Use of mobile technologies in special education: A content analysis

Iskender Volkan Sancar*, PhD Canditate, Anadolu University, CEIT, Eskisehir, Turkey
Suleyman Burak Tozkoparan, PhD Canditate, Anadolu University, CEIT, Eskisehir, Turkey
Hatice Ferhan Odabasi, PhD, Professor, Anadolu University, CEIT, Eskisehir, Turkey

Abstract

This study represents a content analysis of scientific articles on the use of mobile technologies in special education. Within this scope, 19 out of 51 articles that are published in journals indexed in Social Science Citation Index and/or Education Resources Information Center were selected in compliance with inclusion and exclusion criteria. The content analysis was performed on the basis of the year published, countries where the research conducted, number of citations, age or level of the sample, sample size, research method, type of disadvantaged group and the mobile technologies used. Findings show that a great majority of the studies focused on disabilities, such as autism spectrum disorder, Down's syndrome and intellectual disability. Most of the studies were conducted in the USA and focused on skill acquisiton/improvement. Further research on mobile technologies in special education is needed addressing K-12 or higher levels, for visual and hearing impaired individuals. As product design, usage or usability studies were scarce; product development-oriented studies are suggested.

Keywords: Special education, mobile technology, disabled children, content analysis, assistive technology.

---

* ADDRESS FOR CORRESPONDENCE: **Iskender Volkan Sancar** , PhD Canditate, Anadolu University, CEIT, Eskisehir, Turkey
E-mail address: sancar.iskender@gmail.com

1. Introduction

Today, in the age of information, the need and the desire of reaching resources more practically at anytime and anywhere are increasing day by day. Technologies used by the individuals of information society have become widespread and continue to develop in parallel with the need of reaching information more practically. In fact, these technologies have gained such a position that they regulate, direct and shape the social relations of individuals (Englert, Manalo & Zhao, 2003). In the meantime, field and purpose of use of these technologies are expanding. From an educational point of view, it might be considered a factor that facilitates the participation of individuals in the educational process and activities (Englert et al., 2003). It is stated by teachers that it is useful to use educational technologies such as augmented reality, game-based educational software and animation projects in order to attract the attention of students who need special education (Mohd Yusof, Dainel, Low & Aziz, 2014).

In their study, Seemaan and Kiwan (2017) used a Web 2.0 tool called 'Kubbu' to facilitate the learning process of the fourth-grade students with physical, emotional or behavioural learning difficulties. The study reports that the students' performance levels increased and they learned the concepts intended. Monibi and Hayes (2008) have developed a mobile prototype for special education called 'Mobile Communications Tools (Mocoto)' and it is still under development based on the latest advancements in the machine learning technology.

The special education literature supports the use of assistive technologies in educational activities. For instance, as suggested by Alnahdi (2014), it may be more practical and useful to teach students with disabilities to use a calculator than to teach basic mathematical operations. In a similar way, it might be easier and a more effective way to teach a visually impaired individual how to use an automated text reader than to teach the Braille alphabet. Nam, Bahn and Lee (2013) have reported that perceived ease of use was one of the most important factors in the use of assistive technologies in educational environments. Flanagan, Bouck and Richardson (2013) have investigated the perceptions of secondary level special education teachers on the use of assistive technology during their literacy education with students of the high incidence disabilities group. According to the results, although teachers appraised the assistive technologies as useful tools for literacy course, they used them at a minimum level because of the cost and lack of training and experience. In the study, it was also stated that the students who have positive experiences with assistive technologies in the courses are more willing to use assistive technologies in the following courses.

As a consequence of recent concentration on mobile devices in technological developments, significant changes have been experienced in daily lives. Today, mobile technologies have become an indispensable part of human life. So that it is almost impossible to ignore these technologies in educational processes, which bring us to the concept of *mobile learning*. Mobile learning provides individuals with the ability to interact with content via mobile devices and to study with their own speed in a customised learning process (Cevahir & Ozdemir, 2015). Beyond meeting the educational needs of disabled individuals, mobile applications have the potential to solve various problems, such as the development of communication skills and the development of muscles (Cevahir & Ozdemir, 2015). They are also helpful to attract their attention and provide them with edutainment opportunities (Hanayli, Serbest & Urekli, 2015). Mobile technologies also support teachers who are working with disabled students (Kagohara et al., 2013).

The use of mobile technologies such as iPads for educational purposes might increase the communication opportunities of individuals with developmental and neurological disabilities, increase the awareness and social acceptance of augmented and alternative communication systems, increase the level of adoption and functionalise these technologies. It is suggested that these technologies should not be utilised as tools only but should be taken into consideration together with the opportunities they offer as well, and innovative models should be developed based on these technologies. It is also stated that there is a need of an effective cooperation of the main stakeholders

in research and development activities that are carried out to increase the communication opportunities of special education students using mobile technologies (McNaughton & Light, 2013).

Odabasi et al. (2009) investigated the effectiveness of using PDAs in the courses of hearing-impaired students. The research suggests that, at the integration of mobile technologies into educational processes of the students in need of special education, it is advantageous to give continuous and punctual technical support, to provide students with practical information about the usage and also to give long enough time to them to get used to PDAs. The study concludes that PDAs are helpful to motivate students, integrate high-quality images into course content, strengthen constructive communication and collaboration on course contents.

Kuzu, Cavkaytar, Cankaya and Oncul (2013) developed mobile-based skills teaching software for the use of parents of individuals with intellectual disabilities. The software provides parents with general information on mentally handicapped individuals and with educational content on how to teach certain skills to their children. A total of 107 parents who participated in the study appraised the software in terms of usefulness, ease of use and design. They also stated that the software can help parents teach daily life skills to their children and that such software developed for mentally disabled individuals may turn mobile devices into instructional environments.

The most important goals in the education of individuals with intellectual disabilities are to develop independent life skills and to improve the quality of life (Kuzu et al., 2013). In recent studies, although it was suggested that technology applications increased the success of students in need of special education and were recommended to be used in educational processes, it can be said that the technology and opportunities it provides cannot be used with full potential in the field of special education (Englert et al., 2003; Parsons, Daniels, Porter & Robertson, 2008). Meanwhile, it is proposed that there are few research studies in the literature related to the subject area (Cevahir & Ozdemir, 2015). The underlying reasons why this potential could not be fully put in use might be listed as;

- teachers' incompetency about knowledge and usage of technological tools, as well as other educational technologies,
- unsatisfying knowledge on the general curriculum,
- limited perspective and lack of technical staff and support (Judge & Simms, 2009).

Beyond these, the difficulties in the traditional methods, the deficiencies in the infrastructure and the shortcomings in teachers' field of expertise are listed as handicaps in the process of integration of ICT in special education in developing countries, which might be overcome if digital literacy is taken into consideration (Altinay Aksal & Altinay Gazi, 2015). Ayres, Mechling and Sansosti (2013) reports that the cost of acquisition, maintenance and electricity of all devices to be used in the process, keeping these devices ready for use, all individual tasks to be given to students and meeting the needs of students are the drawbacks of the integration of mobile technologies.

Ozguc and Cavkaytar (2016) created a classroom environment equipped with high-tech products such as tablets and interactive boards for students with mild mental disabilities in a public school and prepared technology-based learning activities for the Science and Technology course. As emphasised in their study, while the treatment led to an increase in students' academic achievements, the problems encountered during the training could lead to new behavioural problems in the students, and teachers should be precautious against these situations. Results show that it is crucial to determine the student needs during the integration process, to provide and/or develop e-content and to plan educational activities taking these needs into consideration.

Children in need of special education have problems developing their cognitive skills and need to develop their behavioural, communicative and relational interactions with their environment (Fernandez-Lopez, Rodriguez-Fortiz, Rodriguez-Almendros & Martinez-Segura, 2013). Family support is important, especially in the education of individuals with intellectual disabilities (Kuzu et al., 2013). Besides, in traditional classroom environments, blended learning method is recommended to provide mobile technology-supported education to students with special educational needs (Mohd Yusof et

al., 2014). Updates in teacher education programmes and special education curricula are considered crucial in terms of integration of mobile technologies into special education processes, and in-service training on technologies to be used for teachers and families are also recommended (Altinay Aksal & Altinay Gazi, 2015).

Cevahir and Ozdemir (2015) have examined the studies on mobile learning with handicapped individuals between the years of 2005 and 2015 through content analysis. A total of 31 studies were analysed and analysis showed that the most studied group was individuals with autism and similar disabilities, and the least studied group was individuals with developmental disabilities. It was reported that the majority of the research studies examined were qualitative research studies, which might be due to the challenges in collecting quantitative data from individuals with disabilities, and survey method was used as data collection tool in 42% of the studies.

The literature suggests that the use of mobile technologies in special education is important and it emerges as a new approach (Altinay Aksal & Altinay Gazi, 2015; Cevahir & Ozdemir, 2015; Doenyas, Simdi, Ozcan, Cataltepe & Birkan, 2014; Hart & Whalon, 2012; Miller, Krockover & Doughty, 2013; Odabasi et al., 2009). However, there are no studies to demonstrate the cumulative situation of the literature and to synthesise the use of mobile technologies in special education qualitatively. Therefore, a content analysis on the use of mobile technologies in the field is considered to represent worthwhile findings to the researchers studying on the field and guide them in future studies. Within this scope, the aim of this study is to investigate the studies related to the use of mobile technologies in special education. The relevant studies in Social Science Citation Index (SSCI) and Education Resources Information Center (ERIC) databases have been examined within the framework of certain criteria and the current situation has been synthesised qualitatively. With these purposes in mind, answers to the following questions are sought:

1. In which countries did the studies on the use of mobile technology in special education carried out?
2. What is the number of citations of the studies on the use of mobile technology in special education?
3. What are the age groups of participants in the studies on mobile technology use in special education?
4. What is the sample size of the studies on the use of mobile technology in special education?
5. Which research methods are often used in studies on the use of mobile technology in special education?
6. Which disadvantages are the focus on the studies on the use of mobile technology in special education?
7. What kinds of mobile devices and applications are available for mobile technology use in special education?

2. Method

In this study, content analysis method was preferred for the purposes of the research. Cohen, Manion and Morrison (2007) briefly described content analysis as 'summarising and reporting the main content and the messages of the data'. In other words, content analysis is the composition of data similar to each other within certain concepts and themes and interpretation in an easy-to-understand format (Yildirim & Simsek, 2006). In addition, content analysis and synthesis play an important role in the dissemination of research and shaping future research and applications (Suri & Clarke, 2009).

2.1. Data collection process

In the process of data collection, it was decided by the researchers to examine the articles in SSCI vs ERIC indexes. The main reason for examining the articles in the journals in SSCI and ERIC indexes is the assumption that the articles published in the aforementioned indexes subject articles evaluations in

international standards and that these publications will provide more reliable results (Acar-Guvendir & Ozer-Ozkan, 2015).

Access to the articles has been provided through Anadolu University Library. In order to avoid data loss during the scanning of articles, no year limitation was made. 'Special education' 'mobile' and 'technology' keywords were searched together and a total of 58 articles were reached (SSCI = 18, ERIC = 40). The articles reached were recorded into the database application and compared. It was observed that seven articles have been published in the journals indexed in both SSCI and ERIC. The remaining 51 articles (SSCI = 11, ERIC = 33, SSCI & ERIC = 7) were independently screened by two researchers according to the specified inclusion/exclusion criteria, the results were compared and it was decided by consensus on the inclusion of 19 articles (SSCI = 5, ERIC = 11, SSCI & ERIC = 3) in the study (Figure 1).
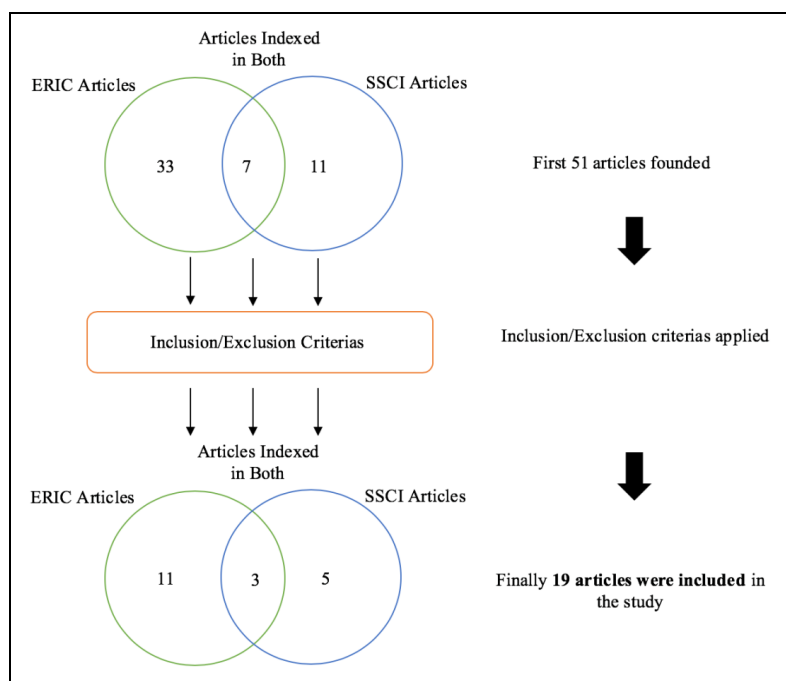
Figure 1. Selection phases of the articles

Criteria for inclusion and exclusion of articles;

- Article published in journals in selected indexes: The articles that have been published in conference and symposium proceedings, book reviews, etc. were not included in the study, only the articles published in peer-reviewed scientific journals in the SSCI and ERIC databases were included.
- Compliance with the research area: The articles on mobile technologies and special education are included in the study.
- Having students among participants: It was paid attention to the participants of the articles included in the study not only formed with teachers, parents, etc. The articles included which at least a part of the participants were special education students or individuals with special needs.

In addition to these criteria, the articles that do not contain an implementation, such as literature review, meta-analysis, meta-synthesis studies, etc. were excluded from the scope of the study.

Table 1. List of the articles

Code	Journal	Article Name	Authors
E01	Education and Treatment of Children	Using a Mobile Handheld Computer to Teach a Student with an Emotional and Behavioral Disorder to Self-Monitor Attention	Gulchak (2008)
E02	International Journal of Special Education	Reflections of Hearing Impaired Students on Daily and Instructional PDA Use	Odabasi, Kuzu, Girgin, Çuhadar, Kiyici & Tanyeri (2009)
E03	Journal of Special Education Technology	An Examination of Hand-Held Computer-Assisted Instruction on Subtraction Skills for Second Grade Students with Learning and Behavioral Disabilities	Nordness, Haverkost & Volberding (2011)
E04	International Journal of Special Education	Exploring Communication Technology Behaviour of Adolescents with Cerebral Palsy in Singapore	Nonis (2015)
E05	International Journal of Mobile and Blended Learning	Moblogging Type and Its Relation with Usability and Development of Knowledge Management Skills for Blind Students	Mostafa (2015)
E06	Journal of Educational Technology	Teaching Math to Deaf/Hard-of-Hearing (DHH) Children Using Mobile Games: Outcomes with Student and Teacher Perspectives	Shelton & Parlin (2016)
E07	Education and Information Technologies	Information Practices and User Interfaces: Student Use of an iOS Application in Special Education	Epp, McEwen, Campigotto & Moffatt (2016)
E08	Journal of Special Education Technology	Effects of Direct Systematic Instruction on Google Glass Orientation with Individuals with Intellectual Disability	Kelley, Rivera & Kellems (2016)
E09	Journal of Special Education Technology	Effects of Explicit Vocabulary Videos Delivered through iPods on Students with Language Impairments	Lowman & Dressler (2016)
E10	IEEE Transactions on Learning Technologies	Specialized Intervention Using Tablet Devices for Communication Deficits in Children with Autism Spectrum Disorders	Cabielles-Hernández, Pérez-Pérez, Paule-Ruiz & Fernández-Fernández (2017)
E11	Journal of Special Education Technology	Examining Augmented Reality to Improve Navigation Skills in Postsecondary Students with Intellectual Disability	Smith, Cihak, Kim, McMahon & Wright (2017)
S01	Journal of Computer Assisted Learning	The Internet for Educating Individuals with Social Impairments	Bishop (2003)
S02	Action Research	iPads as Instructional Tools to Enhance Learning Opportunities for Students with Developmental Disabilities: An Action Research Project	Cumming, Strnadova & Singh (2014)
S03	Education and Science	Integrating Mobile Applications into Hearing Impaired Children's Literacy Instruction	Yaman, Dönmez, Avcı & Yurdakul (2016)
S04	Education and Science	A Mobile Application Design for Students Who Need Special Education	Karanfiller, Göksu & Yurtkan (2017)
S05	Assistive Technology	Employing Mobile Technology to Improve Language Skills of Young Students with Language-Based Disabilities	Rodríguez & Cumming (2017)
SE01	Computers & Education	Especially Social: Exploring the Use of an iOS Application in Special Needs Classrooms	Campigotto, McEwen & Epp (2013)
SE02	Computers & Education	Mobile Learning Technology Based on iOS devices to Support Students with Special Education Needs	FernáNdez-LóPez, RodríGuez-FóRtiz, RodríGuez-Almendros & MartíNez-Segura (2013)
SE03	Journal of Science Education and Technology	Podcasts on Mobile Devices as a Read-Aloud Testing Accommodation in Middle School Science Assessment	McMahon, Wright, Cihak, Moore & Lamb (2016)

In this study; two researchers worked together on coding the included articles, the articles were examined separately by each researcher and two main themes were determined. The themes are discussed in detail and encoded (Tables 2 and 3).

Table 2. Themes and codes

Main theme code	Themes
SI	Skill improvement of participants with mobile technology
PDU	Product design, usability or usage of mobile device or app

In order to ensure the reliability of the study, two articles were selected randomly from the main themes determined by the researchers and analysed on an individual basis and the results were compared; the results were substantially similar. Researchers worked together at points of discordance and required corrections were made at points where inconsistent.

Table 3. Articles analyzed by themes

Main Theme	Article Code	Year	Country	Citation	Sample Ages - Levels	Sample Size	Method	Disability	Mobile Technology
SI	E01	2008	USA	96	8	1	Single Subject Experimental	Emotional and Behaviour Disorder	PDA
	E03	2011	USA	22	7	3	Single Subject Experimental	Learning and Behavioral Disabilities	iPod Touch
	E04	2015	Singapore - Australia	3	14 to 18	9	Qualitative	Cerebral Palsy	Smartphone - Handphone - Tablet
	E05	2015	Saudi Arabia	4	Graduate	17	Quasi-experimental	Blind	Smartphone
	E06	2016	USA	0	9 to 11	24	Design-Based Research	Deaf/Hard of Hearing (Hearing Impaired)	Smartphone
	E09	2016	USA	0	10 to 11	12	Experimental	Specific Language Impairment	iPod
	E10	2017	Spain	2	3 to 8	11	Mixed-Methodology	Autism Spectrum Disorder	Tablet
	E11	2017	USA	3	23 to 25	3	Single Subject Experimental	Intellectual Disability	iPhone
	S02	2014	Australia	43	13 to 16	4	Action Research	Developmental Disabilities	iPad
	S05	2017	USA - Australia	3	6 to 8	31	Mixed-Methodology	Language-Based Disabilities	iPad
	SE03	2016	USA	3	11	47	Experimental	Reading Difficulties	iPod Touch
PDU	E02	2009	Turkey	15	Undergrduate	5	Qualitative	Hearing Impaired	PDA
	E07	2016	Canada	3	12 to 21	23	Mixed-Methodology	Developmental Disabilities	iPhone - iPod Touch
	E08	2016	USA	1	19 to 20	3	Experimental	Intellectual Disability	Google Glass - Google Nexus Tablet
	S01	2003	UK	82	no info	13	Design-Based Research	Autistic Spectrum Disorder - General Social Phobia	Mobile Phone
	S03	2016	Turkey	5	9 to 15	10	Qualitative	Hearing Impaired	Tablet
	S04	2017	Cyprus	1	no info	7	Design-Based Research	Intellectual Disability	Tablet
	SE01	2013	Canada	96	12 to 21	25	Action Research	Developmental Disabilities	iPhone - iPod Touch
	SE02	2013	Spain	269	Elemantary	39	Pre-experimental	Developmental Disabilities	iPhone - iPod Touch - iPad

3. Findings

In the research, the studies included in the content analysis were listed on the basis of the years they were published under the main two themes and according to the indexes coded as; articles indexed only in SSCI 'S01, S02, …', articles only indexed in ERIC 'E01, E02, …' and articles indexed both in SSCI and ERIC 'SE01, SE02, …'. Within the scope of each main theme, information of the index, year of publication, country, number of citations, age level of participants, sample size, research method, disadvantage group studied and findings related to mobile technologies used are presented in Table 3.

The articles' number of the citation was based on Google Scholar data. When Table 2 examined, it was seen that the articles with E01 and S02 codes have the most number of citations respectively from 11 articles included in the SI theme. From the eight articles included in the Product Design, Usability or Usage (PDU) theme, it is seen that the articles SE02, SE01 and S01, respectively, have the most number of citations. In addition, it was understood that articles coded E6 and E9 under the theme of SI have never been cited. It was determined that the articles E8 and S04 in the PDU theme received only one citation.

When the universities of the academics are examined; it was observed that they work mostly in universities within the United States of America (USA). In the universities in Australia, Canada, Spain and Turkey, more studies were conducted by academics relatively than the universities in other

countries. When the sample groups-sizes/participants numbers were examined; it was seen nearly half of the articles consisted with 10 or below 10. Besides, considering the age of the participants; it was determined that the majority of the studies conducted on the students in the K-12 level. In terms of the methods used in the articles; only quantitative research methods were used in the majority of them, quantitative and qualitative data collection techniques were used both while in some, and qualitative research methods and action research were employed in a few. When the characteristics of the participant groups in the articles were examined; while the disadvantaged groups with developmental barriers such as autism, down syndrome and mentally handicapped people are prominent, it was observed that studies on hearing impaired and visually impaired individuals remain in the minority.

When the articles within the research were examined in terms of mobile devices used; it is seen that half of the studies were carried out by the devices produced by Apple (iPhone, iPod, iPod Touch and iPad) and software running on these devices. In some studies, it was reported that tablets or smartphones were used, but no brands were mentioned.

4. Conclusion and discussion

In this research, the articles about special education and mobile technologies in high quality academic peer-reviewed journals evaluated with scientific criteria in international standards and those indexed in the SSCI and ERIC in the literature were examined and it was seen there is not many studies on mobile technologies in the area of special education. This situation shows that there is a lack of literature in the field and subject and the need for quality publications.

When the articles within the scope of the research are examined; it was concluded that studies on the category of mental disabilities, such as autism, developmental disorders, language barriers and reading barriers were mostly conducted. It was observed that research on hearing impaired and visually impaired participants is very few. This intensity can be attributed to the fact that individuals with hearing and visual impairment remain in a minority compared to individuals in the group with the other disabilities. Similarly, Cevahir and Ozdemir (2015) reported that the most studied groups were individuals with autistic and similar disabilities, and the least studied group was individuals with developmental disabilities.

When the articles included in the content analysis are examined within the determined themes, the articles which are under the theme of PDU remain limited according to the articles under the theme of SI (Skill Improvement). This reveals that the issues of developing mobile technologies for special education students, and how special education students use mobile technologies, remain in the background than the skills development and skill-building studies of mobile technologies. Therefore, it can be said that research studies that examining the effect of mobile technology such as skill acquisition and measuring the effectiveness of the students with the existing applications or tools are seen more important than the approach of determining the usage or the usability of the applications developed for education. Based on these results, it may be thought that it takes a long time to develop a new application and challenging and the priority of the researchers, the need of disadvantaged groups are focused on mobile technologies' contribution to students and education rather than the use or usability of existing applications or technologies. Nam et al. (2013) also stated that perceived ease of use is one of the most important factors in the use of assistive technologies in educational environments.

The majority of the articles reviewed in this study were written by researchers in the USA. A federal law in the USA, known as 'The Individuals with Disabilities Education Act' (Garda, 2004), might be the underlying reason of this fact. The law might lead to a high awareness in the society about the special education and support of the state to special education students, and so, special education studies being effective.

Considering the citation numbers of the articles within the scope of the research; it can be said that the majority of the mobile technologies studies in special education have received a very low citation. This situation can be considered as an indicator that there is not much research carried out in this field. As an exception to this situation; the SE02 coded article under the PDU theme has a high number of citations as 296. It might be the number of high citations taken by this article is influenced by the facts the publication year is older than other studies, indexed in both SSCI and ERIC, the number of participants consisted from various schools and more than majority of other studies and different types of mobile devices such as iPhone, iPad and iPod Touch were used.

The sample size of the articles subject to content analysis and the participants were observed with small age group and a small number of participants. The youngest sample of the age group was in the 3–8 age range and the oldest one was in the 23–25 age group. The limited size of the sample can be related to the low number of students in special education classes and the low number of individuals who need special education. The reason for the majority of the sample groups consisted of small individuals; it may be that individuals with special educational needs at a young age are more accessible than the higher education levels.

When the research studies examined are considered in terms of methodology, it was seen that experimental designs are frequently used. Experimental designs were used in 8 out of 19 studies and in three of these eight, 'single subject research model' which is frequently used in special education research studies was used. This result is opposite to the findings in the literature that qualitative research is carried out in research on technology integration in special education, as it is difficult to collect quantitative data from people with disabilities (Cevahir & Ozdemir, 2015). In other respects; if we accept Action Research studies under qualitative research designs, it will not be wrong to say that with two action research studies, a total of five qualitative research studies is the second most frequently used approach. In the third place, it was seen there were Design-Based Research and Mixed-Methodology with three studies each. On the contrary; in the content analysis research of Cevahir and Ozdemir (2015), it was concluded that most of the studies examined were qualitative research studies and that the survey method was used for collecting data near half of these studies. The reason why we reached experimental designs was the studies we examined in the first place for the sake of methodology that is frequently used in special education studies. Besides, the fact that there was a considerable amount of qualitative research, this issue could be considered as an indicator of the development of the qualitative research culture among the special education researchers.

When the disadvantaged groups of the participants of the studies were examined; it was seen that the participants with different types of disabilities were studied in some studies, whereas the participants with only one disadvantage were the subjects in some studies. In the special education classes in public schools, students with different types of disadvantages may have been studied together, mainly because there are students from different disability groups in the same class in these institutions. This situation should not be regarded as negative, in terms of the effectiveness of mobile technology use; the studies carried out with the students who have the same disadvantages and different disadvantages can be considered valuable.

When the mobile technology devices and applications used in the studies included in the research were examined, it can be seen that the total number of studies from the USA, Australia and Canada are as high as 12 and they constitute the majority. Nearly half of these studies were conducted using mobile devices such as iPad, iPod Touch and iPhone. In this context, the high availability of Apple products by users in these countries can be attributed to this finding (Mobile Operating System Market Share Worldwide, n.d.). Besides, the fact that the brands of the devices used in some studies were not mentioned made it difficult to make an evaluation in the area.

In this study, the number of articles reached with the keywords 'special education', 'mobile' and 'technology' shows that there are a very limited number of studies on the use of mobile technology in special education. This may be understandable given the fact that the years of entry of mobile technologies into human life after the millennium. However, the potential of mobile technologies,

which have become an indispensable part of human life in a very short period of time, can be estimated for students who need special education and it is necessary to create a deep understanding on this subject. In the literature, it has been stated that the use of mobile technology in special education is a multi-dimensional subject and it is recommended to be investigated by researchers (Altinay Aksal & Altinay Gazi, 2015; Cevahir & Ozdemir, 2015; Doenyas et al., 2014; Hart & Whalon, 2012; Kuzu et al., 2013; Miller et al., 2013; Odabasi et al., 2009; Park, 2011).

Although there are studies on how to use mobile technologies effectively not only in the area of special education but also in the educational processes in general (Chen, 2005; Elias, 2011; Kukulska-Hulme, 2007), certain directions have not emerged. Studies should also be carried out on how to use the obvious potential of mobile technologies in educational processes in general. For instance, Park (2011) discussed mobile technologies in the context of distance education and presented a theoretical framework, Sharples, Taylor and Vavoula (2005) examined mobile technology and learning in terms of 'Activity Theory' and in both studies, it was stated that mobile technologies should support individual and social learning.

5. Suggestions for further study

Considering the results of the research, the following suggestions can be given:

- In light of the findings obtained in the analysis, there is not much research in special education in the field of mobile technologies in SSCI and ERIC indexes. Moreover, since studies on hearing impaired and visually impaired people are very limited, studies with these disadvantaged groups may be recommended.
- Rather than using available mobile technologies in respect to special education, new applications for disadvantaged groups need to be developed and there is a serious need for this.
- In order to contribute to the literature and to individuals with disabilities all over the world, the field of mobile technologies should be enriched in special education with the work of researchers in the continents other than North America and Oceania.
- It is recommended to work with individuals with special needs other than K-12 and with larger sample groups.
- As a research methodology, qualitative research, action research, mixed method research and design-based research studies about mobile technologies should be carried out more in special education.
- In new research on mobile technologies in special education, it is recommended to develop applications and use existing applications in different mobile platforms such as Android.

REFERENCES

Acar-Guvendir, M. & Ozer-Ozkan, Y. (2015). Turkiye'deki egitim alaninda yayimlanan bilimsel dergilerde olcek gelistirme ve uyarlama konulu makalelerin incelenmesi. *Elektronik Sosyal Bilimler Dergisi*, *14*(52), 23–33.

Alnahdi, G. (2014). Assistive technology in special education and the universal design for learning. *Turkish Online Journal of Educational Technology-TOJET*, *13*(2), 18–23.

Altinay Aksal, F. & Altinay Gazi, Z. (2015). Examination on ICT integration into special education schools for developing countries. *Turkish Online Journal of Educational Technology-TOJET, 14*(3), 70–72.

Ayres, K. M., Mechling, L. & Sansosti, F. J. (2013). The use of mobile technologies to assist with life skills/independence of students with moderate/severe intellectual disability and/or autism spectrum disorders: Considerations for the future of school psychology. *Psychology in the Schools*, *50*(3), 259–271.

Bishop, J. (2003). The Internet for educating individuals with social impairments. *Journal of Computer Assisted Learning*, *19*(4), 546–556.

Sancar, I. V., Tozkoparan, S. B. & Odabasi, H. F. (2017). Use of mobile technologies in special education: A content analysis. *Journal of Education and Special Education Technology*. *3*(1), 001–012.

Cabielles-Hernandez, D., Perez-Perez, J. R., Paule-Ruiz, M. & Fernandez-Fernandez, S. (2017). Specialized intervention using tablet devices for communication deficits in children with autism spectrum disorders. *IEEE Transactions on Learning Technologies*, *10*(2), 182–193.

Campigotto, R., McEwen, R. & Epp, C. D. (2013). Especially social: exploring the use of an iOS application in special needs classrooms. *Computers & Education*, *60*(1), 74–86.

Cevahir, H. & Ozdemir, M. (2015). Mobile learning researches towards individuals with disabilities: a content analysis between 2005 and 2015. *Istanbul Journal of Open and Distance Education, 1*(2), 31–40.

Chen, J. (2005). Mobile technology in educational services. *Journal of Educational Multimedia and Hypermedia*, *14*(1), 89–107.

Cohen, L., Manion, L. & Morrison, K. (2007). *Research methods in education* (6th ed.). New York, NY: Routledge.

Cumming, T. M., Strnadova, I. & Singh, S. (2014). iPads as instructional tools to enhance learning opportunities for students with developmental disabilities: an action research project. *Action Research*, *12*(2), 151–176.

Doenyas, C., Simdi, E., Ozcan, E. C., Cataltepe, Z. & Birkan, B. (2014). Autism and tablet computers in Turkey: teaching picture sequencing skills via a web-based iPad application. *International Journal of Child-Computer Interaction*, *2*(1), 60–71.

Elias, T. (2011). Universal instructional design principles for mobile learning. *The International Review of Research in Open and Distributed Learning*, *12*(2), 143–156.

Englert, C. S., Manalo, M. & Zhao, Y. (2003). I can do it better on the computer: the effects of technology-enabled scaffolding on young writers' composition. *Journal of Special Education Technology*, *19*(1), 5–21.

Epp, C. D., McEwen, R., Campigotto, R. & Moffatt, K. (2016). Information practices and user interfaces: student use of an iOS application in special education. *Education and Information Technologies*, *21*(5), 1433–56.

Fernandez-Lopez, A., Rodriguez-Fortiz, M. J., Rodriguez-Almendros, M. L. & Martinez-Segura, M. J. (2013). Mobile learning technology based on iOS devices to support students with special education needs. *Computers & Education*, *61*, 77–90.

Flanagan, S., Bouck, E. C. & Richardson, J. (2013). Middle school special education teachers' perceptions and use of assistive technology in literacy instruction. *Assistive Technology*, *25*(1), 24–30.

Gulchak, D. J. (2008). Using a mobile handheld computer to teach a student with an emotional and behavioral disorder to self-monitor attention. *Education and Treatment of Children, 31*(4), 567–81. doi: 10.1353/etc.0.0028

Hanayli, M. C., Serbest, S. & Urekli, T. (2015). Otizmli Cocukların Sosyal Becerilerini Gelistirmeye Yonelik Android Uygulamasi. *XVII. Akademik Bilisim Konferansi*. Eskisehir, Turkey: Anadolu Universitesi.

Hart, J. E. & Whalon, K. J. (2012). Using video self-modeling via iPads to increase academic responding of an adolescent with autism spectrum disorder and intellectual disability. *Education and Training in Autism and Developmental Disabilities*, 438–446.

Judge, S. & Simms, K. A. (2009). Assistive technology training at the pre-service level: A national snapshot of teacher preparation programs. *Teacher Education and Special Education*, 32(1), 33–44.

Kagohara D, van der Meer L, Ramdoss S, O'Reilly M, Lancioni G, Davis T, . . . Sigafoos J. (2013). Using ipods and ipads in teaching programs for individuals with developmental disabilities: a systematic review. *Research in Developmental Disabilities*, 34(1), 147–156.

Karanfiller, T., Goksu, H. & Yurtkan, K. (2017). A mobile application design for students who need special education. *Education & Science/Egitim ve Bilim*, 42(192).

Kelley, K. R., Rivera, C. J. & Kellems, R. O. (2016). Effects of direct systematic instruction on Google glass orientation with individuals with intellectual disability. *Journal of Special Education Technology*, *31*(4), 207–216.

Kukulska-Hulme, A. (2007). Mobile usability in educational contexts: what have we learnt? *The International Review of Research in Open and Distributed Learning*, 8(2).

Kuzu, A., Cavkaytar, A., Cankaya, S. & Oncul, N. (2013). Zihin engelli bireylerin ebeveynlerinin kullanımına yonelik gelistirilen mobil beceri ogretimi yazilimina yonelik katilimci gorusleri. *Anadolu Journal of Educational Sciences International*, *3*(2), 1–21.

Lowman, J. J. & Dressler, E. V. (2016). Effects of explicit vocabulary videos delivered through ipods on students with language impairments. *Journal of Special Education Technology*, *31*(4), 195–206.

Sancar, I. V., Tozkoparan, S. B. & Odabasi, H. F. (2017). Use of mobile technologies in special education: A content analysis. *Journal of Education and Special Education Technology*. *3*(1), 001–012.

McMahon, D., Wright, R., Cihak, D. F., Moore, T. C. & Lamb, R. (2016). Podcasts on mobile devices as a read-aloud testing accommodation in middle school science assessment. *Journal of Science Education and Technology*, *25*(2), 263–273.

McNaughton, D. & Light, J. (2013). The iPad and mobile technology revolution: Benefits and challenges for individuals who require augmentative and alternative communication. *Augmentative and Alternative Communication, 29*(2), 107–116.

Miller, B. T., Krockover, G. H. & Doughty, T. (2013). Using iPads to teach inquiry science to students with a moderate to severe intellectual disability: a pilot study. *Journal of Research in Science Teaching*, *50*(8), 887–911.

Mobile Operating System Market Share Worldwide. (n.d.). Retrieved August 11, 2017, from http://gs.statcounter.com/os-market-share/mobile

Mohd Yusof, A., Daniel, E. G. S., Low, W. Y. & Aziz, K. A. (2014). Teachers' perception of mobile edutainment for special needs learners: the Malaysian case. *International Journal of Inclusive Education*, *18*(12), 1237–1246.

Monibi, M. & Hayes, G. R. (2008, June). *Mocotos: mobile communications tools for children with special needs*. In Proceedings of the 7th international conference on Interaction design and children, pp. 121–124. ACM.

Mostafa, A. F. (2015). Moblogging type and its relation with usability and development of knowledge management skills for blind students. *Journal of Educational Technology*, 12(2), 7–18.

Nam, C. S., Bahn, S. & Lee, R. (2013). Acceptance of assistive technology by special education teachers: a structural equation model approach. *International Journal of Human-Computer Interaction*, *29*(5), 365–377.

Nonis, K. P. (2015). Exploring communication technology behaviour of adolescents with cerebral palsy in Singapore. *International Journal of Special Education, 30*(3), 17.

Nordness, P. D., Haverkost, A. & Volberding, A. (2011). An examination of hand-held computer-assisted instruction on subtraction skills for second grade students with learning and behavioral disabilities. *Journal of Special Education Technology*, *26*(4), 15–24.

Odabasi, H. F., Kuzu, A., Girgin, C., Cuhadar, C., Kiyici, M. & Tanyeri, T. (2009). Reflections of hearing impaired students on daily and instructional PDA use. *International Journal of Special Education*, *24*(1), 8–19.

Park, Y. (2011). A pedagogical framework for mobile learning: categorizing educational applications of mobile technologies into four types. *The International Review of Research in Open and Distributed Learning, 12*(2), 78–102.

Parsons, S., Daniels, H., Porter, J. & Robertson, C. (2008). Resources, staff beliefs and organizational culture: factors in the use of information and communication technology for adults with intellectual disabilities. *Journal of Applied Research in Intellectual Disabilities*, *21*(1), 19–33.

Rodriguez, C. D. & Cumming, T. M. (2017). Employing mobile technology to improve language skills of young students with language-based disabilities. *Assistive Technology, 29*(3), 161–169.

Semaan, C. & Kiwan, E. (2017). Impact of "kubbu" on the academic achievement and motivation of 4th grade special needs students. *International Journal of Innovation and Research in Educational Sciences, 4*(6), 683–689.

Sharples, M., Taylor, J. & Vavoula, G. (2005, October). Towards a theory of mobile learning. *Proceedings of mLearn*, *1*(1), 1–9.

Shelton, B. E. & Parlin, M. A. (2016). Teaching math to deaf/hard-of-hearing (DHH) children using mobile games: outcomes with student and teacher perspectives. *International Journal of Mobile and Blended Learning (IJMBL), 8*(1), 1–17.

Smith, C. C., Cihak, D. F., Kim, B., McMahon, D. D. & Wright, R. (2017). Examining augmented reality to improve navigation skills in postsecondary students with intellectual disability. *Journal of Special Education Technology*, *32*(1), 3–11.

Suri, H. & Clarke, D. (2009). Advancements in research synthesis methods: From a methodologically inclusive perspective. *Review of Educational Research, 79*(1), 395–430.

Yaman, F., Donmez, O., Avci, E. & Yurdakul, I. K. (2016). Integrating mobile applications into hearing impaired children's literacy instuction. *Education & Science, 41*(188).