A Mobile Application Design for Students Who Need Special Education

Article *in* Eğitim ve Bilim · November 2017

DOI: 10.15390/EB.2017.7146

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Education and Science

Vol 42 (2017) No 192 367-381

A Mobile Application Design for Students Who Need Special Education

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Abstract

The purpose of this study is to teach basic concepts to students who need special education and to design a mobile application that will serve as a teaching aid. Various applications connected to mobile devices and mobile devices have begun to develop rapidly over the last decade. All fields of science and education have benefited from these developments. In the applied practice, "straggling teaching method" is taken as basis. In this method, materials have been developed to teach basic concepts such as "quantity", "length", "width" and "size". There are also chapters to help sort objects according to the concepts taught in the application. In practice, the skill level of the learner is first determined by a pretest. The student concept is finalized according to the level of readiness of the instructor. The application is built on the Android platform. The designed mobile application was tested in two different schools. When the test results were evaluated, the applicability of this application was observed in the learning process of the students.

Keywords

Mobile device
Technology
Educational application
Teaching-learning processes

Article Info

Received: 02.08.2017
Accepted: 10.10.2017
Online Published: 11.12.2017

DOI: 10.15390/EB.2017.7146

Introduction

Children who require special education need the skills of self-care, basic skills, communication skills, business skills, social skills as well as learning skills in their post education lives (Yıkmış, 1999). For this reason, it is important to teach every skill that is functional in the educational process of children who need special education. In the education of children in need of special education, the top priority is to teach basic concepts. Basic concepts play an important role in the development of children in need of special education.

With the rapid development of mobile technologies such as smartphones and tablets, mobile training applications have also become popular. However, as of yet, teaching software for special education students has not been trialed on a large scale basis. Mobil technology's contribution to the teaching-learning process is only possible through the development of effective course software.

In this study, an educational mobile application was designed to teach basic concepts and relationships to the students who need special education due to their cognitive inabilities. These basic concepts are defined as quantity, width, length and size. In this application, an algorithm is applied to

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the students to apply the straggling teaching method which shows different images with combinations of color, quantity, width, length and size. It has been found that the straggling teaching material is effective in the acquisition of the concepts of quantity, width, length and size from the basic concepts of readiness for children who need special education due to their cognitive inabilities (Gürsel, 1993). The scope of teaching in the straggling teaching method is determined by the way of expression and the basic skills of the student, in a stepwise way from easier to harder (Alptekin, 2000; Cawley, 1972; Gürsel, 1993; Tuncer, 1994; Yıkmış, 1999, 2005). The designed software, as Göksu, Karanfiller, and Yurtkan (2016) suggests, contains special sound effects to attract the attention of the students constantly. In addition to teaching basic concepts, practice guides students to put objects in order using concepts learned at the same time. For each concept, appropriate objects are placed in the application-related partition. Although Turkish sounds are used in the software, they can be easily translated into other languages and the software itself is also available in another language.

While there are applications designed and programmed in Turkey to be used in the training of special education students (Tuncer, 1994), software made in the area of the Turkish Republic of Northern Cyprus is very limited. In addition to the availability of existing software in Turkey and the TRNC, this software is different because the software recommended in this study is adaptable to the learning speed of the student. At the same time, the straggling teaching method is used and it supports other languages with the audio files and the writing language being changed.

The applicability of the application that is developed in this study has been tested in two different schools. Tests were conducted under teacher supervision. The method of teaching basic concepts has been applied to the students who need special education and its usability has been observed.

Literature Review

Since the early 2000s, Internet and mobile learning applications have become more popular (Keskin & Kılınç, 2015; Adalıer, 2013). Özdamar (2011) defined mobile learning as a learning activity that can be accessed without a fixed location, enabling to utilize services and communication, increasing the productivity of the user by responding to the needs of the user instantly and using mobile technologies. Crompton (2013) refers to mobile learning as learning through content and social interaction using personal electronic devices. Bulun, Gülnar, and Güran (2004) found that the advantages of using educational software on mobile devices and mobile devices are lifelong learning, Learning when required, time and space independent learning, learning set according to location and conditions.

In 2011, a software application called PixTalk (De Leo, Battagiri, & Leroy, 2011) was developed for Windows smartphones. With this application, teachers can download images to their smartphones over the network. Students can use PixTalk software to select images to express their desires and feelings. In addition, researchers have worked on the development of educational software for students in need of special education (Kagohara et al., 2013). Developed instructional programs are being used on iPods and iPads. FernáNdez-López, RodríGuez-Fórtiz, Rodríguez-Almendros, and Martínez-Segura (2013) used mobile learning technology to support gifted children in IOS (Iphone Operating System - Iphone Operating System) devices.

Christinaki, Vidakis, and Triantafyllidis (2014) developed an educational game that measured the early childhood self-awareness and intervention skills that measured their pre-school learners' emotions and their ability to recognize themselves. As a result, the natural user interface reaction of alternative interaction techniques is provided to the individuals with autistic spectrum disorders within the technological possibilities.

Another study on mobile education applications for individuals with special education needs; (Achmadi et al., 2012) developed a program that can be used on iPod devices for children with autism spectrum disorder. This developed curriculum consists of two steps. In the first step, the preferred teaching sequence between the two screen pages is emphasized; in the second step, it is aimed to unlock the next program by selecting the correct screen page. The teaching software that was created was found to be available at a faster rate than teaching material. As a result, the procedures performed in both steps were found effective in teaching.

At the beginning of the year 2000 research on this subject had began in Turkey. In the work done by Kuzu, Cavkaytar, Çankaya, and Öncül (2013), participants were asked about the software developed for the parents of mentally handicapped individuals. For this purpose, questionnaire and interview form were prepared and applied to 107 participants. Qualitative and quantitative data were analyzed and positive opinions about the software were obtained from the participants in terms of design, use and efficiency. As a result, the purpose of software is to teach daily life skills with greater ease with the use of devices such as computers and mobile applications. Another study related to the use of mobile devices in education by the students was done by Ağca and Bağcı (2013). In another important study, a sample application (Aruk, 2008) was developed by using the information systems technologies in the education of special needs students.

In recent studies, Soykan and Özdamlı (2017) developed an application for the students who need special education and evaluated it. Their findings state that using computers and educational software increased the interest of the students and affected their attitude in the positive way. Eliçin and Tunalı (2016) investigated the effect of using tablets in the education of the students with autism. Also they developed a software to prepare activity charts. Their research results show that the software can be effectively used in teaching the activity charts for the students with autism. In another study, Silman, Yaratan, and Karanfiller (2017) studied the role of technology in the education of visually impaired students and they point out the imperfections.

When the literature is examined, it is observed that the software developed as a special education aid is not sufficient for the teaching of different knowledge and skills. The applications listed above are not equipped with staggering method as well as they are not adaptive to the student's learning capability. This is the main motivation of this study. Therefore, in this study, the developed application is using staggering method and is adaptive to student's teaching capability. Turkish audio notifications are used but the audio files can be changed in other languages. Therefore, the program is a substructure suitable for teaching at every level. In the case of special education, each student is required to take individual lessons according to the principle of teaching one to one. The developed program provides the opportunity to teach with more than one student at the same time in order to asist the teacher. Moreover, the difference of the program from the other developed programs is that the speed of the teaching depends on the learning speed of the student. For fast learned concepts, the number of repetitions of the program decreases and learning with different images is continuing for the unfamiliar concepts. Thus, teaching continues as much as students learn concepts. The flow process of the program is shaped in proportion to the learning speed of the learners. The operation of the program is explained in detail in the method section.

Method

The application is developed using the staggering method. The algorithm is showing the students different images and explaining the selected concept with audio instructions. The basic concepts taught are the quantity, width, length and size. Quantity concept is taught as "less" or "more". Width concept is taught as "thick" or "thin. Similarly, the length concept is taught as "long" or "short" and the size concept as "big" or "small", as mentioned in the earlier sections.

Principally, the method introduce different types of images with different colors, quantities and objects. Primarily, the student comes across with same type of object with same colors but in different quantities. Then, the application directs the student with audio instructions such as "this is less" and "this is not less". Then, it asks to student to look at the screen and choose the image that includes less number of objects. If the student selects the correct image, the application will continue to the second section which will be related with the quantity. This section will be repeated for four times. If the student fails to give the correct answer in any part of this section, then the application will turn back to the starting point where the concept introduced and the process will be repeated. Secondarily, if the student is successful to complete the first section, then two different images of the same type of objects with same colors but in different sizes will be appear on the screen and application will ask to student to look at the screen and choose the image which has the less number of objects. This section will be the test section, if the student scores at least three correct answers out of four this section will be completed without turning back to the starting point and the application will continue to the next section

Furthermore, student will start to the next section where there are two same types of objects but in different sizes with different colors. Unlike the previous section which is the introduction section and test section in this part if the student is successful to complete, then the application will continue to the next section. The next section includes two images with different types of objects, with different sizes and different colors. Then, the teaching and testing methods will be the same as previous parts. Again, a successful result will lead the student to the next section which is in the same concept with previous sections but this time the student will have three images. Another successful stage will be continuing to the next section with four images and so on so forth. Being successful in the last section finalizes the teaching of "less" concept for the student. Similar approach is followed for the other concepts at first introduction or teaching part will be held on then it's followed by test sections. Students can continue to the other section. The corresponding pseudo-code is provided in Figure 2. The flowchart of the overall process is available in Figure 1.

Considering the two methods known in educational software development which are "branching programming" and "linear programming", this methodology is similar to "branching programming". It tests the student after teaching a concept, and then in case of false answers, it is repeating the teaching. This kind of iterations are applied in the teaching sections.

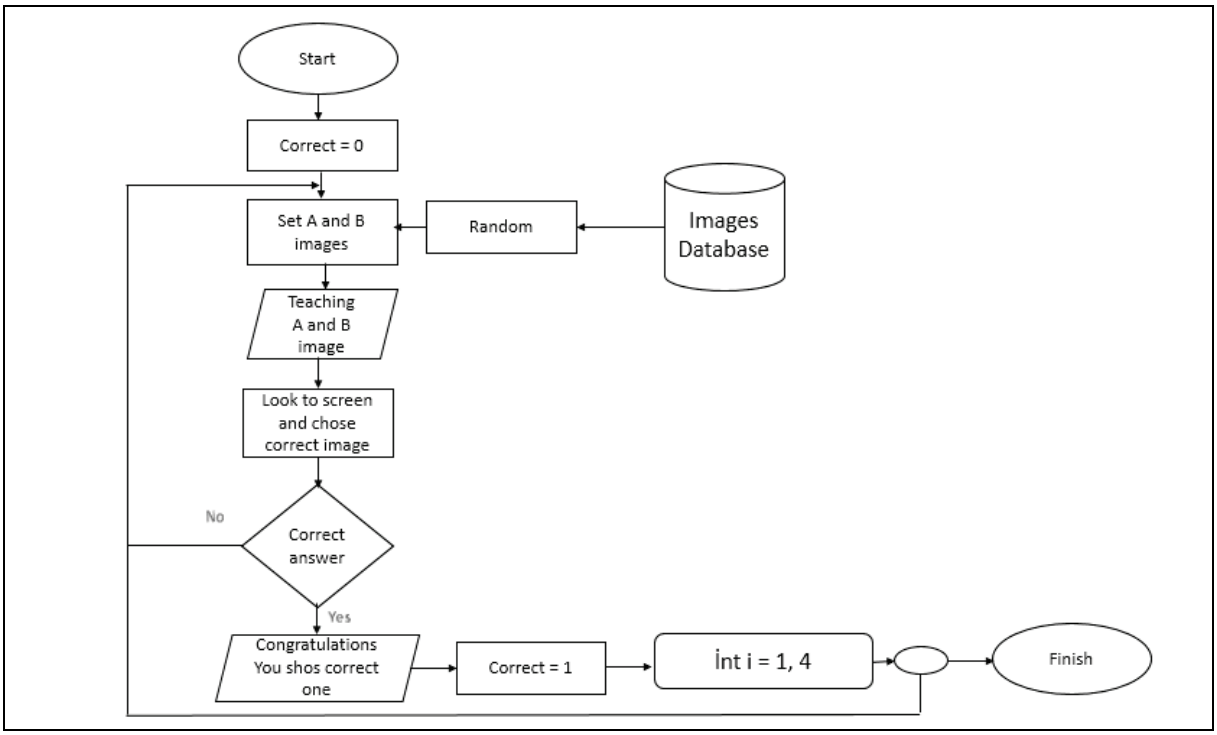

Figure 1. Flowchart of Teaching Module

1. Start
2. Set two images from database
3. Introduce images (teaching)
4. Look at the screen and choose correct image
5. If the student selects correct image go to 7
6. If the student selects wrong image go to 2
7. Congratulations you show the correct one
8. Increment correct scores by one
9. Repeat this section four times
10. Finish

Figure 2. Pseudo-code for Teaching Module

The algorithm mainly depends on visual inputs to the student, and assuming that the student (a potential user) has special needs, we employ a repetitive structure in order to teach the student slowly and efficiently. As it is seen from Figure 1, looping structures that show different images to the student to teach the less or more objects in the scene, includes an image database. A sample instruction is used for the comparison is shown in Figure 3. In total, we employ 48 sample images currently for each concept.

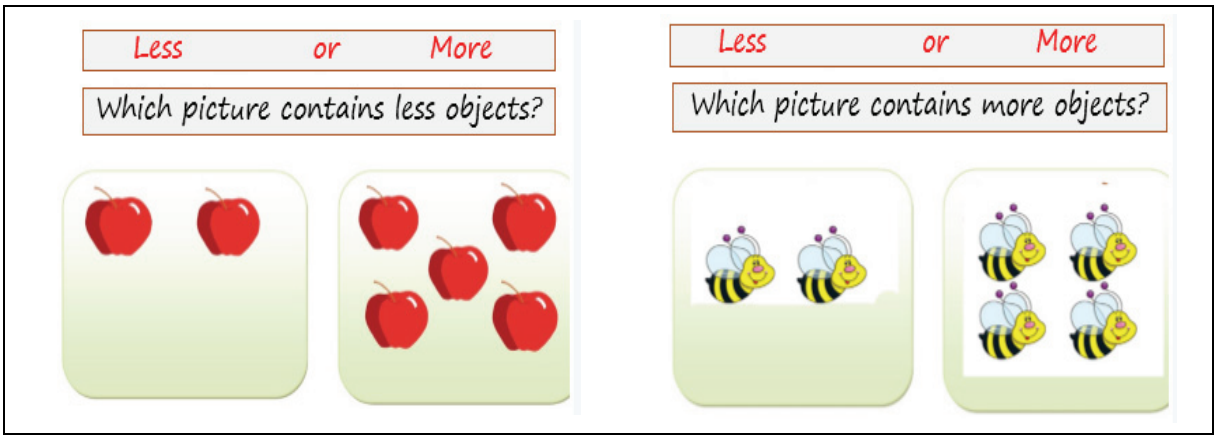

Figure 3. Instructions used for "Less or More" Comparison

Teaching the Concept of Quantity

This part mainly focuses on the teaching and differentiating the objects in accordance with their quantity. The teaching algorithm is based on Figure 1. The methodology is same with previous teaching concept, but unlikely, in this section students are going to study on different images and explaining "less or much" concept with audio instructions. Sample images for this concept are presented in Figure 4.

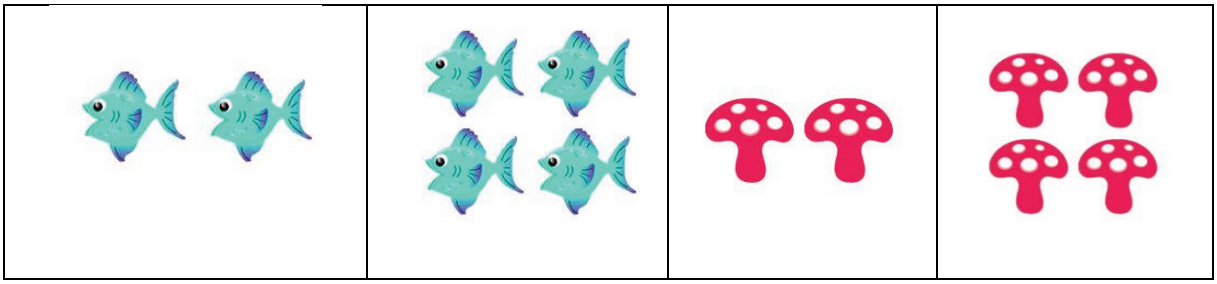

Figure 4. Images used: Teaching "Less" and "More" Concepts

Teaching the Concept of Size

This part mainly focuses on teaching differentiating the objects in accordance with their size. The teaching algorithm is based on showing Figure 1. The methodology is same with previous teaching concept but in this section students experience different images and learning "big or small" concepts with the guidance of audio instructions. Sample images that are used in this section are presented in Figure 5.

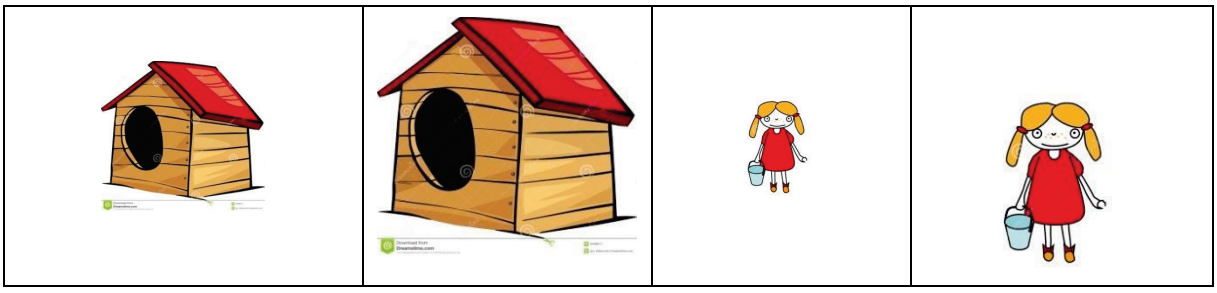

Figure 5. Images used: Teaching "Big" and "Small" Concepts

Teaching the Concept of Length

This part mainly focuses on teaching differentiating the objects according to their length. The teaching algorithm and the methodology are the same with previous teaching concepts except that in this section students are experiencing different images and learning "short or long" concepts again with audio instructions. Sample images are presented in Figure 6.

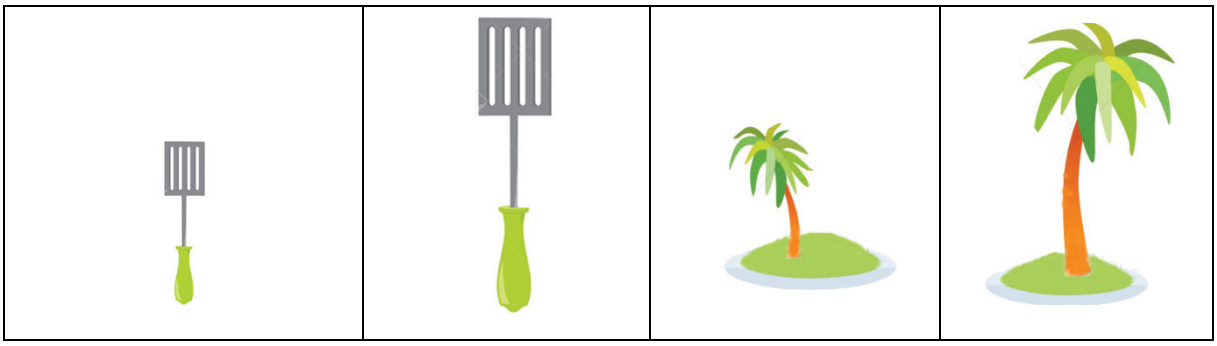

Figure 6. Images used: Teaching "Short" or "Long" Concepts

Teaching the Concept of Width

This part focuses on teaching the width concept. The teaching algorithm and the methodology are same with previous teaching concepts except the images shown. Here, the students are experiencing different images and learning "thick or thin" concepts. Sample images are presented in Figure 7.

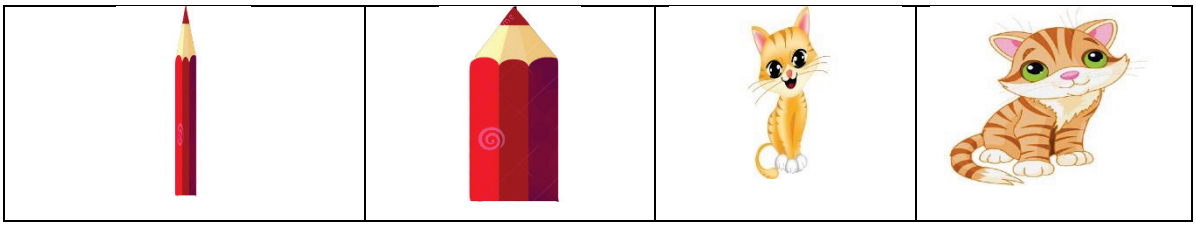

Figure 7. Images used: Teaching "Thick" or "Thin" Concepts

Ordering the Objects According to the Concepts Learned

The next feature of the application is that it provides the ordering of objects section. This section focuses on ordering and differentiating the objects in accordance with their quantities, sizes, length and width. Here, the students are expected to put the given objects in an order according to the concept chosen. For example, ordering the objects according to their sizes result in starting from the smallest object, going into the biggest object.

The pseudo-code of the ordering algorithm is provided in Figure 10. The flowchart is shown in Figure 9. The methodology here is same with the testing section. Additionally, students complete teaching on different images and explaining the concept with audio instructions. Sample images used are shown in Figure 8.

The application takes the first 2 images from the image database and put them into image views. Then, without teaching, the application will ask to student to put the images in to correct order, according to concept, guided by audio instructions. So on, if he/she gives a correct answer, the number of correct answers will be increased by one. If he/she fails to give a correct answer, the number of wrong answers will be increased by one and application will pass to the next level section, that section will be repeated for four times. If student scores at least 3 out of 4, the ordering section will be completed. Otherwise, the application will continue by returning to the beginning of the current teaching section.

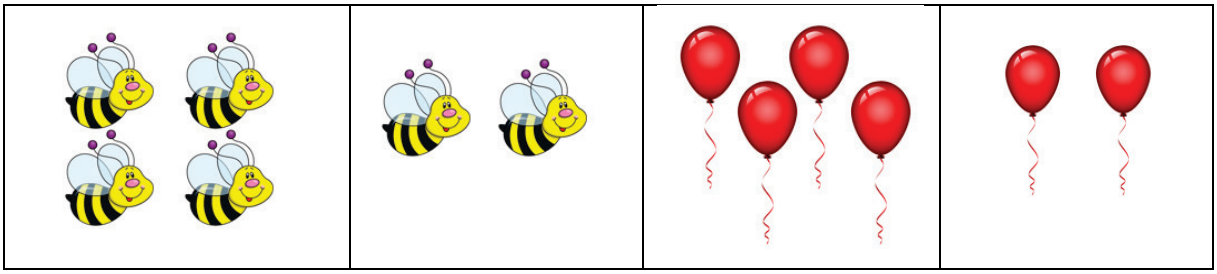

Figure 8. Sample Images Used in Ordering Section

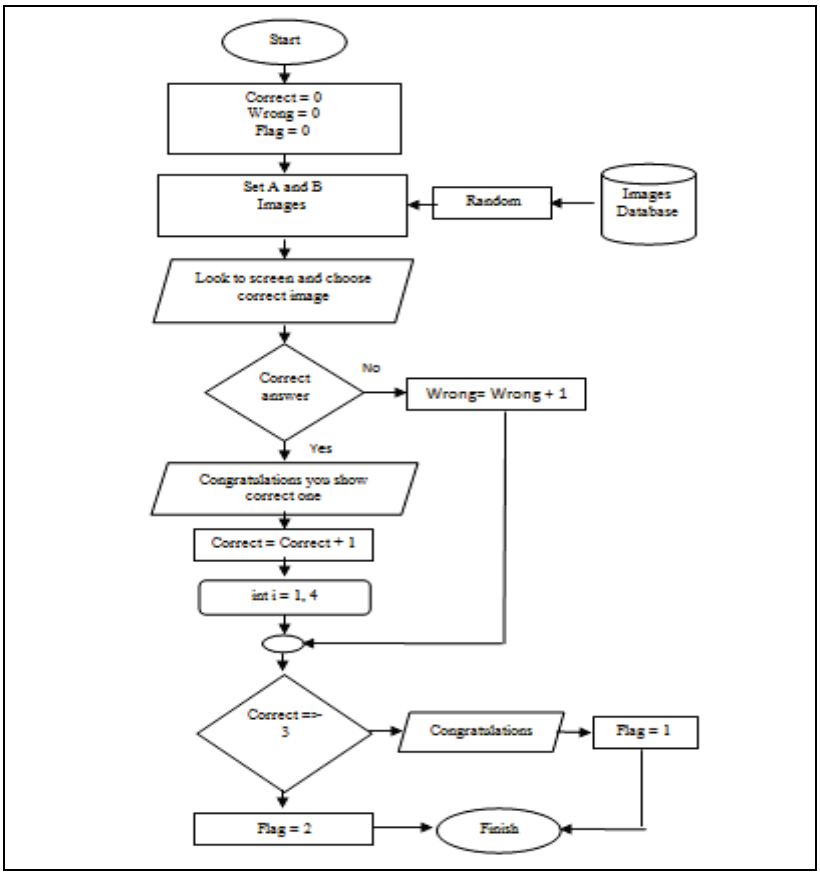

Figure 9. Flowchart of Ordering Section

1. Başla
2. Doğru, Yanlış ve bayrak değerlerini 0 yap
3. Resim Kaynağından İki resimi yükle
4. Ekrana bak ve resimleri kavrama göre sırala
5. Eğer doğru sıraladıysa, Adım 6 ya git
6. Doğru değişkenini bir artır
7. Eğer doğru sıralayamadıysa Adım 8 e git
8. Yanlış değişkenini bir artır.
9. Bu bölümü 4 kez tekrar et
10. Eğer 4 soruda 3 doğru cevap verdiyse, Adım 11'e git
11. Tebrikler çok güzel sıraladın ve bir sonraki bölüme geç
12. Eğer 3'ten daha az doğru sıraladıysa eğitimin başına dön
13. Bitir.

Figure 10. Pseudo-code for ordering section

Results

Application Development

The mobile application is developed on Android Studio, based on java programming language. It is planned to run on devices which use android operating system. Devices with the installed version of at least Android 4.0 (Ice Cream Sandwich) operating system will be compatible (Android Developers, 2016).

In the dataset there are 192 images in total. We employ 48 images for each concept. For example, there are 48 images used for the concept of quantity. The first 16 images are employed for testing, which include varying number of the same objects in the image. Similarly, one of the attributes that are the size, type and the colour, is fixed, and the other attributes are used in combinations. In this way, the image sets are created for the next sections of teaching and testing. For the quantity concept, the "less" and "more" sections use the same 48 images. Other concepts are using different 48 images but follows the same procedure. Example images are provided in Figure 11.

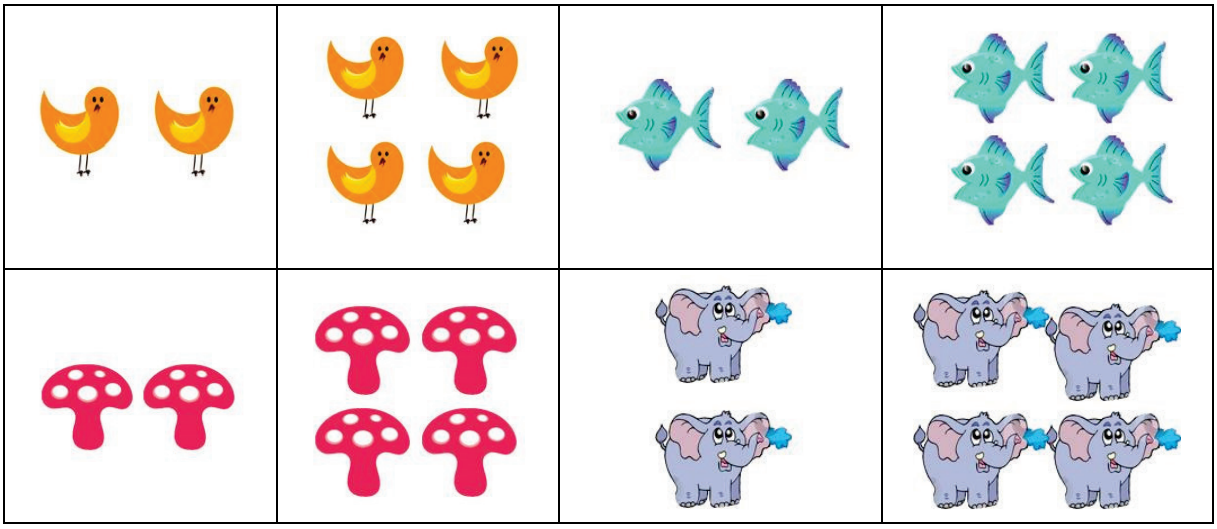

Figure 11. Sample Images Used

The navıgation drawer is the last stage of the application development. It displays the application's navigation choices. It appears on the left part of the scene. It automatically arises when the user makes a swipe action on the left part of the screen. Otherwise, it is out of sight. Also, it arises when the user touches the icon of the application that is located in the action bar. A guide is needed to use that panel to reach the concepts. Moreover, the teaching module will start as soon as guide clicks to the concept name on the navigation drawer panel.

As soon as the student reaches to the teaching module, the selected module should be completed. It is not possible to go back to the main menu until the selected study finishes. During the teaching section, the student will not be able to click to any part of the screen or image, thus, until the audio instructions are finished, image views are disabled for touch. If the student achieves to finish the selected study on any of the concepts, the application will turn back to the main menu automatically. Starting from the main menu, any other concept may be studied. Otherwise, the session can be ended by closing the application. Figure 12 shows the actual screenshots of the running application.

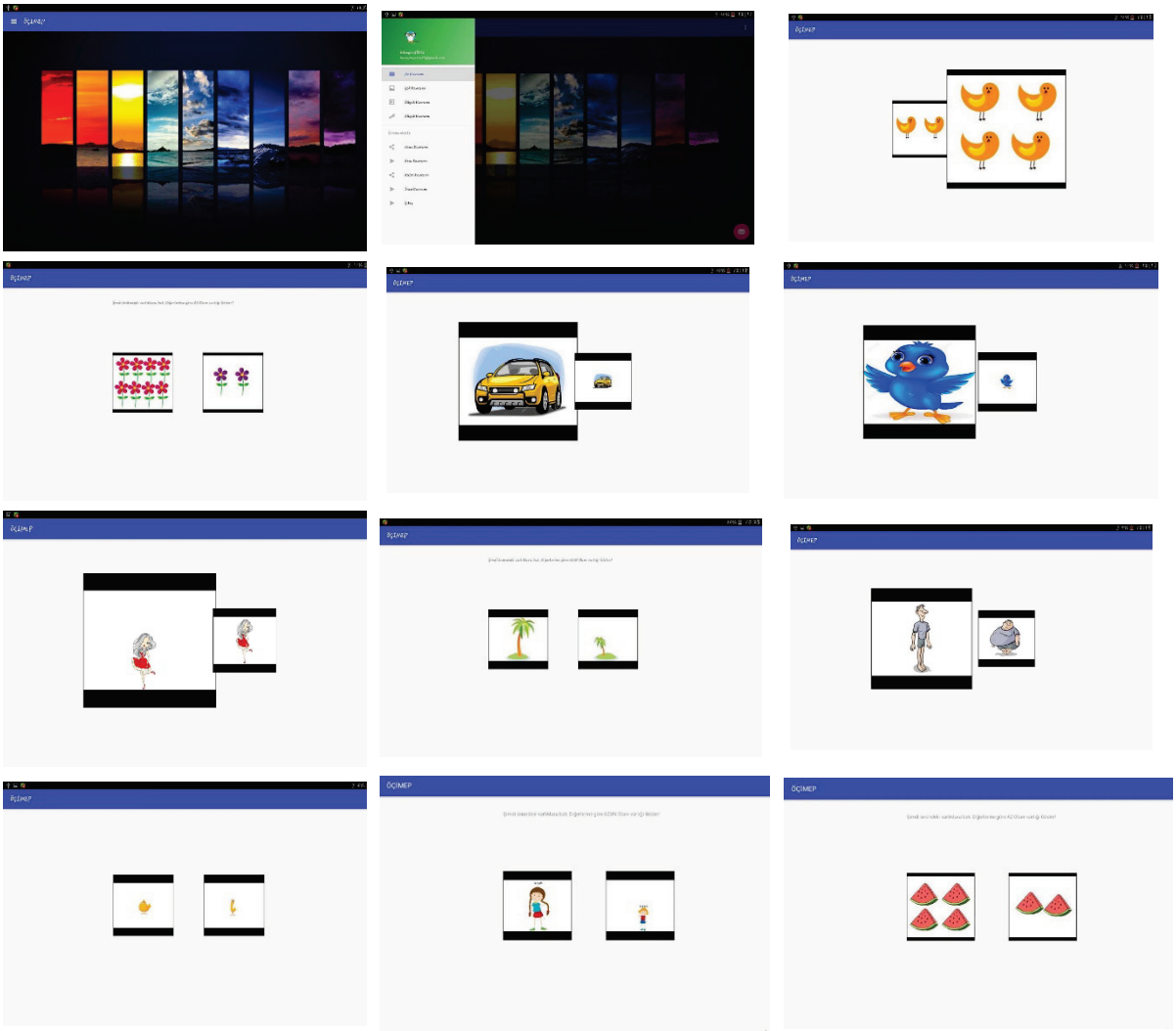

Figure 12. Application Screenshots

Testing the Application

The first part of the testing session is done at special education centre at Nicosia. One of the students refused to use the tablet computer in his learning activity, whereas other four students agree on using the tablet computer and the application.

The test phase of the application is organized in order to verify that the application is usable and can be used by exceptional students without any problems. To achieve this usability test, we organize test sessions in two different schools. Several students participated in our test sessions and use the application with the guidance of the teacher.

Test results are shown in Table 1. Here, all the students were able to answer the initial test questions related to the concepts, and because of this, as they already know the concepts; they did not start the teaching activity by using the application. Results indicate the correct scores of the students who participated in the testing session. "+" means the student answered correctly and "-" means the student fails to answer correctly.

Table 1. Test Results for the First Test Session

Questions related to quantity Audio instruction: Look at the screen and show the less	**Student 1**	**Student 2**	**Student 3**	**Student 4**	**Student 5**
2 Turtles (Green) – 5 Penguins (Black)	+	+	+	+	
3 Bells (Yellow) – 6 Trees (Green)	+	+	+	+	
2 Wood (Grey) – 8 Snowman (White)	+	+	+	+	
3 Deer (Grey) – 6 Gift Package (Blue)	+	+	+	+	

The second session of the test is done in the special education centre at Gaziantep, in Turkey. In this session, three students participated in our tests. The test results for the four students are provided in Table 2. Here, the students learn the concepts, some of them in the first iteration whereas some others in second and third iterations, shown by iterative "-" for not learned, and "+" for learned, in the tables.

Table 2. Test Results for the Second Test Session

Questions related to quantity Audio instruction: Look at the screen and show the less	**Student 1**	**Student 2**	**Student 3**
2 Birds - 4 Birds	+	-, +	-, +
2 Fishes - 4 Fishes	+	-, +	-, +
2 Musrooms - 4 Musrooms	-, +	-, +	-, +
2 Elephants - 4 Elephants	-, +	-, +	-, +
2 Piece of wathermelon – 4 Piece of wathermelon	+	+	+
2 Bees – 4 Bees	+	+	+
2 Ball – 4 Ball	-,+	-, -, +	-, +
2 Balloons – 4 Balloons	-, +	+	+
3 Scissors (Barrow) - 6 Scissors (Yellow)	+	+	+
2 Houses (Blue)-5 Houses (Green)	+	+	+
3 Owls(Purpul)- 5 Owls(Pink)	+	+	+
2 Flowers (Blue)- 8 Flowers (Red)	+	+	+
2 Houses (Barrow) – 6 Houses (Black)	-, +	-, -, +	-, +
3 Fishes (Blue) – 6 Fishes (Red)	-, +	-, -, +	-, +
3 Pencil (Reds) – 6 Pencils (Blue)	+	+	+
3 Cars (Yellow) – 6 Cars (Purple)	-, +	-, -, +	-, +
5 Flowers (Colored) - 2 Duck (Yellow)	-, +	-, -, +	-, +
6 Girls (Black) – 3 Animals (Green)	-, +	-, +	-, +
2 Person (light skin)- 6 Birds (Light Blue)	-, -, +	-, +	-, +
6 Cherries (Red) - 2 Mushrooms (White)	+	-, -, +	-, +
2 Turtles (Green) – 5 Penguins (Black)	+	-, -, +	-, +
3 Bells (Yellow) – 6 Trees (Green)	+	-, +	-, +
2 Wood (Grey) – 8 Snowman (White)	-, +	-, +	-, +
3 Deer (Grey) – 6 Gift Package (Blue)	-, +	-, -, +	-, +

The test results given in the Tables 1 and 2 indicate that the application, with its current version, is suitable for educational purpose. The students used the application without any problems. The usability of the application among the exceptional students makes it possible to enhance their learning activity together with the guidance of a teacher. The completed tests motivates the study to further improvements related to mathematics teaching. The Figure 13 shows the correct and incorrect answers of the students who joined our second test as a graph. In general, the test results are satisfactory and verifies the usability of the application for the students who need special education.

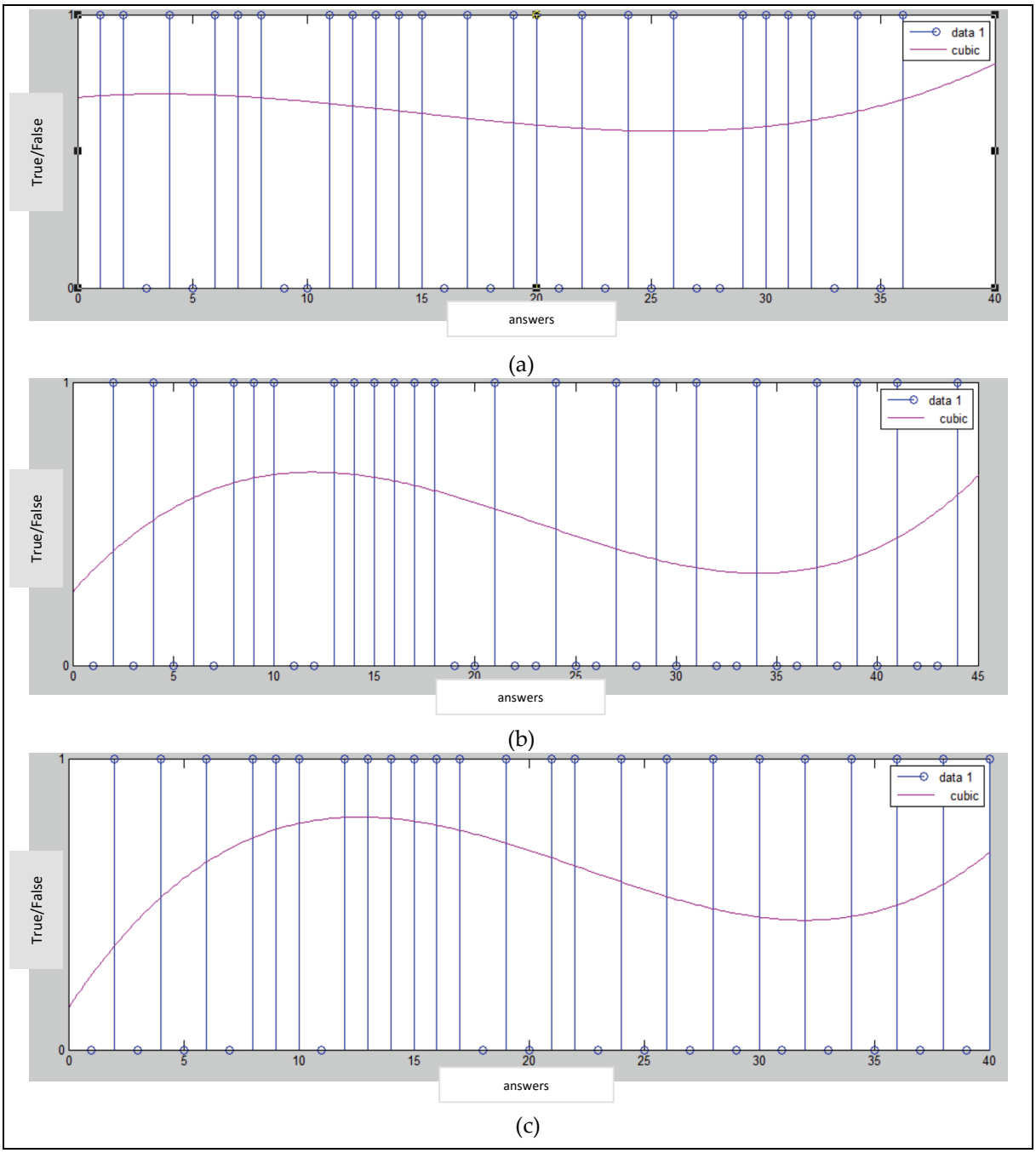

Figure 13. The Answers of the Students in the Sceond Test Part and Adaptation with Cubic Function: (A) Answers of the First Student (B) Answers of the Second Student (C) Answers of ohe Third Student

Discussion

In this study, a mobile application was developed to support the training of students who need special education. As indicated in the result section, the software was tested in two different schools. The aim of the tests is to determine the level of usability of the developed application. The test results indicate that the application can be used without any problem under the supervision of a teacher.

The current version is designed to teach the skills of identifying the quantity as "less" and "more", width as "thick" or "thin", length as "long" and "short", and the size as "big" or "small", based on objects. The teaching methodology that application uses is the staggering method that teaches starting from easy examples and going to more difficult examples.

With the current version, the program can be used as a supporting material to teachers in order to enhance their teaching activity. Although the effect of the program in teaching is not tested yet, it is planned to be tested in one of our future works. Considering the effect of visual information in teaching, obviously we expect that the student who watches the educational images of the program will improve their teaching. Therefore, the application is enriched in terms of images. Besides, the images are chosen in a way that not to fear or disturb the students.

Conclusion

The main purpose of this work is to design and develop software for children who need special education, teaching basic concepts via mobile devices and teaching aids. The designed software is aimed to be a teaching learning environment. The program is able to adapt to the different levels and learning speeds of individuals who need special education. Its purpose is to teach the basic concepts of quantity, width, length and size. The reason for choosing these concepts is to help students to become aware of the basic concepts in special education and to ensure that teaching is flexible. The developed software provides a more comprehensive written base that includes teaching all other concepts. For this reason the program has been developed in a modular structure. It is intended that the flow of the program that can teach the concept is updated if the images and audio files of the concepts are updated according to the concept to be taught. Another goal is that the program can be used by children who need special education. Audible notifications and visuals were selected in this direction.

The usability of the developed application has been tested. The test phase was completed with the contributions of real students. Current test results show that the developed application can be used by students who need special education. The future studies can be summarized as follows:

- The effectiveness of the developed software will be investigated by experiments.
- In the next version, chapters that teach basic arithmetic and mathematical skills will be added.
- All other concepts that are taught in the education of pupils in need of special education will also be added to the teaching software.
- The program will be redeveloped to be more responsive to students' educational needs. The staggering instruction method for the level of the learners will be restructured for each student according to different simplicity and difficulty ratings.
- Another topic is student level. For students at different levels, the program will also need to include different levels and apply the staggering method.

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