use of mobile devices as a learning tool and provides relevant guidelines for integrating mobile learning into the educational system(Oyelere, 2018).

Methodology

This application aims to teach the concept of numbers to educate mental disabilities that fulfil the prerequisite behaviours by using “Stepwise Method” which is developed for teaching mathematics to mentally handicapped students.

Stepwise method

Stepwise Method is developed by Cawley. It is a mathematical skill and instruction teaching model that is especially applied to students with mental disabilities to gain mathematical concepts and skills. The mathematical concept or skill to be taught is divided into small steps. It is an instructional model which consists of 16 different combinations which includes interaction between teacher, student and teacher-student-material in teaching mathematical skills and procedures (Cawley, 1972 and Balçık, 2013).

The teaching process begins with real objects, continues with visuals and is completed with written or verbal symbols. It forms the output behaviours that indicate the teacher-student interaction, the teacher's presentation level and the student's reaction level. For each teaching purpose, the behaviour of the teacher and the student must be clearly stated.

As in teacher-student interaction, this application can be taught in all phases (do-show-say-write) of the Stepwise Method. This teaching method consists of 16 steps that the firstly teacher performs the action, and then the student applies the directives. For example, in the do-do phase that the teacher performs the action and asks the student to repeat the same procedure, or in the phase of say - write the teacher demonstrates by instructing and expects a response from the student by hand.

There are four sets of tools in each phase and these sets are used in turn. If the child gives 3 correct responses from presentations consisting of 4 sets, the criterion is met and is passed on the next step.

Prerequisites for learning numbers are:

1. Tapping
2. Rhythmic countability
3. To be able to distinguish the concepts of low-multiplicity
4. Say, take, give, show, point, say, etc.

The names of the materials used to teach the numbers should be well known by the child.

In the method consisting of do-show-say-write phases, teaching is completed in a total of 16 steps. (In each session, the start and finish dates, the session duration, and the evaluation are carried out at the end of the session (Cawley, 1972 and Balçık, 2013).

With the Stepwise Method, the teaching of the numbers is conducted as below:

Concept: two (2)

Step 1: Do-do

Material:

1st Set: 4 beads in the same colour, type, and material on one plate.

2nd Set: 4 buttons in the same colour, type, and material on one plate.

3rd Set: 4 erasers of the same colour, type, and material on one plate.

4th Set: 4 covers in the same colour, type, and material on one plate.

Application: Sit with the child at the desk. The sets of materials are left at one time where the educator can easily reach and the child can’t see. One of the tables with beads is placed in front of the teacher and the other is placed in front of the child. The material is displayed to the child and asked, "What are these?" If the child responds correctly, teaching begins. The teacher puts 2 beads on the table and "I bought 2 beads, you get 2 beads," the instruction is given. If the child is unresponsive or responds incorrectly, the presentation will be repeated. If the child does not give the desired response in three experiments, clues are used. With physical help, the hand is taken to the tray and 2 beads are provided. Continue to work with the same set is used until the child responds independently. The child's accurate reactions are rewarded. When the criterion is satisfied independently, it is studied using the same method as the other sets.

Step 2: Do-show

Material:

1st Set: 4 beads of the same colour, type and material on one plate.4 separate cards with 1, 2, 3, 4 beads.

2nd Set: 4 buttons in the same colour, type and material on one plate.4 separate cards with 1, 2, 3, 4 buttons.

3rd Set: 4 erasers of the same colour, type and material on one plate.4 separate cards with 1, 2, 3, 4 eraser pictures.

4th Set: 4 lids of the same colour, type, and material on one plate.1, 2, 3, 4 separate cards with 4 cover art.

Application: Sit with the child at the desk. The sets of materials are left at one time where the educator can easily reach and the child cannot see. Place the beads in the plate over the table. The child's attention is drawn to the table. The beads are displayed and asked, 'What are these?' If the child is says "Bead", the bead pictures are taken and put them in front of the child in turn. After saying "Look, these are also beaded paintings." Allow 2 to 4 seconds for the child to take the cards away, and then take the cards out of the child's hand and place them in front of them. 2 beads are taken from the beads on the table. "I bought two beads and you show the card with two bead pictures from these cards," he says, showing the beads and cards in front of the child. If the child reacts correctly, the reward is given. If it becomes unresponsive or is found in the wrong reaction, the presentation is re-established. In three trials if the child does not give the desired response the clues are used. Continue to work with the same set until the child responds independently. The child's accurate reactions are rewarded. When the criterion is satisfied independently, it is studied using the same method as the other set.

All steps of the Stepwise Method can be represented by a table as follows:

Table 1.*Teacher/Student interaction in Stepwise Method*

Teacher/Student	DO	SHOW	SAY	WRITE
DO	*DO-DO*	*DO-SHOW*	*DO-SAY*	*DO-WRITE*
SHOW	*SHOW-DO*	*SHOW-SHOW*	*SHOW-SAY*	*SHOW-WRITE*
SAY	*SAY-DO*	*SAY-SHOW*	*SAY-SAY*	*SAY-WRITE*
WRITE	*WRITE-DO*	*WRITE-SHOW*	*WRITE-SAY*	*WRITE-WRITE*

Adaptation of stepwise method to the mobile application

In the mobile application, this method will be applied as follows: First of all, while setting research subjects, students will be selected to have well understanding of less-than-concept and to be able to demonstrate prerequisite behaviour of rhythmic counting from 1 to 10. It is also expected that subjects will have basic self-care skills (toilet, eating, and dressing), matching skills in terms of concepts and recipient language skills. The two-word directions should be understood and their fulfilment is important in terms of using this practice.

If the student is just starting to use the program, the first one will be the do-do step of the concept of number one. Before the teaching begins, the student will be asked about which item is to be used at this step. If the student answers correctly, the training will start. If the student is unresponsive for 10 seconds or responds incorrectly, the student is taught what the item is.

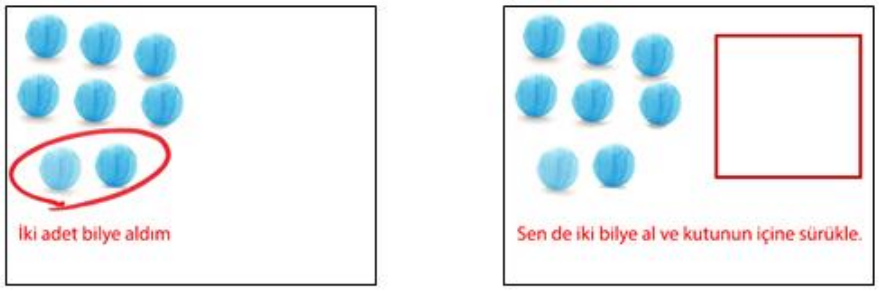
After the training starts, if the student is unresponsive for 10 seconds or responds incorrectly to a question asked, that question will be repeated. If the student answers the question asked 3 times in succession or is unresponsive for 10 seconds, the program will give the student a clue. The same question is asked again after the clue is given. If the student remains unresponsive for the 4th time or gives the wrong answer, the application restarts to teach the same concept. At the end of one step, if the student knows at least 3 out of 4 (75%) of the questions asked with the 4 sets, the application will pass to the next one.

There are 16 steps in the teaching of each concept. These are implemented in the form of do, show, say and write phases, by applying with teacher-student interaction like do-do, say-write. Because of this reason, the same algorithm is iterative, only the methods vary.

Teaching the concept of numbers

The images on the left side are displayed by the application, the right side is the student response. The demonstration of the activity will be in the form of animation. The student interaction with the tablet will be carried out by sound, touching, dragging or typing.

Do - Do*(Yap - Yap in Turkish)* **Step**



(a) (b)

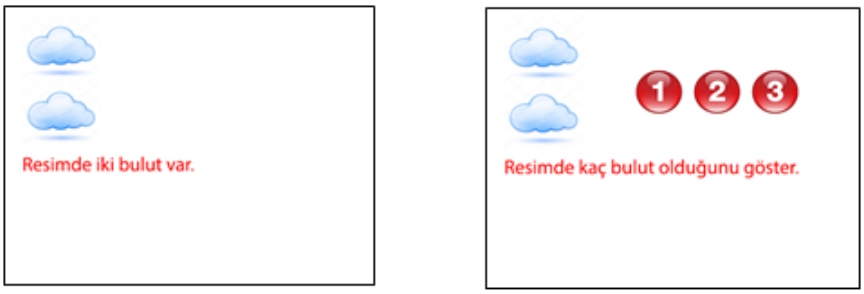
Figure 1. *In the image(a), the application shows how to take two balls. In the image(b), the student is asked to drag two balls into the box*

Show - Say*(Göster - Söyle in Turkish)* **Step**

(a) (b)

Figure 2. *In the image(a), the application shows two stars. In the image(b), the student is asked to say the number of stars.*

Show – Show *(Göster-Göster in Turkish)* **Step**



(a) (b)

Figure 3. *In the image(a), the application shows two clouds. In the image(b), the student is asked to show the number of clouds.*

Do - Write *(Yap - Yaz in Turkish)* **Step**

Figure 4. *In the image(a), the application shows two stars. In the image(b), the student is asked to write the number of stars.*

As previously noted, the instructions and clues given by the teacher in the traditional Stepwise Method, are given as animation in demonstration. In the areas where the answer of the teacher is expected, according to the phase of the application, various tools will be used to respond with the phases of do, show, say and write.

In the do phase, the Touch / Drag feature of Android Studio will be used to drag the desired amount of the items to the desired area. In the show phase, the Android Studio touch feature will be used so that the student can show the item at the desired amount. In the say phase, when the student says the number of items, voice recognition will be used so that the application can identify this voice. In the write phase, handwriting recognition will be used so that the application can verify whether the written digit to the desired region is correct or not.

The flowchart of the overall process

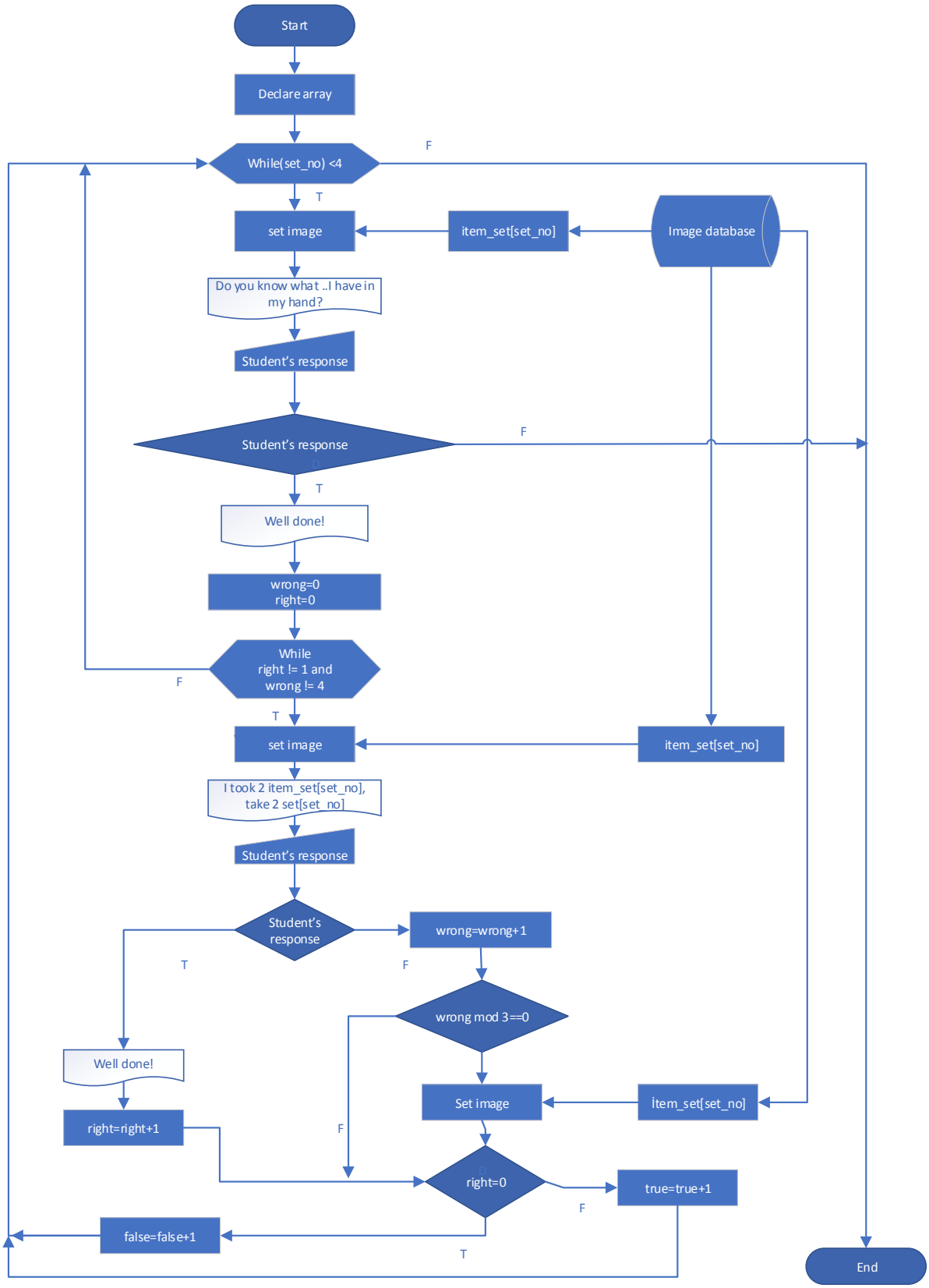


Figure 5*. The generic flowchart of the teaching module.*

This flowchart is shows the teaching process of number 2. The same algorithm will be applied to all numbers. In the flowchart; item_set[] is an array for item set pictures to demonstrate the teaching part and set_no is the index of item sets. Pictures will be taken from image database. The objects of item sets are shown below:
item_set[0]=beads
item_set[1]=buttons
item_set[2]=erasers
item_set[3]=lids

There will be 16 steps in this algorithm and in each step, the four item set will be shown to the student in an orderly manner. During the teaching process, if necessary, a hint picture will be shown to the student.

Block diagram of the application

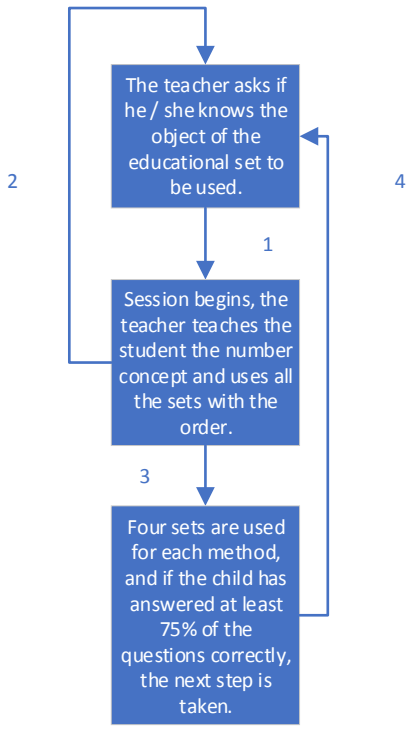


Figure 6. *The block diagram of the application (numbers in the diagram indicates the order of processing).*

Application platform

The application is developed in Android Studio program, based on Java Programming Language. In order for users to be able to run this application, the operating system installed on their phone or tablet must be at least Android 4.0 (Ice Cream Sandwich).

Android Studio chosen as a program development environment; because, Android-powered devices are much more common than others. According to the Netmarketshare.com, year 2017 market share of operating systems for mobile devices are: IOS (32.34%), Android Studio (65.53%) and other (2.13%). Also, Android-powered devices are cheaper and more accessible than other competitors.

Conclusion

The paper presents a mobile application developed in Android Studio program, that is designed for the teaching of the digits (0-9). It is aimed to use the developed application in order to assist teaching process of students who need special education. The software is intended to be a teaching and learning domain and with the help of this application, students will be able to study independently, anytime, anywhere. Also they will be able to repeat lecture until learning is achieved. The application will start to teach by using Stepwise Method where there are do-show-say-write phases. This teaching method consists of 16 steps. First, the application demonstrates actions and then the student applies according to the directives. This method is used to design the algorithm of the program because it is a very efficient method to teach mathematical concepts to the students who need special education. The unique feature of this study is that the system is designed to implement all combination of the steps of Stepwise Method. To achieve this, the design proposes the use of voice recognition tool to recognize the voice of the student in the steps that require speaking and handwriting recognition tools will be also used to recognize the hand writing of the student in the steps that required drawing. In the mobile application, the proposed application will be applied to the students who have qualification in some subjects like understanding of less-than-concept, rhythmic counting from 1 to 10, having basic self-care skills, matching skills in terms of concepts and recipient language skills. Although the preliminary target language of the application is Turkish, other languages will be also supported.

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