

An Evaluation of The Mobile Apps for Children with Special Education Needs Based on The Utility Function Metrics

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Abstract— Mobile apps can be used in various environments and at any time. People used them for learning, communications, and entertainment. Because of the ease use of mobile devices interface (like smartphone and tablet), then everyone, including the children with special needs, can have used them. In recent years, there has been an increase in the efforts of educational institutions and of scientists to support children in their daily life. Ongoing developments in communication and information technologies contribute to this process. The main goal of this study is to present the basic functional requirements for the mobile apps for children with special needs. The current state of the scientific research related to the design and development of mobile apps is discussed. This issue became very important in the last years because of an increase in the number of children with special needs on a worldwide scale is observed. And the same time the increase in the use of mobile technologies of them. The proposed model for the evaluation of potential utility provides for the classification of the mobile applications designed for children with special needs about their functionality features. This model is based on our studies of the state-of-art scientific works of many authors. What the model for the evaluation of potential utility, the 27 mobile applications for children with special needs, downloaded from the mobile application stores: Apple Store, Google Play and Store Windows Phone Apps, were classified and analyzed. The results showed that despite the variety of mobile applications, those that are suitable for children with special needs are too few. Most of the applications cover only half of the evaluation criteria, which means they have functionalities only for individual needs. Therefore, the proposed utility function metrics of the evaluation can be used as a basis for interface developing for mobile apps, appropriate for children with special needs.

Keywords— child-computer interaction; software engineering; children with special education needs; evaluation mobile apps utility.

I. INTRODUCTION

The term "Special education needs and disabilities (SEND)" is used for the children or young persons, who have certain disorders such as: reading/writing; an inability to socialization; inability to understanding; inability to concentrate for a long time; etc.

According to the last report of the National Statistical Institute of Bulgaria published in 2017, the number of the children's clinical diagnoses in Bulgaria below the age of 16 with some degree of disability was 5014, or 4.7 in one thousand people [1].

These figures are indicative of the need for the design and development of interactive platforms that will be used for support and development of the cognitive and social skills of children with disabilities in Bulgaria.

Among the most common illnesses are those of the autistic spectrum, cerebral palsy, Down syndrome, etc.

At present national programs aiming at the integration and socialization of children with special needs are implemented in Bulgaria. The problem in these programs is that the system of training is slow, and a lecturer is not able to manage the education process of all the children with special needs in the school. These methods are standardized and same for all the different cases; however, every child with such needs is unique and specific. In addition, there is not a standardized diagnostic methodology approved by the Ministry of Education and Science which can be used to determine the linguistic development of children and can be applied with children with communication disorders as well [2]. Computer technology such as specialized robots, smart rooms, personal computers with specialized sensory devices, mobile devices etc., can be used to support children with disorders and their families.

The use of self-learning artificial intelligence models and speech recognition are an integral part of the modern

development of assistive applications that adequately meet the needs of children with cognitive disorders.

However, the mobile technologies have achieved the greatest development in recent years. They represent the significant technological advances and are often the cheapest from the rest of the computer technology.

The main goal of this article is to present an evaluation model based on the utility metrics on mobile apps functions appropriate for children with special needs. To show the effectiveness of the proposed evaluation model several mobile apps are analyzed and evaluated. The results obtained are presented visually in charts and graphs at the end of the article and the ensuing conclusions are made.

II. MATERIAL AND METHOD

The idea of using computer technology including the mobile apps for children with special needs is not new. New computer technologies can support successfully the learning, social development and daily life of children with special needs and their parents [3], [4]. In recent years, there has been a significant interest of scientists and companies that develop mobile apps in the Mobile Learning for children with special needs. The use of mobile apps for learning has several advantages and they can be used in various environments and at any time. Because of the easy use of technologies, the smart mobile devices can be used by everyone. Moreover, the mobile apps enable collaborative learning and interaction between people, who are in different places in some moment. But when we develop mobile apps for the children with special needs, we must use different pedagogical methodologies, a different design way of the interface elements, and different functions of apps should be used to ensure their optimum utility [3].

In the considered scientific studies more attention is paid to children with autism and there are more mobile apps developed for them. Autism and the general term Autism Spectrum Disorders (ASD) are disorders in the human nervous system that often occur in infancy. The autistic children demonstrate difficulty in communication, social relationships and limited ability to focus on more than one stimuli [5]. These difficulties are named in [4] as the "Triad of Impairments". M. S. Eder and all. have presented a design to the interactive mobile game app for children with ASD, based on their study and analysis on previous studies of other authors.

The apps that can help to create a daily schedule for children with special needs are presented in [6], [7]. Those apps teach the children how to do their daily routine situations with photo pictograms. Their interfaces are simple and easy to use.

During the research for this article, the robotic devices that support children with special needs, described in the research literature, were found. Several scientists have used the robotic technology to support the development of their social skills and training, such as the humanoid robot Milo [8]. Another scientific experiment is related to the use of a robot in a smart room with the purpose to conduct free communication in the form of a game with children with ASD [9].

A mobile application, based on the principles of persuasive technology, which supports children with ASD

for their social and daily life skills is presented in [10]. This application is included in the practical training in several schools.

These are examples of different computer and robotic technologies for the support of the daily activities of children with various disorders, which are known with the term Assistive Technology in the literature.

The modern mobile technologies are becoming a mass phenomenon. Software developers have also directed their efforts towards the development of mobile apps.

And now the use of mobile apps as a means of support, rehabilitation, training and other activities related to the support and the treatment of people with disabilities and special needs is known as Assistive Technology Mobile. The features of the applications for children suffering from such diseases, that are the object of evaluation, are discussed in next subsection of this article.

A. Research methodology

The mobile application development for children with special needs can take place through various approaches in the modern software engineering. All of them are based on the interaction and the use of different kinds of media objects. But when it comes to applications for children and especially for those with special needs, then the approach used in developing the application, embedding some functionality and interactivity in it, must be clearly defined. Therefore, an approach for determining the evaluation classifiers, named utility function metrics, that can evaluate a mobile application as an appropriate one for children with disabilities is presented here.

M. Dawe presents an interesting approach reflecting the opinions of families with children with cognitive disabilities about their assistant technologies in their daily routine concerning the role and usefulness [11]. This article deals with the need for a detailed investigation of the actual benefits in the practical use of advanced technology in the lives of people with disabilities.

A study for the assistive mobile application for adults with disabilities is made in [12]. However, this study lacks an analysis of the applications designed for children with disabilities.

Similar surveys are given in [13], [14]. Many of the classifiers proposed in the present study lack in Ref. [13] and Ref. [14] which suggests that it must be considered as far more exhaustive.

Based on the literature review our utility metrics for evaluation of mobile apps functions, appropriate for children with special needs in Bulgaria, are:

- **Age:** According to the age which they are intended for, the apps are divided into two main groups: for ages 2-12 and without age restrictions.
- **Price:** The prices are: Free and Pay.
- **Mobile platform** (mobile operating systems): Generally speaking, there are three mobile platforms in Bulgaria: Android (Google Inc.), iOS (Apple Inc.), and Windows Phone (Microsoft) [15].
- **Related to science research:** It determines the availability of scientific publications related to specific mobile applications. This is extremely important to determine the ways in which scientific

theories related to Child-Computer Interaction and software engineering are used and practically applied in the software design. The importance of this classification is discussed by A. Antle in [16].

- **Work offline:** The work of children on the Internet is often associated with many risks and dangers, like inappropriate content, the provision of personal data to persons with unacceptable intentions, etc. This problem is intensified when they have some disorders though there is no scientific proof of this. One of the important advantages of software products designed for children is their work in the offline mode [17]. If necessary, the exchange of data on the Internet is preferable to be done in safe mode, and by web services [18].
- **Accessibility:** The applications must provide features as a minimum of gestures for control, children's speech recognition, appropriate colors of interface elements and characters, and a simple and intuitive interface [19]. There are studies on the participation of children with special educational needs and/or disabilities (SEND) in the interface design of the applications [20]. This allows the development of the application adapted to the views and needs of the children themselves.
- **Communication:** The children with autism have disorders in social relationships and social communication. The individuals with ASD usually have stereotypic behavior. It is believed that it is due to a deficiency in empathizing [21], [22]. The children with motor impairments also should talk with their friends and parents. Therefore, the availability of a way to send and receive short messages, or to maintain a video call or video chat, is an important part of the applications for children with special needs.
- **Social skills:** This classifier covers the use of secure virtual environments and the promotion of role-playing games as a means for exercising certain behavior in a social situation which will allow overcoming the social problems of children with autism [23].
- **Math skills:** Nowadays the use of educational games adapted for the age of children is a popular practice, although there is no precise and reasoned study related to the actual benefits of it [24]. The classifier "Math skills" covers all the functionalities of the applications which allows the development of logical thinking and mathematical skills.
- **Functional skills:** The use of mobile technology by children with disabilities and their families lead to improving their quality of life [25]. The children with ASD often have problems with the executive function (EF) [26]. This metric includes all the features that can enhance or can improve the functional skills of children, as their learning skills, cognitive skills, motor skills etc.
- **Languages:** This classifier covers the functionalities such as the apps for children's speech recognition including the speech of children with special needs, speech production, automatic reading of a text introduced by the child. According to [27] the children

with ASD often cannot deal with more than one stimulus and this affects their ability to understand speech. There are too few scientific studies on speech prosody in children with special needs. This is due to the limited set of data, the specifics of each case and the difficulty of speech production. In addition, children with autism have difficulty in understanding the joke (humor, irony), lie (deception) and figurative speech [28].

- **Organizer:** The ability to create organizational calendars in which daily or weekly tasks can be distributed at a certain time and day. They can be accompanied by a description with a text or pictograms to illustrate the action. Applications suitable for children with special needs should be able to illustrate systematic, consistent and simplified daily operations such as getting dressed, eating, walking, etc. [29].
- **Entertainment:** It includes modules for entertainments as games, music and other fun items. The games must stimulate their ability to focus on more items at the same time, because children with ASD often focus only on one stimulus ignoring all other incentives [30], [31].
- **Educational:** The interactive applications that are run only with a touchscreen display are attractive for all children, including those with cognitive disorders. The last few years have seen a growing number of mobile applications used as a main or additional resource in the education of children in the early stages [17]. The interest in their use as a way of training children with special educational needs is the same.
- **Medical care:** The apps should allow quick connection to a medical practitioner, short instructions with pictograms for primary care or some other situations associated with medical care [32], [33]. Mobile devices such as tablets and smartphones have been already used in the support of the speech therapy of children [34]. On the other hand, despite the considerable number of literary sources, showing the positive impact of mobile technology, the scarcity of academic research related to the degree of improvement in specific communicative, emotional or cognitive skills in children with specific educational needs must be pointed out.
- **Use media like video, audio, images:** Each sentence represents a sequence of pictograms which describes an event or action that the child must carry out or wants to say. The aim is to stimulate the production of speech, since the pictograms can be used as visual markers. Similar cardboard cards are used in the actual work with children with communication disorders known as the PECS [35]. Another frequently used incentive in the applications for children with communication disorders are video instructions [36].

The discussed utility function metrics are used to determine the evaluation model on mobile apps functions appropriate for children with special needs. The evaluation aims to assess applications for mobile devices designed for children with special needs depending on their functionality.

The proposed metrics are important both for the developers of such software products and for the users who can decide to what extent an application will be helpful. This will reduce the tendency families with children with disabilities to purchase costly applications which they subsequently do not use since they are not applicable to their needs, as noted in Dawe [11].

It should be noted that these metrics cover all the functionalities that apps intended for children with special needs may have. Since our model is universal, we have assumed that the weight of all metrics is the same. The effectiveness of similar mathematical models applied in software design, software architectures and software evaluation are discussed in [37], [38].

The proposed utility metrics are used in the evaluation of potential usability of mobile apps for children with special needs, denoted by E_{PU} .

E_{PU} is obtained by the equation (1):

$$E_{PU} = \frac{\sum_{i=1}^n x_i}{n}, \text{ where } x_i = \begin{cases} 1, & \text{if true} \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

In equation (1) the utility function metrics are denoted with x_i , and n is their total number.

The resulting evaluation can be in the range of 0 to 1. If the obtained value is 0 it means that the application is inappropriate, and, if this value is 1, it means that the application is entirely the most appropriate. If an application has more functionality, then its evaluation for potential utility (E_{PU}) will be a number with decimal point, with a value between greater than 0 and less than 1. When the obtained value of the E_{PU} is under 0.25 then we can say that application is rather unsatisfactory for children with special education needs. When the obtained value of the E_{PU} is greater than or equal to 0.25 and less than 0.5, then the evaluated mobile application is unsatisfactory for children with special education needs. If the obtained value of the E_{PU} is greater than or equal to 0.5 and less than 0.75 then this mobile application is appropriate for children with special education needs because it has more usability functions. If the obtained value of the E_{PU} is greater than or equal to 0.75 that it means this mobile application is the more appropriate for children with special education needs because it has more usability functions.

The outlined utility function metrics can be used as a base for applications design with the appropriate interface adapted for all children while attention is paid mainly to the specific needs of children with special needs. Also, it should be noted that a classifier combines similar indicators whose influence will be analyzed and studied in a future study.

III. RESULTS AND DISCUSSION

In these section 27 mobile applications for children with special needs, downloaded from the mobile application stores: Apple Store (for iOS), Google Play (for Android) and Windows Store (for Windows Phone) are discussed (Table I). For their classification, evaluation and analysis the utility metrics described in the previous section of this article are used.

All apps were found by searching in the search engine Google with a keyword "autism", "mobile application for

children with special needs", "assistive mobile technology", and respectively, in the stores of Apple, Google and Microsoft. Some of these applications were recommended by the International Association Autism Speaks [39].

The research apps are suitable for children with the following disorders: Autism, Cerebral Palsy, Down syndrome, Angelman syndrome, Rett syndrome, and children with physical and hearing impairments. Most of them are designed for children with autism (93% or 25 applications from 27), the smallest number of the apps are de-signed for children with cerebral palsy (33% or 9 applications from 27). Only 6 applications (22%) of all investigated apps are suitable for all the disorders listed above. These are: A BuZoo Story, Aacorn AAC, Avatalker AAC, Learn with Rufus: Emotions, LetMeTalk, Quick Talk AAC. The only specialized application for children with Down syndrome is Match & Find. Thus, after this investigation it can be concluded that on average one mobile application is suitable for approximately 69% of the presented disorders (see Figure 1).

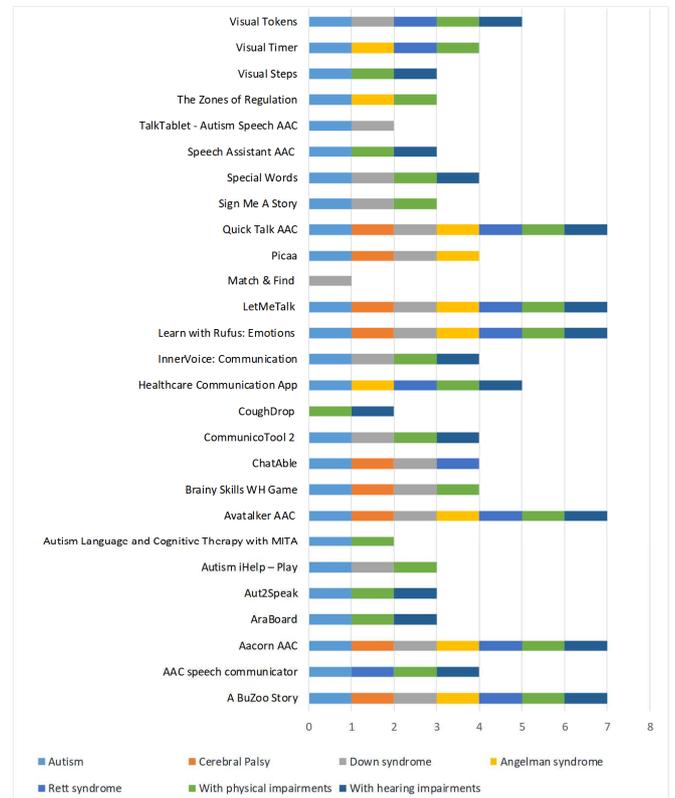


Fig. 1 A diagram of the mobile applications suitable for the children with disorders

English is the main language of the investigated mobile apps' interfaces. The other supported languages are Spanish and French (in 9 apps); Polish and German (in 7 apps); Russian (in 5 apps); Brazilian Portuguese, Catalan, and Arabic (in 4 apps); Portuguese, Galician, Italian, Swedish, Japanese, and Dutch (in 3 apps); Chinese, Bulgarian, Romanian, and Norwegian (in 2 apps); Afrikaans, Albanian, Turkish, Ukrainian, Welsh, Croatian, Finnish, Hindi, Luxembourgish, Basque, and Euskara (each of them in 1 app). This statistical information is presented in Fig. 2.

From the perspective of this study the major drawback of these applications is that there are only 2 applications of the Bulgarian language (the apps “LetMeTalk” and “Special Words”), and so they are too scarce for the Bulgarian children with special needs. Therefore, this study suggest that it is important to design appropriate assistive applications for children with special needs in the Bulgarian

language. A conceptual model and interface of the pilot application for teaching children with special needs “ChilDiBu” is presented in [40]. For the present moment this app is establishing the effectiveness of the developed application for a larger audience.

TABLE I
ANALYSIS OF AGE, PRICE, MOBILE PLATFORM AND AVAILABLE SCIENTIFIC PUBLICATIONS FOR RESEARCH APPLICATIONS

Mobile apps	Age	Mobile platform			Price	Science research	Links to download
		Windows Phone	Android	iOS			
A BuZoo Story	All	No	Yes	No	\$15,00	No	https://play.google.com/store/apps/details?id=com.shailah.BuZooStoryPaid
AAC speech communicator	All	No	Yes	No	Free	[41]	https://play.google.com/store/apps/details?id=com.epfl.android.aac_speech
Aacorn AAC	All	No	No	Yes	\$189,00	[42]	http://www.aacornapp.com/
AraBoard	All	No	Yes	No	Free	[19], [43]	http://giga.cps.unizar.es/affectivelab/ara_dwnId.html
Aut2Speak	All	No	Yes	No	\$1,00	[12]	https://play.google.com/store/apps/details?id=com.pineapple.aut2speak&hl=bg
Autism iHelp – Play	All	No	Yes	Yes	Free	[33]	https://play.google.com/store/apps/details?id=com.mindpacetech.Autism_iHelp_Play
Autism Language and Cognitive Therapy with MITA	All	No	Yes	Yes	Free	[29]	https://play.google.com/store/apps/details?id=com.imigration.mita
Avatalker AAC	6-12	No	No	Yes	\$49,99	No	http://avatalkeraac.com/
Brainy Skills WH Game	All	No	No	Yes	\$1,99	No	https://itunes.apple.com/us/app/avatalker-aac/id796694627
ChatAble	All	No	No	Yes	\$99,00	No	https://www.therapy-box.co.uk/chatable
CommunicoTool 2	2-12	No	Yes	Yes	Free	No	http://communicotool.com/en
CoughDrop	All	Yes	Yes	Yes	\$200,00	No	https://itunes.apple.com/us/app/communicotool-2/id1034318912
Healthcare Communication App	All	No	Yes	Yes	\$6,00	No	https://play.google.com/store/apps/details?id=net.ctexdev.communicotool&hl=bg
InnerVoice: Communication	All	No	No	Yes	\$99,99	[42]	https://itunes.apple.com/us/app/innervoice-augmentative-alternative/id730856179
Learn with Rufus: Emotions	2-12	No	Yes	Yes	\$4,99	No	https://github.com/CoughDrop/coughdrop
LetMeTalk	All	No	Yes	Yes	Free	[12]	http://healthcarecommunicationapp.com/
Match & Find	2-12	No	No	Yes	\$7,99	No	https://itunes.apple.com/us/app/innervoice-augmentative-alternative/id730856179
Picaa	All	No	No	Yes	Free	[44]	https://itunes.apple.com/us/app/picaa/id373334470
Quick Talk AAC	All	No	Yes	Yes	\$24,99	No	https://itunes.apple.com/us/app/learn-with-rufus-emotions/id721911239?
Sign Me A Story	6-12	No	Yes	Yes	Free	[14]	https://play.google.com/store/apps/details?id=de.appnotize.letmetalk
Special Words	2-12	No	Yes	Yes	\$12,99	[45]	https://itunes.apple.com/us/app/match-find/id833434155
Speech Assistant AAC	All	No	Yes	No	\$9,99	[46], [47]	https://itunes.apple.com/us/app/picaa/id373334470
TalkTablet - Autism Speech AAC	All	Yes	Yes	Yes	\$79,99	[47]	http://www.talktablet.com/
The Zones of Regulation	All	Yes	Yes	Yes	\$5,99	[32]	https://itunes.apple.com/us/app/sign-me-a-story/id628136371
Visual Steps	All	Yes	No	No	\$5,99	No	https://play.google.com/store/apps/details?id=com.signmeastory.apps.gb&hl=bg
Visual Timer	All	Yes	No	No	Free	No	https://itunes.apple.com/us/app/special-words/id451723454?mt=8
Visual Tokens	All	Yes	No	No	\$3,99	No	https://play.google.com/store/apps/details?id=com.specialiapps.specialwords&hl=bg

TABLE II
THE FUNCTIONAL CHARACTERISTICS OF THE MOBILE APPLICATIONS BASED ON THE UTILITY METRICS

Mobile apps	Work offline	Accessibility	Communication	Social skills	Math Skills	Functional skills	Languages	Organizer	Entertainment	Educational	Medical care	Use media like video, audio, images
A BuZoo Story	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	No	Yes
AAC Autism Talk Now	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes
Aacorn AAC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AraBoard	No	No	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes
Aut2Speak	Yes	No	Yes	No	No	No	Yes	No	No	No	No	No
Autism iHelp – Play	Yes	Yes	No	Yes	No	No	Yes	No	No	Yes	Yes	Yes
Autism Language and Cognitive Therapy with MITA	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	No	Yes
Avatalker AAC	Yes	No	Yes	Yes	No	No	Yes	No	No	No	No	Yes
Brainy Skills WH Game	Yes	No	Yes	No	No	Yes	Yes	No	Yes	Yes	No	No
ChatAble	No	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	No	Yes
CommunicoTool 2	Yes	No	Yes	No	No	Yes	No	Yes	No	No	No	Yes
CoughDrop	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	Yes
Healthcare Communication App	Yes	No	Yes	No	No	Yes	No	No	Yes	No	Yes	Yes
InnerVoice	No	Yes	Yes	No	No	No	Yes	No	No	No	No	Yes
Learn with Rufus: Emotions	Yes	No	Yes	Yes	No	No	Yes	No	No	No	No	Yes
LetMeTalk	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	No	Yes
Match & Find	Yes	No	Yes	No	Yes	No	Yes	No	No	No	No	Yes
Picaa	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	No	Yes
Quick Talk AAC	Yes	No	Yes	No	No	No	No	No	No	No	No	Yes
Sign Me A Story	Yes	No	Yes	No	No	No	No	No	No	No	No	Yes
Special Words	Yes	No	Yes	No	No	No	Yes	No	No	No	No	Yes
Speech Assistant AAC	No	No	Yes	No	No	No	No	No	No	No	Yes	Yes
TalkTablet	No	No	Yes	No	No	No	No	No	No	No	No	Yes
The Zones of Regulation	No	No	No	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes
Visual Steps	No	No	No	No	No	Yes	No	Yes	No	No	No	Yes
Visual Timer	Yes	No	No	No	No	Yes	No	Yes	Yes	No	No	No
Visual Tokens	Yes	No	No	No	No	Yes	No	Yes	No	No	No	Yes

Table 1 presents the analysis of the studied mobile applications with the utility function metrics: Age, Price, Science research and Mobile platform. Only 33% (9 apps) from all apps are free; some of the paid apps cost about \$200. Per Google Scholar and Scopus 52% of the applications (Table 1, column “Science research”) have been dealt with in scientific publications related to their development, analysis and/or results of their practical use are presented. From all 27 tested mobile applications 21 are without age restrictions; the others are appropriate for children aged 2 to 12 years. The widest variety of applications belong to Android – 63% (17 out of 27), iOS – 70% (19 out of 27), and the smallest variety belongs to Windows Phone – 22 % (6 out of 27).

Some of the publications investigate only the availability of mobile apps for children with special needs, without providing an analysis or assessment; others (only 10% of the total number) have provided in-depth research and analysis, but they lack evaluation.

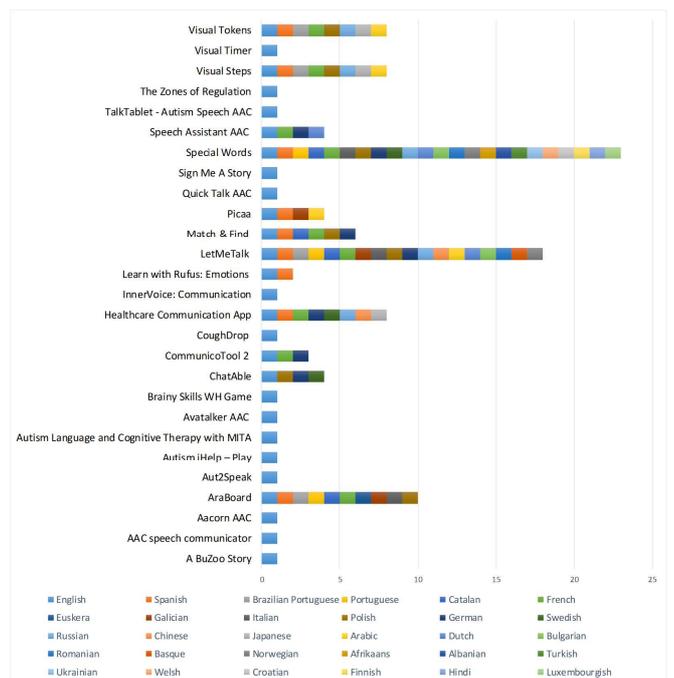


Fig. 2 Supported languages in the investigated mobile applications

The results obtained from the study of the functional characteristics of the mobile applications based on the evaluation proposed in the previous section (Work offline; Accessibility; Communication; Social Skills; Math Skills; Functional Skills; Languages; Organizer; Entertainment; Educational; Medical Care; Use media like video, audio, images) are presented in Table 2. The biggest part of the apps interfaces (89% of all, or 24 out of 27) use media like video, audio, image. The math function is the least of all (7% of all, or only 2 out of 27). In addition, more than half of the applications can work offline (70% of all, or 19 out of 27), and they support some communication (81% of all, or 22 out of 27). There is language support such as speech recognition and/or speech generation in only 63% (17 out of 27 apps) of all. The other tested features are supported in fewer than half of the whole number of them.

What is common for all the investigated mobile apps is that they are primarily aimed at assisting the communication between users providing the ability to send short messages, video messages, e-mails, and in most cases, their interface is based on pictograms.

The evaluations of the potential usability for each of the apps are calculated using the data presented in Table 1 and Table 2 and with equation (1), where “Yes” is replaced with “1” and “No” is replaced with “0”, and “n = 12”. As already mentioned, this is the evaluation that can determine whether an app is satisfactory for various disorders and whether it has more utility functional features. The obtained result is presented in Fig. 3.

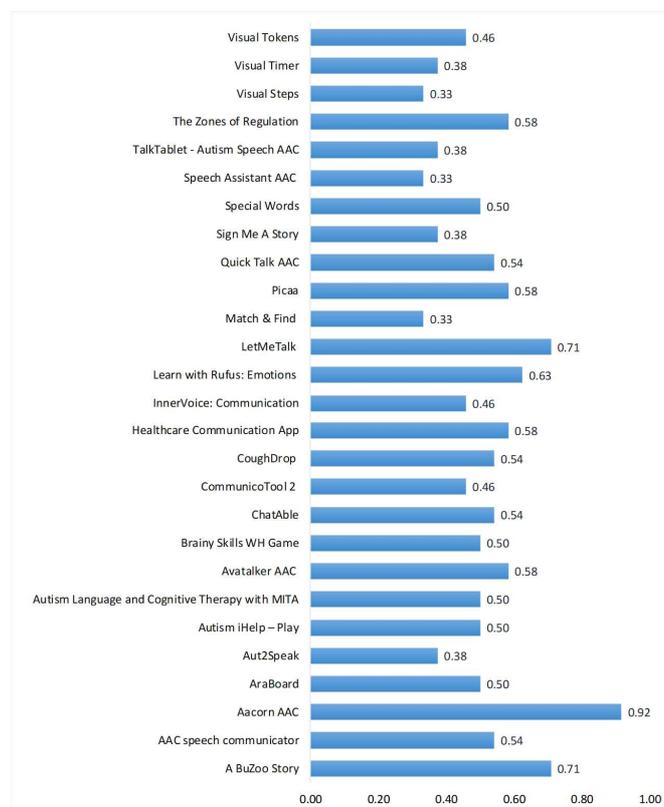


Fig. 3 The evaluations of the potential usability for mobile apps

From the obtained results of the evaluation of the potential usability of the mobile applications, we can see that

63% of all (17 of 27) satisfy half of the proposed utility function metrics, and only 3 apps satisfy them over 70%.

The lack of such a wide variety of applications that can be downloaded for free or be purchased from the shops of the mobile operating systems is a troubling fact. This is an indicator from which it can be concluded that the assistive mobile technology is still developing and refining. This model is an attempt to achieve a unified standardization of all mobile applications for children with special needs.

IV. CONCLUSIONS

The fast development and the lower price of mobile devices lead to their widespread use in daily life. Today they are used as assistive technologies by people with disorders. In modern software engineering, the development of mobile applications can be designed in different ways. What is common for all of them is the degree of interactivity and the use of various media objects. But when it comes to applications for children with special needs, in that case, the design of the interface, the media objects and the degree of interactivity must be strictly defined. That is why this article has presented an approach for determining the basic functional requirements for the mobile assistive applications for children with special educational needs. The current state of the existing research related to the design and development of interface of applications for children with communication disorders has been discussed. The 27 mobile applications (apps) for children with special needs, downloaded from the mobile application stores: Apple Store (for iOS), Google Play (for Android) and Store Windows Phone Apps (for Windows Phone) have been taken into consideration. For their classification and analysis, the proposed utility function metrics have been used which are designed to define the applications offering the most functionality and are suitable for children with special needs. For the evaluation of apps, the proposed evaluation of potential usability was used.

As a result of this study it can be said that despite the huge variety of applications in the various stores, those that are suitable for children with special needs are too few. Most of the applications cover only half of the evaluation criteria, which means they have functionalities only for individual needs. With the use of these criteria (utility function metrics) more large-scale applications that will be of greater benefit for children with special needs and their parents can be developed. The future work on this issue is the design and development of apps with these utility function metrics and then testing them in real conditions.

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