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The Use of Assistive Technologies in Increasing the Participation of the Individuals with Severe and Multiple Disabilities to Leisure: Systematic Review

Evgin ÇAY*
Balıkesir University, Necatibey Faculty of Education, Special Education, Türkiye
ORCID: 0000-0002-1199-3939

Burak BOZAK
Turgut Reis secondary school, Antalya, Türkiye
ORCID: 0000-0001-7557-4576

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Leisure participation is one of the highly neglected areas. Supporting the leisure participation of the individuals with severe and multiple disabilities is important for them to be able to spend their leisure time in a quality and efficient way. In this study, the line of research through which assistive technologies have been used to increase the leisure participation of the individuals with severe and multiple disabilities have been examined. The studies in accordance with the criteria determined have been examined within the context of the published journal, used technology type, participant properties, used models and research findings. The examined studies have been scanned via electronic media using indexical scanning and then, manual scanning has been conducted on the basis of the references of the reached studies. 57 studies have been reached as a result of these scans. The studies reached have been assessed using the criteria determined by the authors. 12 studies meeting the criteria have been examined with descriptive analysis method. It has been seen when the study findings have been analyzed that the assistive technologies are efficient in increasing the leisure participation of the individuals with severe and multiple disabilities. Besides, when the studies in the scope have been examined, communication has been determined to be an important key for the participation of the individuals with severe and multiple disabilities to leisure activities. Communication based assistive technologies have been revealed to have a significant role in increasing the leisure participation. The obtained findings have been discussed in various contexts and suggestions have been made to the partners.

* Correspondency: evgin.cay@balikesir.edu.tr

Introduction

Individuals with severe and multiple disabilities (SMD) are defined as those who have very little opportunities to establish positive interaction with their environment due to their appearance and the social image they leave in the society, are isolated from the society and continue their lives in a very passive way (Stasolla, 2015). Though SMD is defined in different ways, it expresses the individuals with significant and severe motor deficits such as spastic quadriplegia or tetraparesis as well as severe intellectual disability (Harding et.al., 2011; Lancioni et.al., 2013). Many individuals with SMD clearly have health problems such as chronic diseases as well as hearing disability and/or visual disability (Orelove et.al., 2004).

The individuals with SMD have very limited behavioral repertoire, self-repeating behaviors, language and speech disorders and also have difficulties in controlling their muscles. Moreover, the children taking place in this group need more medical support (Stasolla, 2015). They have problems in breathing and breath controlling and they may have spasm or spasm seizures. In this way, the individuals taking place in this group have difficulties in participating in their houses, schools and the environments where they take rehabilitation services and in interacting with people (Lancioni, 2012). They have fun after they fulfill their tasks and responsibilities, they learn things while having fun and they may show limitations in using the leisure time left for them (Çay, 2022).

Leisure could be defined as the period of time in which the individuals deal with the activities they choose with their own will after fulfilling their tasks and responsibilities, they have fun while dealing with these activities and have pleasure while having fun (Argan, 2013; Cohen-Gewerc & Stebbins, 2007; Çay, 2017; Shalock et.al., 2010; Torkildsen, 2005). In addition, the individuals with severe and moderate intellectual disabilities, having limitations in their motor skills and having speech disorder may have significant problems in vocational skills and leisure participation as well as problematic social interaction and communication skills (Chantry, & Dunford, 2010; Sigafoos et.al., 2009). Therefore, the individuals taking place in this group are in the disadvantageous group in terms of leisure participation and developing leisure skills (Hogg & Cavet, 2013; Russell, 2002). For this reason, leisure participation of the individuals with SMD will also have been supported by teaching them the leisure activities and skills.

Leisure time activities can be defined as activities that individuals carry out to evaluate their leisure time and have fun (Çay & Eratay, 2019). leisure time activities have benefits for individuals. Specifically, occupation with age-appropriate leisure activities has positive effects both on the social, sentimental, physical and intellectual health of the individuals with leisure participation deficiencies and on their life quality (Caldwell, 2005; Iwasaki, 2007). So, it becomes crucial for the individuals taking place in this group to learn leisure skills and increase their leisure participation (Jerome, Frantino, & Sturmey, 2007). Leisure participation of these individuals could be encouraged by teaching them the skills of the use of television and radio, being a part of the leisure activities. Leisure participation could be ensured via the technology-based programs and assistive technologies with basic and easy motor skills existent in the repertoire of the individuals with SMD (Fager et.al., 2006; McNaughton & Bryen, 2007). Furthermore, technology-based programs may significantly contribute to the leisure participation, vocational participation and leisure skill development of the individuals with disability (Maki et.al., 2008; Naude & Hughes, 2005).

Different assistive technologies such as toys, computer games, various sportive activities and materials adapted according to the needs and properties of the individuals with disability

ensure leisure participation and making use of the leisure time of the individuals (Reed, 2004; Reed, 2007; Reed, 2009; Day et.al., 2011). When these positive contributions provided for the individuals with SMD by the assistive technologies are taken into consideration, assistive technologies could be benefited to terminate or minimize the limitations they experience (Lancioni, 2012).

Assistive technologies contain various electronic devices ensuring the individuals with disability to adapt to the social environments and take an active place in their lives as active individuals. Also, assistive technologies ensure the participation of the individuals with disability and help increase their quality of life (Borg, Larson, & Ostegren, 2011; Felce & Perry, 1995). For instance, microswitch help the individuals with SMD control their environment (Mechling, 2007). The technological devices such as voice pedometers and voice positioning devices facilitate the individuals with visual disability to do exercise. The voice description of the theatre, cinema and television works enables the individuals with visual disability to easily understand these types of publications (Hersh & Johnson, 2008b). In this way, these types of assistive technologies ensure leisure participation of the individuals with SMD and increase their participation.

When studies involving technology applications for individuals with SMD are considered, findings from applications supporting communication technology (Lancioni et.al., 2001; Lancioni et.al., 2018; Lancioni et.al., 2013; Shih & Shih, 2010; Shih et.al., 2013) and the and studies supporting independent movement skills and adaptive skills (Besden, 2007; Lancioni et.al., 2013; Lancioni et.al., 2014) demonstrate the efficacy of assistive technologies. Besides, findings of the studies containing the technology supporting the leisure participation of the individuals with SMD (Kagohara et.al., 2011; Kemp et.al., 2016; Lancioni et.al., 2010; Lancioni et.al., 2012; Shih & Shih, 2010; Stasolla et.al., 2019) support this view.

When the review studies containing assistive technology for the individuals with disability are examined, Erdem, (2017) has reviewed the studies for the assistive technologies used in the educational environments of the students with special needs. Nicolson et.al., (2012) have examined the studies determining the impacts of the assistive technologies conducted for the families of the children with physical deficiency. Roche et.al., (2015) have reviewed the studies revealing the impacts of the microswitch technologies providing opportunities for the children with SMD to gain the skills of life responsibility. Stasolla, (2017) has reviewed the studies containing assistive technology supporting the children with moderate and severe developmental deficiencies in terms of communication, vocational and leisure time. When the conducted review studies are examined, no review studies could be reached containing the use of assistive technologies in increasing the leisure participation of the individuals with SMD. Such a review study has been needed due to the fact that the leisure skills are an important field for the development and life quality of the individuals with SMD and assistive technologies have an important role in increasing the leisure participation. The aim of this study is to review the studies containing the use of assistive technologies in increasing the leisure participation of the individuals with SMD and reveal the impact of the technology use on leisure participation. In addition, it has been aimed to examine the studies taken to the scope of this study within the context of the published journal, used technology type, participant properties, used models and research findings.

Method

The process of the determination of the studies

The indexes in digital media have been scanned to determine the studies included in the scope of this study. Scans have been conducted upon the databases of Google, ERIC, Google Scholar, JSTOR and PROQUEST. Afterwards, the studies have been reached as a result of the manual scans conducted from the references of the attained studies. The keywords "severe and multiple disabilities, individual with severe and multiple disabilities, leisure, leisure participation and assistive technology" have been benefited while conducting online scans. Researchers started the scanning process on January 2nd, 2023. They finished the scanning process on March 2nd, 2023. Some processes have been followed during the scanning process. This project has been given place in detail in Figure 1. 57 international studies have been reached in total as a result of the scanning process.

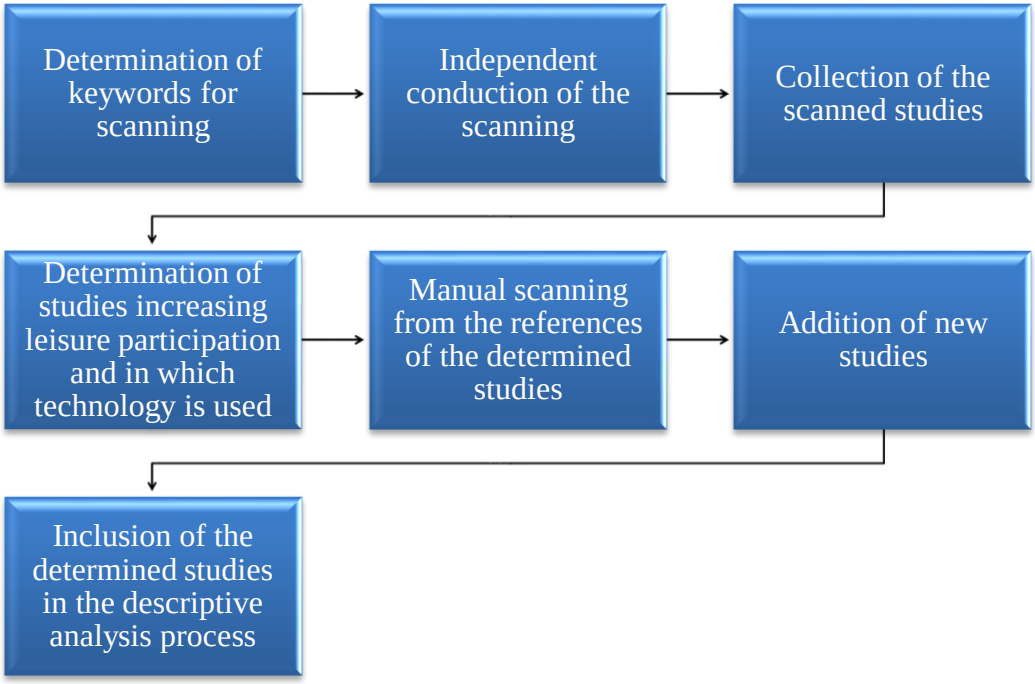

Figure 1. The process followed in the scanning process

Inclusion and exclusion criteria for descriptive analysis

Some criteria have been determined for the studies to be included in the scope of the study. These inclusion criteria are as follows: (a) conduction between the years 2010-2023 (b) publication in journals with international readers (c) conduction with subjects with severe and multiple disabilities (d) conduction of the studies using single subject research models (e) writing the studies in English language (f) inclusion of assistive technology (g) being related to increasing the leisure participation (h) participants have severe and multiple disabilities. 12 studies conforming to these criteria have been determined in total among the 57 examined studies. The criteria determined for the studies excluded from the scope of the study are (a) the use of a model (group, experimental, qualitative etc.) other than single subject research models (b) publication in journals with no readers or being written in a language other than English (c) working with participants with no multiple disabilities or with a single disability.

Reliability among coders

Reliability calculations have been made for this study. Reliability calculations have been conducted by a special education expert who has expertise in the field of special education and also has academic studies in this field. The formula "Consensus among coders / Consensus among coders + Dissensus among coders X 100" has been benefited in the reliability analyses. The reliability analysis process of the conducted study has been realized in two stages. The inclusion and exclusion calculations have been made in the first stage and the reliability calculations regarding the descriptive analysis process have been made in the second stage. The reliability calculations conducted regarding the inclusion and exclusion have been made for all studies and found as 100%. The reliability calculations regarding the descriptive analysis process of the studies have been made for all the studies included in the study and found as 92.30%.

Descriptive analysis process

The studies conforming to the criteria determined by the researchers during the descriptive analysis process of the study have been examined within the context of (a) the published journal (b) used technology type (c) participant properties (d) used models and (e) research findings. The detailed information on the descriptive analysis process of the studies included in the scope of the study is given in Table 1.

Findings

In this study, it has been aimed to examine the studies conducted regarding the use of assistive technologies efficient in increasing the leisure participation of individuals with SMD within the context of the published journal, used technology type, participant properties, research model and research findings. The data related to the studies taken to the scope of this study are given in Table 1 in detail in this part.

The journals in which the studies taken to this research scope have been published

Which journals the study desired to be published in after reporting is seen important for the study results to be able to appeal to wide masses and partners. Four out of all the studies taken to the scope of this study have been published in Research in Developmental Disability, three of them have been published in Disability and Rehabilitation: Assistive Technology, two of them have been published in Developmental Neurorehabilitation, one of them has been published in Clinical Case Studies, one of them has been published in NeuroRehabilitation and another one has been published in Infants & Young Children. The distributions of the studies taken to the scope of this study among journals are given in Figure 1.

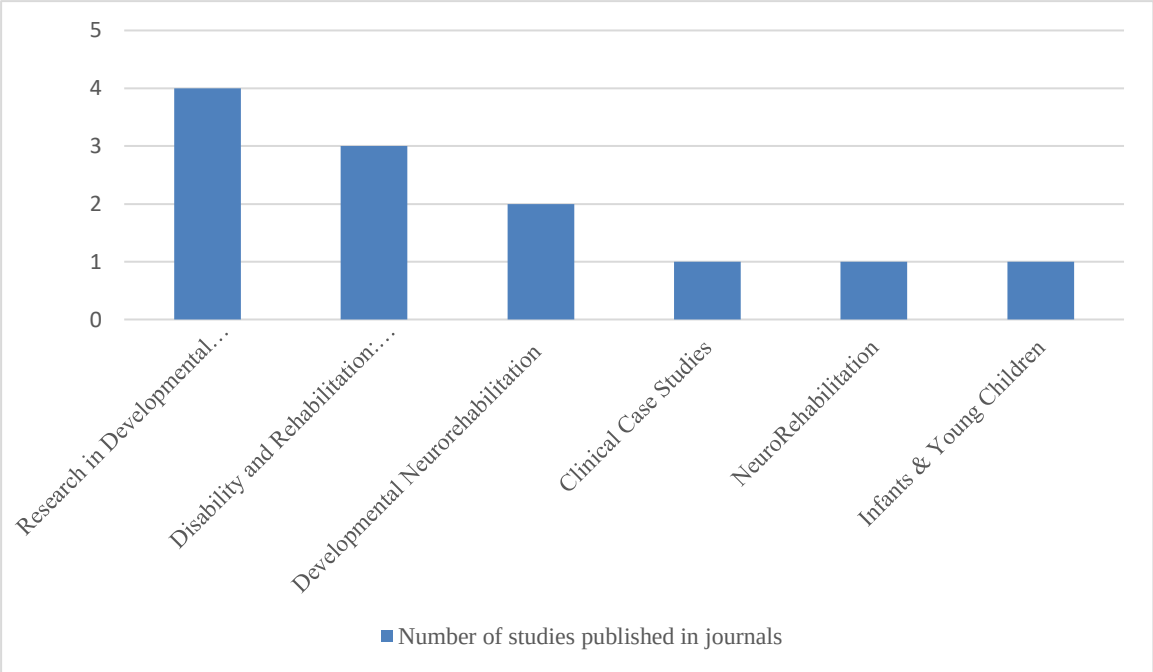

Figure 1. The distributions of the studies taken to the scope of this study among journals

Technology type used in the studies

Assistive technologies are the ones efficient in increasing the movement, playing games, communication and leisure participation of the individuals with SMD and especially with physical deficiency. These properties of assistive technologies provide the individuals with SMD with opportunities of independent movement, self-management and interaction with environment (Isabelle et.al., 2003). Therefore, assistive technologies are seen important in the lives of the individuals with SMD. The studies taken to the scope of the research by taking these properties into consideration also in the conducted reviewing have been examined within the context of the types of assistive technologies efficient in increasing the leisure participation. Microswitch have been used as the assistive technology in increasing the leisure participation of the individuals with SMD in four of the studies taken to the scope of this research. Microswitch have been used together with other assistive technologies in four studies. While technology based programs have been used in one of the studies, picture books and iPad have been used in another study.

Properties of the participants taking place in the studies

The studies taken to the scope of this research have been examined referring to the properties of the participants taking place in the studies. It is seen that the participants are of different ages, all participants have more than one deficiency and they are severely affected by these deficiency types. When Table 1 is examined, it is observed that the participants taking place in the studies taken to the scope of this research are within the age range of 4-85, 17 of them are males and 15 of them are females. Most of the participants have cerebral palsy, autism spectrum disorder, severe intellectual disability, epilepsy, developmental disability, speech disorder and visual disability.

Models of the studies taken to the scope of this research

The studies examined in this conducted study have been analyzed within the context of the used models. It has been seen as a result of the conducted examinations that mostly ABAB model has been used. ABAB model has been used in six of the studies (Lancioni et.al., 2010; 2011; 2012) taken to the scope of this research. Cross-participant multiple probe model has been used in two of the studies, cross-behaviour multiple probe model has been used in one of the studies, cross-participant multiple baseline model has been used in one of the studies, ABABAB model has been used in one of the studies and cross-participant multiple applications model has been used in one of the studies.

Findings of the studies taken to the scope of this research

Assistive technologies have been benefited to increase leisure participations of the individuals with SMD in all of the studies taken to the scope of this research. When all the studies in the scope are examined, it has been determined that the interventions applied via assistive technologies have been successfully applied. Leisure skills such as skills of using television and opening the desired program (Lancioni et.al., 2012), skills of using radio and texting the desired people (Lancioni et.al., 2011), skills of using computers (Shih & Shih, 2010) and skills of making a choice (Stasolla, 2019) have been taught to the individuals with SMD using assistive technologies.

Table 1. The summary of the studies on assistive technology increasing leisure participation

Studies	Published Journal	Used Technology Type	Participant Properties	Research Model	Research Finding
1. Lancioni, Singh, O'Reilly, Sigafoos, Oliva, Signorino, & Tommaso, 2010	Clinical Case Studies	Microswitch	Man (46 years old) with intellectual disability and cerebral palsy.	ABAB design	It is seen that technology based program is efficient in teaching the participant the skill to use television and open the programs s/he chooses.
2. Lancioni, O'reilly, Singh, Sigafoos, Oliva, Smaldone, La Martire, Navarro, Spica & Chirico, 2011	Disability and Rehabilitation: Assistive Technology	Microswitch	Man (52 years old) with advanced multiple sclerosis, pervasive motor and multiple disabilities. One boy (17,4 years old) with encephalopathy, perinatal hypoxia and cerebral haemorrhage, spastic tetraparesis, limited speech.	ABAB design	Assistive technology has been efficient for both participants to gain the skills of using radio and texting the desired people.
3. Shih & Shih, 2010	Research in Developmental Disability	Dynamic Trackball-Pointing Assistive Program (DTPAP) and a newly developed trackball driver	One boy (17 years old) with moderate intellectual disability, congenital cerebropathy, and spastic tetraparesis. One boy (16 years old) with profound range of physical disability and mild range of intellectual disability.	Multiple probe design across participants	Technology based program has been efficient in teaching computer using skills to the participants.

Table 1 (cont.)

Studies	Published Journal	Used Technology Type	Participant Properties	Research Model	Research Finding
4. Lancioni, Singh, O'reilly, Sigafoos, De Pace, Chiapparino, Ricci, Navarro, Addante & Spica, 2011	Disability and Rehabilitation: Assistive Technology	Microswitch	Woman (40 years old) with acquired brain injury and profound multiple disabilities. Man (39 years old) with acquired brain injury and profound multiple disabilities.	ABAB design	At the end of the study, both participants have learnt watching television and watching the programs they want to choose using the existent technology.
5. Kagohara, Sigafoos, Achmadi, Meer, O'Reilly & Lancioni, 2011	Research in Developmental Disability	Portable multimedia device (i.e., an iPod Touch)	Girl (17 years old) with severe intellectual disability and epilepsy. Girl (16 years old) with cerebral palsy and severe intellectual disability. Boy (15 years old) with Klinefelter syndrome and severe intellectual disability.	Multiple-probe across participants design	At the end of the study, participants have learnt to listen to music via iPod in their leisure time.
6. Lancioni, Singh, O'reilly, Green, Oliva, Buonocunto, Sacco, Biancardi & Nuovo, 2012	Developmental Neurorehabilitation	Portable computer, commercial software and a microswitch	Woman (26 years old) with congenital encephalopathy with total blindness and moderate intellectual disability. Boy (19 years old) with spastic hypertonia and moderate intellectual disability.	ABAB design	At the end of the study, female participant has opened the radio thanks to the technology supported programs, she has also sent text message and could listen to this message. Male participant could sing a song thanks to the technology supported programs and could make a phone call.

Table 1 (cont.)

Studies	Published Journal	Used Technology Type	Participant Properties	Research Model	Research Finding
7. Lancioni, O'Reilly, Singh, Sigafoos, Buonocunto, Sacco, Navarro, Lanzilotti, Tommaso, Megna & Oliva, 2013	Research in Developmental Disability	Portable computer with commercial software, and a microswitch	Woman (44 years old) with suffered aneurysm rupture and mild intellectual disability. Man (24 years old) with neurological syndrome characterized by myoclonus, cerebellar ataxia, and mild intellectual disability.	Multiple probe across behaviors design	At the end of the study, participants have shown the target skills with the technology supported programs.
8. Lancioni, Singh, O'Reilly, Sigafoos, Oliva, Buonocunto, Sacco, D'Amico, Navarro, Lanzilotti, Tommaso & Megna, 2014	NeuroRehabilitation	Sound amplifier, a mobile communication modem, a microswitch	Two men (63 and 68 years old) with post-coma and multiple disabilities. Woman (85 years old) with post-coma and multiple disabilities.	ABAB design	At the end of both studies, participants have sent short text messages with technology supported programs and they have shown the skill of calling the people in front of them.
9. Lancioni, Singh, O'Reilly, Sigafoos, Ricciuti, Trignani, Oliva, Signorino, D'Amico & Sasanelli, 2015	Disability and Rehabilitation: Assistive Technology	Computer screen and microswitch	Man (73 years old) with spinal cord injury and multiple disabilities. Man (50 years old) with cerebral aneurism rupture and coma and multiple disabilities.	ABAB design	Technology supported programs have been efficient in supporting the leisure participation and communication skills of individuals with severe and multiple disabilities.

Table 1 (cont.)

Studies		Published Journal	Used Technology Type	Participant Properties	Research Model	Research Finding
10	Lancioni, Singh, O'Reilly, Sigafoos, Belardinelli, Buonocunto, D'Amico, Navarro, Lanzilotti, Denitto, De Tommaso, & Megna, 2015	Research in Developmental Disability	Technology-aided programs	Woman (31 years old) with coma and multiple disabilities. Man (81 years old) with coma and multiple disabilities. Woman (39 years old) with coma and multiple disabilities. Man (63 years old) with coma and multiple disabilities.	Multiple baseline design a cross participants.	At the end of the study, technology supported programs have encouraged the leisure participation and communicational skills of the participants.
11	Kemp, Stephenson, Cooper & Hodge, 2016	Infants & Young Children	Picture books and iPad apps	Two boy and one girl (61, 46, 63 month) with severe developmental delay, epilepsy, hydrocephalus, hypopituitarism, cerebral palsy, vision impairment, fragile x syndrome, autism spectrum disorders and multiple disabilities.	Multiple treatment design a cross participants.	The assistive technologies used in the leisure participation of the participants have been efficient.
12	Stasolla, Caffò, Perilli & Albano, 2019	Developmental Neurorehabilitation	Microswitch	Six girls (8.64, 8.16, 8.28, 9.36, 10.2, 11.52 years old) with rett syndrome and profound intellectual disability.	ABABAB design	Assistive technology used in the choice making and leisure participation of the participants has been efficient.

Discussion

This systematic review has been conducted to review the studies on the use of assistive technologies in increasing the leisure participation of the individuals with SMD and descriptively reveal the impact of technology use on leisure participation. Moreover, it has also been aimed to examine the studies in the scope within the context of the published journal, used technology type, participant properties, used models and research findings.

When the journals in which the studies taken to the scope have been published are examined, it is observed that four out of all the studies taken to the scope of this study have been published in Research in Developmental Disability, three of them have been published in Disability and Rehabilitation: Assistive Technology, two of them have been published in Developmental Neurorehabilitation, one of them has been published in Clinical Case Studies, one of them has been published in NeuroRehabilitation and another one has been published in Infants & Young Children. Half of the studies within the scope of this research (n=6) are seen to be in the journals scanned in the database of Social Sciences Citation Index™ (SSCI) and two of them are seen to be in the journals scanned in the database of Science Citation Index Expanded™ (SCI-e). Three of the remaining studies are seen to be scanned in the database of Emerging Sources Citation Index™ (ESCI) and one of them is seen to be scanned in the database of Scopus. Furthermore; when the Q values of these studies are considered, it is seen that only one study has been published in the journals at Q3 level (Lancioni, 2010) and others have been published in journals at Q2 level. It could be said when the publication acceptance criteria and peer review processes of the studies published in these journals are taken into consideration that they have been published in qualified journals and they are qualified studies.

When the technology types used to increase leisure participation are examined, four studies are seen to have used microswitch (i.e.: Lancioni et.al., 2010; Stasolla et.al., 2019). It is seen in the other four studies that amplifier and portable communication modem (Lancioni et.al., 2014), computer screen (Lancioni et.al., 2015), portable computer and software (Lancioni et.al., 2012). Lancioni et.al., 2015 have been used in addition to microswitch. Microswitch are the technical devices enabling the children with SMD and with low communication potential to give basic reaction to the environmental phenomena as much as their performance levels allow (Lancioni et.al., 2006). In other words, with the use of microswitch, the children with SMD are enabled to establish communication by revealing the reactions they need to give to communicate. This communicational behavior could both be yes or no and it allows them to open a determined voice record to communicate or put on any music they want (Lancioni et.al., 2005; Lim et.al., 2001). The individuals with SMD have been gained the computer using skills by supporting them to click on anywhere they want on the computer via a trackball mouse used in one of the studies (Shih & Shih, 2010) in which microswitch have not been used. Also in this study, it has been aimed to ensure the individuals to give reactions within the direction of their wishes although the technology type is different. When the technology types used in almost all of the studies are observed, it is seen that they are the communicational supports aiming to reveal the convenient reactions of the individuals with SMD. The main problem frequently experienced by the individuals with SMD is the communicational deficiencies (Downing and Falvey, 2015). For this reason, when the studies within the scope are examined, the key to increase the leisure participation could be specified as supporting the communicational behaviors via assistive technologies.

When the age groups of the participants are examined, it is observed that the studies in the

scope have been conducted within a very wide range. It is seen that leisure participation has been tried to be increased with the participants whose ages vary between the age of 4 being the early childhood period and the age of 85. It is possible for the individuals with SMD to have difficulties in leisure participation (Evensen, 2021) due to some difficulties they have (skill deficits, communication deficits, deficits in motor skills and mobility skills etc.). When it is thought that it is important for people at every age level to sufficiently participate in leisure activities, conduction of studies related to the individuals with SMD at every age level and minimum affection of them due to the disabilities they have could be ensured via assistive technologies.

It is seen that single subject research models have been used in all of the studies examining the impact of assistive technologies on increasing the leisure participation. The individuals with SMD could be thought as a heterogeneous population due to the various disabilities or the chronic disease combinations they have (Van der Putten et.al., 2005). From this aspect, the use of single subject research models becomes mostly inevitable. When the studies are considered, it is seen that ABAB model (n=6) or its derivatives (n=1) are used in more than half of the studies. ABAB models which are based on comparing the phases in which intervention is applied and is not applied in the situations in which there is an independent variable convenient for withdrawal may be frequently used (Gast & Ledford, 2014). Multiple baseline (n=1) and multiple probe models (n=3) being the adaptations of the traditional AB models have been used in other studies. Multiple applications model (ABC Design) enabling to reveal the impact of the independent variable convenient for more than one withdrawal has also been used in another application.

When the general findings of the studies are considered, it is seen that all of the technology-supported and systematic interventions have been efficient in increasing the leisure participation of the individuals with SMD. It has been concluded that the assistive technologies used in increasing the leisure participation of individuals with SMD have been efficient and have increased the participation in all of the conducted studies. For instance, as a result of the study conducted by Lancioni et.al., (2011), both participants have learnt watching television and choosing the programs they want by using the existent technology. In another study conducted by (Lancioni et.al., 2012), a female participant has opened the radio thanks to the technology-based programs and she could also text message and listen to this message. The male participant could sing and perform the skill of making a call thanks to the technology-based programs. Increasing leisure participation makes the individual happy as much as the pleasure they take in working or other fields and appears as an important aspect of life (Caldwell & Gilbert, 2009). Assistive technology could be an important key in the interventions to be applied to reintegrate the individuals with SMD into society by increasing their leisure skills. Especially communicational deficiencies form a barrier in the leisure participation of the individuals with SMD. Assistive technologies could be a support for families and teachers in the termination of this.

Review studies also have some limitations just like other studies. This study also has some limitations. The databases determined for scanning are a limitation for this study. The scanned studies to be only in English language and their publication within the year ranges determined for scanning are other limitations. Besides, we also do not deny that there could be some studies unnoticed during the conducted scans.

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