



JÖNKÖPING UNIVERSITY

*School of Education and
Communication*

***The effectiveness of Assistive Technology to support
children with specific learning disabilities:
Teacher Perspectives***

A systematic literature review

Mary Pushpy Tony

One year master thesis 15 credits

Supervisor: Sara Goico

Interventions in Childhood

Examiner: Elaine Mc Hugh

ABSTRACT

Author: Mary Pushpy Tony

The effectiveness of assistive technology to support children with SLD: Teacher perspectives

A Systematic Literature Review

Pages: 26

According to the UNICEF report, up to ten percent of children in the world have affected specific learning disabilities (SLD) and the majority of these children are educated in general education classrooms. An important resource for children with learning disabilities to flourish in the classroom is access to assistive technology. To prepare children on how to utilize assistive technology in the learning environment is important for teachers. This systematic review focused on teacher perspectives on assistive technology regarding children with SLD. Six scholarly articles were used for this study. The information drawn from the articles showed that teachers are receptive to assistive technology in their classrooms. They perceived assistive technology as an important supportive device for improving the vital skills of reading and writing comprehension. However, it is clear from their perspectives that the teachers needed more support than they were able to access in order to feel comfortable to implement and use assistive technology in the classroom. Therefore the need for professional development and training and the integration of appropriate technical devices are vital to enhance the development of children with SLD. Future research will be focus on how pre-service teachers are being prepared for AT use as a part of their pre-service training program and professional development.

Keywords: Specific learning disability (SLD), Teachers, Children, Perspectives, Assistive Technology, Effectiveness, Intervention, Software

Postal address

Högskolanförlärande
och Kommunikation (HLK)
Box 1026
551 11 JÖNKÖPING

Street address

Gjuterigatan 5

Telephone

036-101000

Fax

036162585

Table of Contents:

- 1. Introduction-----5
- 2. Background-----5
 - 2:1 Specific Learning Disability-----5
 - 2:2 Inclusive Education-----6
 - 2:3 Assistive Technology-----7
 - 2:4 Teacher Perspectives-----8
- 3. Rationale for the Study-----10
- 4. Research Aim-----10
- 5. Research Questions-----10
- 6. Methodology-----11
 - 6:1 Method – Systematic Literature Review -----11
 - 6:2 Search Procedures -----11
 - 6: 3 Selection Criteria -----11
 - 6: 4 Screening Process – Title & Abstract level-----13
 - 6: 5 Full text screening -----13
 - 6:6 Data extraction -----13
 - 6:7 Quality Assessments -----15
 - 6:8 Ethical considerations -----16
 - 6:7 Data Analysis-----16
- 7. Results -----17
 - 7:1 Overview of the Results -----17
 - 7:2. Teacher Perceptive on the effectiveness of AT -----21
 - 7:2.1 Children’s reading enhancement -----21
 - 7:2.2 written language developments -----21
 - 7:2.3 overall academic performances -----22
 - 7:2.4 Children’s self-esteem & Confidence -----23
 - 7:3 Factors Impacting Teacher Perspectives -----23

7:3.1 Training/Experience	23
7:3.2 Level of confidence & knowledge	24
7:3.3 Unavailability of resource& technical support	24
7:3.4 Time constraints & unique needs of children	25
8. Discussion	25
8:1 Teacher perspectives on AT	25
8:2 Factors influence on teacher perspectives	27
9. Limitations.....	29
10. Future Direction	30
11. Conclusion	30
12. Reference	32
13. Appendix	36
13: 1 appendix A	36
13:2 appendix B	37
13:3 appendix C	38

1. Introduction

Specific Learning disability (SLD) can be defined as a disorder of one or more of the basic cognitive abilities involved in understanding or using a language. This disability may manifest itself in an imperfect ability to read, write or to perform mathematical calculations (Rufus, Liman, Abubakar & Kwalzoom, 2015). Children with Specific Learning Disabilities are educated in the general education classrooms and often experience difficulties in classroom settings in comparison to their peers (Wood, et.al, 2017). One way to address these difficulties is to adopt innovative educational strategies in the classroom to enhance the performance of children with learning disabilities and to eliminate weaknesses that can be a barrier to successful life.

In recent years, researchers have become increasingly interested in investigating the use of technological devices to enhance the achievement of children with specific learning disabilities in inclusive classrooms (Starcic & Istenic, 2010; Susan, 2009 and Wood, et.al, 2017). These studies have demonstrated that assistive technology is a potential aid to promote the educational needs of children with SLD and the integration of technology is important to increase the efficiency of learning among children with learning disabilities (Starcic & Istenic, 2010 and Wood, et.al, 2017). However, little information was drawn from teachers regarding how the technological devices would be beneficial for children with specific learning disabilities (Rufus, et.al. 2015: Susan, 2009 and Wood, et.al. 2017). The successful implementation of technologies in the classroom largely depends on the knowledge and attitude of teachers regarding the use of technology in the teaching and learning process (Cope & Ward 2002). Therefore, it is essential to focus on teacher perceptive on the effectiveness of assistive technology among children with specific learning disabilities.

2. Background

2:1. Specific Learning Disability

Learning is the acquisition of new knowledge and skills. During the early years of development, children start learning to read, write and do arithmetic according to their age and intellectual capacity. However, it seems that, in spite of having normal intellectual capacity and normal visual, hearing or physical abilities, some children are specifically unable to acquire language and arithmetic skills, even when adequate opportunities for learning are provided (Dhanda & Jagawat, 2013). Children with learning disabilities are behind in the acquisition of cognitive skills, however, they have an average or above average IQ level, which means they do not

struggle with low intelligence (Kumar & Raja, 2010). The concept of learning disabilities covers an extremely wide range of characteristics. Because of the effect on cognitive processes, students with learning disabilities may have difficulties in a variety of academic areas as well as social and emotional development; however, major problems are more often found in specific areas such as reading, writing, and doing arithmetic, which are the core fundamentals of education.

The majority of children with specific learning disabilities have problems in reading, which is known as dyslexia. It normally affects the children's ability to recognize and manipulate the sounds in language as well as problems with decoding and recognizing new words. Children who suffer from this problem have difficulty with learning to read accurately and fluently. Writing difficulty (dysgraphia) is another problematic academic area for students with learning disabilities. Children with dysgraphia have difficulties in organizing and expressing their thoughts and ideas in written form. It impacts the basic writing skills of handwriting, typing and spelling. Another learning disability is the problem unique in remembering and correctly applying the steps in mathematical problems (dyscalculia). Specific problems may include difficulty in understanding size and spatial relationships, concepts related to direction, place value, decimals, fractions, time and remembering mathematical facts (Dhana, & Jagawat, 2013).

2:2. Inclusive Education

Inclusive education is the process of responding to the diversity of children by enhancing participation in the classrooms and reducing exclusion from education (UNESCO, 1994). Inclusive education ensures quality education for all students by effectively meeting their diverse needs in a responsive, respectful and supportive manner in mainstream settings. Mainstream schools include children with special needs in the classroom with their typical peers and seek to address the needs of all children with quality education. The United Nations Convention on the Rights of the Child (UNCRC, 1989), states that every child has the right to education, irrespective of their disability and without any kind of discrimination. Therefore, the children with special needs are effectively educated in either special or mainstream schools, in order to facilitate their independence and a sense of well-being with maximum inclusion and active participation in the communities where they live (Hornby, 2015).

Salamanca statement asserts that the general education setting should be regarded as a venue of child development, open to all children regardless of their physical, emotional and intellectual disabilities (UNESCO, 1994). Inclusive schools are expected to view various categories of differences and having unique traits that distinguish individuals from each other. Therefore, the

teaching and learning should be tailored according to the learner's condition. The Individuals with Disability Act (IDEA) in the USA requires that, when a child is identified for special education services, an individual education program (IEP) should be developed (IDEA, 2004). Each child's IEP develops by a team that included the child's teacher, parent, child and the person who is qualified for special education. The IEP team must prepare the individualized Education Plan (IEP) according to the unique needs of special need children in a general school.

The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD, 2006) emphasizes the rights of people with disabilities to access lifelong learning without discrimination and on an equal basis with others as well as not to be excluded from mainstream education due to their disability. The major goal of education for children with disabilities is to provide the best possible facilities for all children with disabilities in the most appropriate setting, with the aim of achieving the highest possible level of education in a mainstream setting (Felicia, et.al, 2014 and Hornby, 2015). However, the learning development of children with learning disabilities in a general education classroom depends on the skilful application of teaching techniques and materials to facilitate the learning of these children (Keetam & Alkahtani, 2013). Teachers should have the responsibility of organizing, implementing and evaluating instructional activities in the classroom according to the children's needs. Interventions involving assistive and instructional technologies, peer tutoring, co-operative learning and the teaching of meta-cognitive strategies have been identified as useful in optimizing the effectiveness of teaching for children with specific learning disabilities (Lindeblad, et.al, 2016).

2:3. Assistive Technology

According to the Individuals with Disability Education Act (IDEA), any equipment that is used to improve functional capabilities of individuals with disabilities is considered as AT. It may include any software program, or product system that is used to increase, maintain, or improve the functional capabilities of people with disabilities (Kumar & Raja, 2010). By implementing assistive technology as an integration to school curriculum, the educators can assist children with special needs by providing remedies to solve specific learning problems and can promote independent learning. However, the selection, acquisition and use of AT depends up on the evaluation of the needs of the child and the adequate level of the professionals, who work students with learning disabilities (Campbell, et.al, 2006).

Assistive technology allows students with disabilities to increase their accessibility to the curriculum and the quality of the learning experience (Alkahtani, 2013). Many assistive

technology devices are available to assist teachers in improving the functional capabilities of their students by increasing their participation in learning opportunities and involvement in activities (Staric & Istenic, 2010). Computer assisted instructions include various software applications that can assist children to enhance their academic achievement and attain their potential. These technologies range from simple spellcheckers to more complex speech recognition systems and educational software. Among them, software such as voice recognition, word prediction, spell checker and math software are found to be effective in catering to the needs of children with specific learning disabilities (Rufus, et.al, 2015). When students with learning disabilities are unable to achieve academic and behavior goals in school, teachers must recognize the need to provide appropriate technological tools and support that will enable them to successfully complete the required tasks. Therefore, assistive technology is an integral part of special education and a necessary component when planning and developing educational programs for students with disabilities.

2:4. Teacher Perspectives

To facilitate learning opportunities for children with SLD, teachers should use appropriate teaching strategies and materials to reduce or eliminate children's deficits in specific learning areas. The major responsibility of a teacher is to provide children with successful learning experiences regardless of their disabilities, in order to reach their goal for a brilliant future (Kumar & Raja, 2010). Therefore the teachers should use suitable technological devices for these students and ascertain how, with whom, where and when these devices can be provided most effectively. They might have the knowledge about teaching methods and how to design the curriculum according to student's needs, which are the key components of children's academic success (Netherton & Deal, 2007). However, inadequate information and insufficient pedagogical strategies on how to integrate the assistive technology into the ordinary curriculum is still an anxiety among teachers. To illustrate this, the research study (Keetam & Alkahtani, 2013), demonstrated teacher concerns about their training programs that do not provide sufficient coursework and field experience to enable them to support students with special educational needs.

Despite teachers knowledge and training, the use of technology in school settings varies based on children's preference as well as their interest and readiness toward technology use (Bagon, 2018).The individualized Education Plan (IEP) can determine the child's strengths as well as their weaknesses, their likes and dislikes and what strategies are helpful in interacting with the child (Campbell, et.al, 2006).Furthermore, through personalized learning the teacher can enhance students' motivation and engagement by increasing their autonomy and self-direction.

Bronfenbrenner's bioecological model (Bronfenbrenner & Morris, 2006) is useful in application to personalized learning because it explains the interactions that children experience that help their development and learning. The bioecological model consists of important environments that children and teachers inhabit and is organized and conceptualized into separate systems, including the microsystem, mesosystem, exosystem, macrosystem and the chronosystem (Paquette & Ryan, 2001). The microsystem, the closest layer comprises the relationships and interactions of a child in his/her immediate surroundings (family, peers, school, or neighbourhood). The meso system provides the connection between the structures of the child's microsystem (family-school, peers-family, neighbourhood-peers). The exosystem consists of the linkages and processes between settings in which the child does not function directly. However, the structure of this layer may impact the child's development by interacting with some structures in the microsystem. The macrosystem is the outer layer of the child's environment comprised with cultural values, customs and laws. Finally, the chronosystem is also relates to a child's environment, might be internal or external (Paquette & Ryan, 2001). Urie Bronfenbrenner's theory of child development has provided a comprehensive conceptual rationale of how central social contexts in a child's life interact and influence key outcomes, including social and emotional adjustment and school performance and engagement (Bronfenbrenner & Morris, 2006).

Teachers' perceptions towards assistive technology can determine the extent to which technologies are used in the process of teaching and learning (Lindeblad, et.al, 2016). In order to enhance the utilization of assistive technology as an intervention, the teachers should know which techniques and strategies are useful in different kinds of learning situations, and how to use the technique as an effective intervention that can enable children to become more strategic, effective and lifelong learners. (Alper & Raharinirina, 2006). However, what teachers do, and what they really know about assistive technology is dependent upon their skills, experience, knowledge and level of competence in inclusive practices (Cope & Ward, 2002). For example, teachers who perceive learning as an accumulation of information are more likely to view teaching as a transfer of information, means they most probably use assessments and tests for rote learning. In contrast, teachers who view learning as a conceptual change are more likely to be facilitators and will always encourage the children for independent learning. Their perceptions and attitudes will have great influence on their acceptance, style of implementation, and the outcome of using assistive technology for teaching children with learning disabilities.

3. Rationale for the Study

Research studies on the use of assistive technology suggest that, to be used effectively and successfully, practitioners must have the necessary knowledge and skills to use AT for its successful implementation for children with learning disabilities. According to the IDEA act (IDEA, 2004), teachers should be actively involved in the selection of AT and possess the knowledge and ability to implement, integrate and evaluate the devices. However, teachers are reluctant to use technology because of hindrances such as insufficient knowledge, lack of training and support (Keetam & Alkahtani, 2013). Several studies have investigated how technological devices can influence the learning development of children with SLD, however, many of these studies provided little evidence from teachers regarding their perspectives (Rufus, et.al, 2015: Susan, 2009 and Wood, et.al, 2017). Therefore, this study is a systematic review regarding teacher perspectives on the effectiveness of assistive technology among children with specific learning disabilities.

4. Research aim

The aim of this systematic review is to examine and analyse the perceptions of teachers regarding the effectiveness of assistive technology for children with specific learning disabilities. Two research questions were created for the purpose of the study.

5. Research Questions

- According to teacher perspectives, how effective are technological devices for assisting children with specific learning disabilities?
- Based on teacher responses what school related factors influenced their perceptions of AT in the classroom?

6. Methodology

6:1. Method – Systematic literature Review

To identify research on the teacher perceptions of the effectiveness of assistive technology among children with specific learning disabilities, the present study conducted a systematic literature review. A systematic review is a comprehensive and reproducible research method used to establish the extent to which existing research has progressed towards clarifying a particular problem. The purpose of a systematic literature review is to answer the research question by merging information from multiple sources (Jesson, Matheson & Lacey, 2011).

6:2. Search procedure

The database search procedure for this systematic review was performed in February 2019. The relevant databases used for the search category were, ERIC, Psycho INFO and Scopus. These particular databases were selected because they provided relevant articles from the fields related to education, teacher perspectives, assistive technology and specific learning disability. The search terms used in the databases were:

(“Assistive technolog*” OR digita* OR software*) AND (dysle* OR dysgraph* OR dyscalculia*) AND (Teacher* OR Educat*)

These search terms were used in all databases. The search terms were chosen according to the aim of the research and with the help of thesaurus terms in the selected databases. The asterisk (*) was used to find each relative word with any possible endings. The database ERIC produced 95 articles and Psycho INFO yielded 82 articles. Finally in Scopus, the enquiry came out with 166 articles. In the advanced search, the search criteria was limited to peer-reviewed articles published in the English language, from 2001-2018. After this exclusion, the search produced 53 articles from ERIC, 51 from Psycho-INFO and 56 from Scopus. A total of 160 articles were yielded for title and abstract screening.

6:3. Selection Criteria

When drawing up inclusion and exclusion criteria, it is important to specify the particular items that should be relevant to the aim of the study. The inclusion and exclusion criteria were created to retrieve relevant articles for the study. To be included in the study, the articles had to be focus on teacher perspectives on the effectiveness of AT for children with specific learning disabilities; dyslexia, dysgraphia and dyscalculia. This systematic review aimed at children with

specific learning disabilities, therefore; studies focused on children with physical disabilities, autism and ADHD were excluded.

In order to get deeper knowledge on teacher perspectives based on research questions, the researcher's origin plan was to limit the search on qualitative studies. However, two articles were found with mixed methods, the design of the included studies changed to qualitative and mixed methods. For the participants of the study, the researcher planned to focus on children aged with 12-18 (adolescents) because this is the age children are in secondary grades, where the demands of the curriculum that they are expected to meet is wide and they often need support to complete their learning tasks (Blackhurst, 2005). Since, two articles were found children from pre-school and primary, the age range was changed to 4-18. The inclusion and exclusion criteria are described in the following table.

Table: 1. Inclusion and Exclusion criteria

Inclusion	Exclusion
<p>Publication type</p> <ul style="list-style-type: none"> • Article Peer reviewed • Published from 2001 to 2018 • In English • Full text available for free <p>Age group</p> <ul style="list-style-type: none"> • Children/adolescence (4 to 18 years) with learning disabilities <p>Design</p> <ul style="list-style-type: none"> • qualitative studies • Mixed methods <p>Focus</p> <ul style="list-style-type: none"> • Dyslexia • Dysgraphia • Dyscalculia • Children with SLD • Teacher perspectives 	<p>Publication type</p> <ul style="list-style-type: none"> • Only abstracts available, conference papers, seminars, book chapters • Published in other languages • the articles were published prior to 2001 <p>Age group</p> <ul style="list-style-type: none"> • Childhood (0 to 5 yrs) and Adulthood <p>Design</p> <ul style="list-style-type: none"> • Quantitative, empirical and clinical case studies <p>Focus</p> <ul style="list-style-type: none"> • Typical children • Children with physical disabilities • Autism • ADHD

6:4. Screening process – Title and abstract level

Articles retrieved from the databases ERIC, Psycho INFO and Scopus were imported to Endnote, which is an online tool facilitating the screening process used in a systematic literature review. After importing the 160 articles, 18 were automatically detected as duplicates and 6 articles were excluded due to title screening. The abstracts were screened by using the inclusion and exclusion criteria as a checklist (appendix: B). After reading the abstracts, out of the 136 articles, 128 were excluded from this study. These articles were excluded because they were not related to the specific age group (n=19), were focused on learners' experiences (n=18), were not qualitative studies (n=23), were comparative studies that focused on children with ADHD and Autism (n=25), were not related to the teacher perspectives (n=34) or were not related to the subject, for e.g.: related to children's self-image, behavioural issues and psychological well-being (n=9). The abstract screening retrieved 8 final articles for full text screening. Again, a hand search was also performed, which selected 5 articles, and furthermore, a total of 13 articles (7+5) were selected for full text screening.

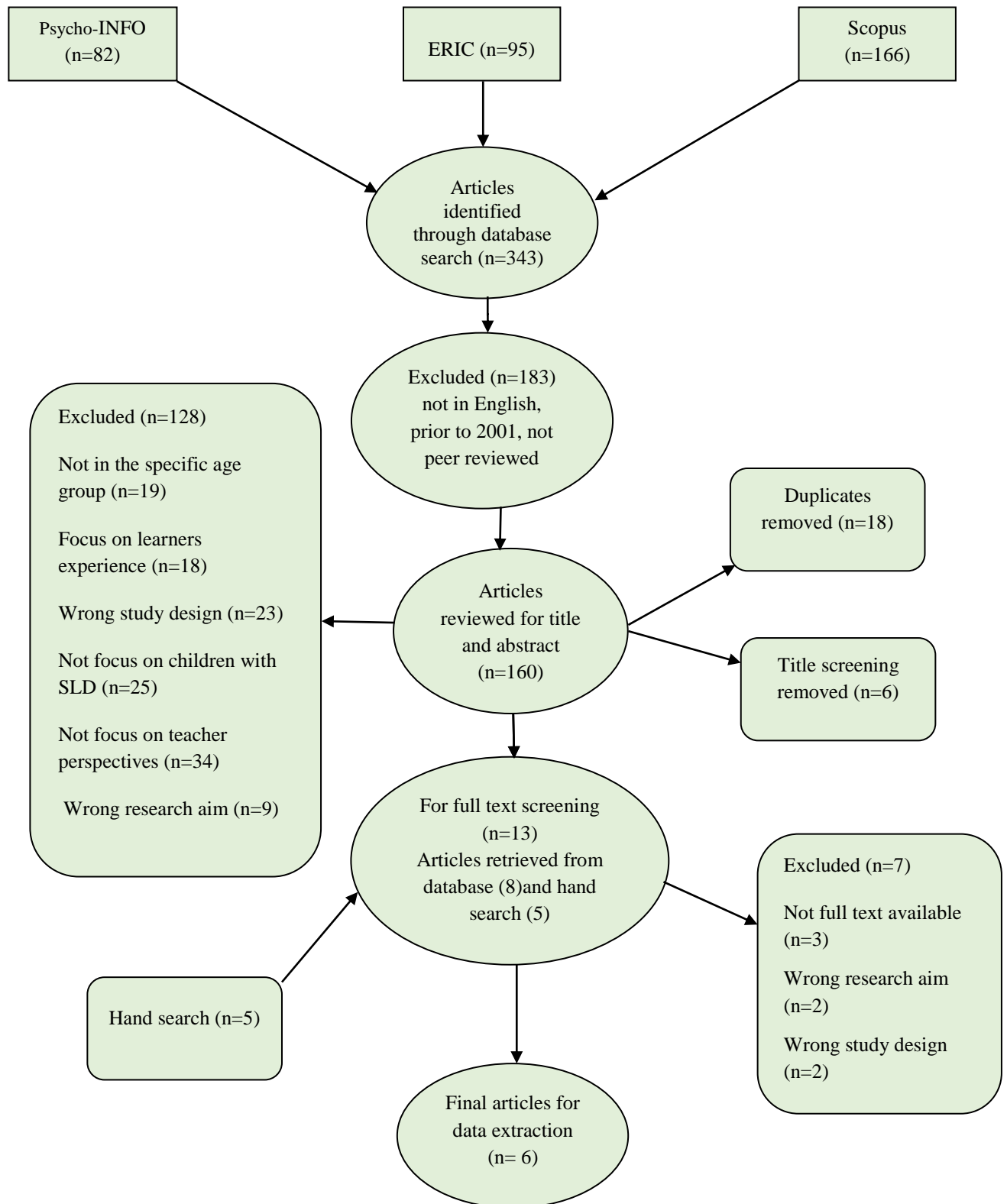
6:5. Full text screening

After the title and abstract screening, the full text was performed on 13 articles that fulfilled the inclusion criteria. At this stage, an extraction form (appendix: C) was used which contained information about the methods used, the participants, the aim, study focus and the results of the study. Out of the 13 articles, three of them were not available in full-text. Out of 10, two were excluded for not being qualitative and mixed method studies and another two were excluded due to having the wrong research aim. Finally six articles remained for data extraction.

6:6. Data Extraction

Data was extracted with the help of a data extraction tool (combined full-text protocol and quality assessment checklist (see Appendices A & C). Extracted data included general information about the participants, the assistive technology devices used and the perspectives of the teachers. General information (authors, year, title, journal, aim, research questions, method, country, ethical considerations), participant information (number, age, diagnosis, recruitment), use of AT for children with SLD (software/apps) teacher perspectives of AT (knowledge, experience, training, positive effects, varied perspectives, contextual factors) and final information (conclusions, quality assessment, limitations) were used for the extraction. The whole screening process is pictured in the following flowchart.

Flowchart



6:7. Quality Assessment

A quality assessment tool was used to assess the quality of the included studies. The quality assessment checklist was created with modifications of the Critical review Form – Qualitative studies (Version 2.0) (Letts et al. 2007). The checklist used for quality assessment is described in appendix A. Based on the checklist, the quality of included studies were assessed on 17 selected items such as study design, data collection, analysis, and findings (see appendix: C). The articles were rated on a scale from 0 to 17. Zero to 5 was scored as low quality, 6-11 as medium, and 12-17 as high. Three of the chosen articles were rated as high quality of research (Chiang & Jacobs, 2010; Flanagan, et.al, 2013 & Nordstrom, et.al, 2018) and three articles were rated as having medium quality (Ghazi Abed, 2018; Harper,et.al, 2016 & Julia, et.al, 2008). The reason for this was small sample size, numbers of participants were not specified and they did not have a reliability of measurement. These assessments are listed in table 1.

Table: 2. Selected articles

Author	Year	Title	Quality
Chiang, H. & Jacobs, K.	2010	Perceptions of computer based instruction system in special education: High school teachers and student views	High
Flanagan,S.,Bouck,E,& Richardson, J.	2013	Middle school special education teachers perceptions and use of assistive technology in literacy instruction	High
Ghazi Abed, M.	2018	Teachers’ perspectives surrounding ICT use amongst SEN students in the mainstream educational setting	Medium
Harper,K.,Kurtzworth,K. &Marable, M.	2016	Assistive technology for students with learning disabilities: A glimpse of the live scribe pen and its impact on homework completion	Medium
Nordstrom,T., Nilsson, S., Gustafson, S. &Svennson, I.	2018	Assistive technology applications for students with reading difficulties: Special education teachers experiences and perceptions	Quality
Stoner, J., Parette, H., Watts, E. &Wojcik, B.	2008	Pre-school teacher perceptions of assistive technology and professional development responses	Medium

6:8. Ethical considerations

It is imperative to ensure that ethical standards should be mentioned in all research studies. The research studies should gain ethical approval from relevant ethics board, maintain the participant's confidentiality when storing and presenting data, provide information to the participants and obtain their consent (Creswell, 2009). Four of the articles used for this systematic review wrote explicitly about the ethical steps they had taken in their study (Chiang & Jacobs, 2010; Flanagan, et.al, 2013; Nordstrom, et.al, 2018 and Ghazi Abed, 2018). However, two studies had no mentioned either consent or ascent (Harper, et.al, 2016 & Julia, et.al, 2008).

6:9. Data Analysis

The analysis was performed during and after the data extraction process. In order to get an overview of the articles, general information about the studies were analysed first (table: 2 in the results section). To answer the first research question, the effectiveness of assistive technology were analysed based on different categories such as type of software used, the usefulness of AT for children with dyslexia, dysgraphia, overall academic performance, children's self-esteem and their confidence. To answer the second research question, teacher perspectives were analysed based on sub-categories such as teacher's training/experience, their level of confidence and knowledge, availability and cost of software, time constraints and unique needs of children. The results of the articles will be presented according to the identified categories.

7. Results

7:1. Overview of the results

In order to answer the research questions, six articles were identified which fulfilled the inclusion criteria and explored the perceptions of teachers regarding the use of assistive technology for children with disabilities. Of the six articles included in this systematic literature review, four of them were conducted in the USA (Chiang & Jacobs, 2010; Flanagan, et.al. 2013; Harper, et.al. 2016 and Stoner, et.al, 2008), one study was conducted in Saudi Arabia (Ghazi Abed, 2018) and another study in Sweden (Nordstrom, et.al. 2018). Of these six articles, four studies were qualitative studies (Chiang & Jacobs, 2010; Harper, et.al. 2016; Ghazi Abed, 2018 and Stoner, et.al, 2008) and two used mixed methods (Flanagan, et.al. 2013 and Nordstrom, et.al. 2018). The participants included in the articles were teachers from pre-school to high-school and children from various age groups.

Of the six articles, three studies (Chiang & Jacobs, 2010; Nordstrom, et.al. 2018 and Harper, et.al, 2016) used intervention programs to explore the effectiveness of assistive technology. The research study by Chiang & Jacobs (2010), used the educational software program Kurzweil 3000 (K-3000) as an intervention which, serves as a speech synthesis system, scanning software, a writing support, note maker and an organizer. In this study, the teachers perceived how it affects the reading, functional task performance and academic self-perception of high school students with special needs. A six week app intervention (primarily with text-to-speech, TTS, and speech-to-text, STT functions for students in Grade 4, Grade 8, and in high school) was used on how reading and writing applications were perceived to function with regard to students' possibilities to read and write text (Nordstrom, et.al. 2018). Here, teachers perceived that the intervention sessions impacted highly on student development. Another study investigated the effectiveness of an assistive technology tool, the Livescribe Pen (LSP), as an intervention with an elementary student identified with dyslexia (Harper, et.al. 2016). While the LSP was primarily utilized for curriculum accessibility and as an audio tool to promote academic independence, the study's findings revealed the development of the child in the academic and non-academic area. Descriptions of the articles are in the following table.

Table 3. Description of the selected articles

<i>Author & Year</i>	<i>Country</i>	<i>Interventions/ Assessments</i>	<i>Method</i>	<i>Participants</i>
Chiang & Jacobs (2010)	USA	6months intervention. Educational software program Kurzweil 3000 (K-3000)	Qualitative (Interview & Focus group)	6 English from high school (experienced with AT) + 16 children studying in 9 th grade having special needs.
Flanagan,S., Bouck,E. Richardson, A. (2013)	USA	Intervention not used. Assessment was based on low-tech (ex: pencil grips, highlighters) and high-tech AT (ex: spell check, speech to text)	Mixed (Interview and questionnaire)	51 middle school special education teachers (1 to 5 years experience AT) + 7 th grade children with high incidence disabilities.
Harper, K., Kurtzworth, K. & Marable, M. (2016)	USA	One academic year. Used the Livescribe Pen (LSP) as intervention	Qualitative (Interviews and Focus group)	The teacher, SEN consultant and the intervention service teacher + 4 th grade child with dyslexia.
Stoner, B., Parette, H., Watte, E. &Wojick, W. (2008)	USA	The Early Language and Literacy Class Observation (ELLCO) Toolkit was used to assess the language development.	Qualitative (Semi-structured interviews and observation in the classroom)	9 pre-school teachers teaching children with identified disabilities + Children (age 4 to 7) with identified disabilities.
Nordstrom, T., Nilsson,S. &Svenson, I. (2018)	Sweden	6 week app intervention. Used reading and writing apps (with text-to-speech, TTS and speech-to-text, STT)	Mixed (Quantitative survey with written comments)	54 SEN teachers from middle & high school + 59 students with reading difficulties (4 th & 8 th grade and high school)
Ghazi Abed (2018)	Saudi Arabia	Intervention not used. Assessment was based on varied ICT tools	Qualitative (Semi-structured interviews)	20 teachers from mainstream school (6 of them have no AT experience) + Children with special needs (age group and number not specified)

7:2.0 Teacher perspectives on the effectiveness of AT

Achieving the meaningful use of assistive technologies in the field of education can be influenced by many factors. One of these factors is teachers' perceptions towards the use of technology in teaching and the learning process. The articles used for this systematic review, clearly reflected the effectiveness of assistive technology among children with specific learning disabilities.

7:2.1 Children's reading enhancement

In all of the research articles, the teachers perceived the usefulness of AT devices for the learning development of children with reading difficulties (dyslexia). In order to facilitate children's reading enhancement, the researchers used K-3000 as an intervention program and teachers reported its effectiveness for the speed, quantity and quality for improving children's reading comprehension (Chiang & Jacobs, 2010). By using a six week app intervention (primarily with text-to-speech, TTS, and speech-to-text, STT functions), the special education teachers responded positively about the impact of the assistive technology app usage regarding their students' ability to assimilate text and that it could compensate for their reading difficulties (Nordstrom, et.al. 2018). The teachers revealed the performance of children in reading activities by using the Livescribe Pen (LSP), as an assistive technology tool for a one year intervention programme (Harper, et.al. 2016). Teacher perceptions on the use and effectiveness of technological software to support children with high incidence disabilities were reflected that screen readers, speech-to-text and word prediction software are promoted as effective tools to support literacy instruction (Flanagan, et.al. 2013). Similarly, teachers described the importance of literacy in the curriculum and consistently made references to reading because it has the primary focus of all learning activities (Stoner, et.al, 2008). The recent study by Ghazi Abed (2018) also reviewed the perceptions of special education teachers and emphasized the importance of text-to-speech and optical character recognition (OCR) tools for children having difficulties in reading.

7:2.2 Written language development

Of the six articles, in four research studies (Chiang & Jacobs, 2010; Harper, 2016; Nordstrom, et.al. 2018 and Ghazi Abed, 2018), teachers reported not only the enhancement of reading development, but also of children's writing comprehension. It reflected the effectiveness of K-3000, the software program to check the dentitions of words and the spelling (Chiang & Jacobs, 2010) and the use of intervention sessions that increased awareness and knowledge among students written and oral language programs (Nordstrom, et.al. 2018). They reported that, by

using appropriate apps, it facilitated the skills needed for writing comprehension, such as improved access to vocabulary and understanding of written language. The apps were also perceived to contribute positively to writing skills, particularly regarding the structure of the text. By using Livescribe Pen (LSP) as an intervention, it provided evidence on development in word vocabulary, create bullet points and write in a comprehensive manner (Harper, 2016), Also, the use of LSP as an assistive tool, allowed the student more access to the curriculum and the ability to develop strategies for homework success. The SEN teachers focused on the importance of word processing tools, such as word processors and text-to-speech programs that provide benefits for learners in regard to writing production and help to improve levels of writing accuracy (Ghazi Abed, 2018). By assimilating and communicating text with apps, the teachers intended that it facilitated the skills needed for comprehension, such as an improved access to vocabulary and spelling (Nordstrom, et.al, 2018).

7:2. 3 Overall academic performance

With the enhancement of reading and writing comprehension, in most of the articles (Harper, et.al, 2016; Ghazi Abed, 2018; Chiang & Jacobs, 2010 and Nordstrom, et.al. 2018), the teachers reflected that integration of technology in the classroom enhanced student's academic performance in the classroom environment. Researchers reflected the use of LSP (Livescribe Pen), which increased the child's better participation in all academic activities and deepened the connection between reading and writing (Harper, et.al, 2016). The teachers claimed that, students were able to benefit from e-learning environments in terms of their ability to organise and plan their work in line with teachers' requests and achieve better academic outcomes (Ghazi Abed, 2018). Furthermore, the use of assistive technological devices facilitated student's independent participation through completing the academic tasks and appeared to have an improved self-perception in their learning competence (Chiang & Jacobs, 2010 and Nordstrom, et.al. 2018). On contrast, the teachers reported that, the academic performance of children depends on the collaboration between the faculty members who involved in special education (Harper, et.al, 2016 and Ghazi Abed, 2018). For example, the collaboration of the teacher, the special education consultant and the academic intervention service teacher and how they provide individualized instructions to children according to their unique needs (Harper, et.al, 2016 and Ghazi Abed, 2018).

7:2. 4 Children's self-esteem & confidence

When considering teacher perceptions in regard to children's self-esteem and confidence, all studies reported that, children have developed higher self-esteem, greater self efficacy in school performance, and better attitude towards school, regardless of their actual academic achievement. The results of four of the articles revealed that, technology is useful to support self- determination and positive emotions among children with learning disabilities (Chiang & Jacobs, 2010; Harper, et.al, 2016; Ghazi Abed, 2018 and Nordstrom, et.al, 2018). Teachers reported that the use of technology increased student's self-perception after integrating the software as a classroom instruction (Chiang & Jacobs, 2010). In a recent study, 60% of teachers responded positively regarding their students motivation towards doing schoolwork; however, 40% of teachers reported it depends on how the children use it as effective equipment, their interest to learn and how they will be motivated (Nordstrom, et.al. 2018). For example; support from family members and school authorities. However, the teachers emphasized the use of assistive technology by encouraging student independence, motivation and that it would be useful in improving their confidence and self-esteem (Harper, et.al, 2016 and Ghazi Abed, 2018).

7:3. Factors impacting teacher perspectives:

Teacher perspectives on the effectiveness of technology can influence by several factors. The articles used for this systematic review, clearly reflected the factors influenced on their varied perspectives on assistive technology among children with specific learning disabilities.

7:3.1 Training/ experiences

Teachers' perceptions and understanding of AT depends upon the effective instructions they received during their pre-service training programs and professional developments. Teachers' lack of training programs and experience is found in most of the articles (Flanagan, et.al, 2013; Chiang & Jacobs, 2010 and Ghazi Abed, 2018). To illustrate this, researcher reported that, teachers' previous experiences and own knowledge determined how effectively AT is used for literacy instruction and how well it supported children's learning development (Flanagan, et.al. 2013). Teachers who have years of experience and received more training activities relating to AT (i.e. coursework, workshops, in service programs) reported the effectiveness of technology more positively (Flanagan, et.al, 2013). However, 30% of teachers in this study reported that, they did not feel prepared, or were unsure of how to use technology, and unaware of how to effectively implement, integrate and evaluate AT. Similarly, in another research study, the

teachers who currently use computer based instructions argued that it is an effective tool that enhances students' learning and the teachers who did not have experience with technology reported the lack of familiarity with using it (Chiang & Jacobs, 2010). Additionally, 60% of teachers reported their lack of training and experience in regard to assistive technology and hesitation on how to integrate different activities in children having learning disabilities in different ages (Ghazi Abed, 2018).

7:3.2 Level of confidence and knowledge

Of the six articles, three studies revealed the reflections of teachers related to their level of confidence and knowledge regarding the use of technology in the classroom (Chiang & Jacobs, 2010; Flanagan, et.al, 2013 and Stoner, et.al, 2018). Teachers revealed that, their specific skills related to assistive technology impacted their levels of confidence such as knowing how to set up an AT and how to customize it as an effective tool for a specific child's learning development (Flanagan, et.al, 2013). Similarly, the teachers who reported low-levels of confidence explained how they needed additional training and knowledge of AT, including its instructional purposes and functions (Chiang & Jacobs, 2010). Teachers' level of confidence was related to their perceived ability to use and integrate AT during instruction. To illustrate this, the teachers who have more knowledge expressed their confidence in their abilities in order to provide assistance to children and stated that, assistive technology can foster independence and makes children active learners. However, the teachers who have less confidence and knowledge, perceived AT as a supplement rather than an integrated aspect of their curriculum (Stoner, et.al, 2008).

7:3.3 Unavailability of devices and technical support

In order to integrate technology for children with learning disabilities, the availability of appropriate software and learning programs are essential in the classrooms. Of the six studies, three studies explored teacher concerns regarding the unavailability of devices, lack of technical support and the high cost of different software programs (Chiang & Jacobs, 2010; Flanagan, et.al. 2013 and Ghazi Abed, 2018). The teachers reported low-tech AT as being used more frequently than high-tech AT, possibly due to the factors that they are less costly and easier to use without technical support (Flanagan, et.al. 2013). In this study, 75% of teachers reported their hindrance to use high-tech devices, as its high cost and the unavailability of technical services (Flanagan, et.al, 2013). Furthermore, the teachers were concerned about the poor access of appropriate technological devices in the classroom to support children with special needs (Ghazi Abed, 2018). Similarly, they reported the lack of accessibility of technology, for

example, not enough computers, expense of software and lack of IT technicians (Chiang & Jacobs, 2010).

7:3.4 Time constraints and unique needs of children

Research articles indicated that time constraint is a major drawback to facilitate the use of instructional technology (Chiang & Jacobs, 2010; Stoner, et.al, 2008 and Ghazi Abed, 2018). For using computer-based instruction as an educational tool, the teachers needed more time for the preparation of scheduling programs in the computer (Ghazi Abed, 2018 and Chiang & Jacobs, 2010). Time concerns included the time required to learn AT, time required to incorporate the AT into the lessons, and the time needed to teach the children how to use AT (Stoner, et.al, 2008). Furthermore, two articles indicated the individual differences among children, their autonomy, motivation for learning and their interest to using apps for learning (Flanagan, et.al, 2013 and Nordstrom, et.al, 2018). The effective use of assistive technology depends on the supporting instructions the teachers give and the children's willingness and interest to use it as an effective tool.

8. Discussion

The purpose of this systematic literature review was to identify, and analyse existing literature regarding teacher perceptions of assistive technology for children with specific learning disabilities. Based on the aim of this research, six studies were identified; five focused on the perceptions of teachers, who were teaching middle and high school students and one focused on the perceptions of pre-school teachers. The results of the six studies will be discussed and used to answer the two research questions (1) According to teacher perspectives, how effective are technological devices for assisting children with specific learning disabilities? (2) Based on teacher responses what school related factors influenced their perceptions of AT in the classroom?

8:1. Teacher Perspectives of AT

According to the first research question, the analysis of the results highlighted the implications of assistive technology that can address deficits in academic skills and can foster opportunities for self-determination and independent learning among children. All articles reflected teacher perspectives on the effectiveness of assistive technology, which is a powerful tool to enhance learning for those having difficulties in writing and reading (Nordstrom, et.al, 2018; Flanagan, et.al, 2013 and Stoner, et.al, 2008). Furthermore, AT is recognized as a positive valuable tool to

enable learning access, to enhance the levels of learning reinforcement, motivation, confidence and self-esteem (Ghazi Abed, 2018; Chiang & Jacobs, 2010 and Harper, et.al, 2016). However, in the two studies (Flanagan, et.al, 2013 and Nordstrom, et.al, 2018), the teachers emphasized that all children are unique and the effectiveness of AT depends on children's willingness to use AT as a learning tool. Therefore, how the children are motivated and how autonomous the children by using AT, in different age groups should be emphasized.

From the perspectives of teachers, assistive technology should be aligned with teachers understanding on children's needs, teacher-student relationship and the creation of an active learning environment. Through Individualized Education Plans (IEP), teachers can maximize student's ability to access curriculum and to demonstrate their learning. The Individuals with Disabilities Education Improvement Act in the USA (IDEA, 2004) requires that IEP should develop in collaboration with parents, children and professionals and the IEP team must consider the necessity of assistive technology with the individualized learning for children. In correspondence with special education, individualized education plan is mandatory, which address the individual needs of students with special needs (Felicia,et.al, 2014). By using assistive technology as a part of IEP, which can foster goals and progress in student's learning by establishing a clear relationship between student needs, assistive technology devices and services, and the student's goals and objectives.

Furthermore, the formation of personalized learning environments could be useful for teachers to understand the needs, preferences and experiences of their learners. Through individualized learning, the teachers can foster teacher-child relationship and can realise their unique needs. From the perspective of teacher-student relationships, the bioecological model suggests that the process of learning and development takes place through teacher-student interactions in the classroom(Taylor &Gebre, 2016). In Bronfenbrenner's bioecological model, Microsystems consist of the most immediate contexts in which a child may reside, such as the family, peers, school, or neighbourhood (Paquette& Ryan 2001).For teachers, the home environment and parenting practices have important implications for creating personalized learning environments for students. Knowing more about children's home lives and experiences (microsystem) may provide teachers direction in shaping learning contexts that fit the particular needs of their students. According to the bioecological model, children learn and develop through teacher-child interactions, and instruction and participation in educational activities. Therefore, in managing teacher-student relations, teachers might be able to capitalize the children's experiences on their contexts by positive interactions in the classroom. Then, the teachers can

maximize the effectiveness of assistive technology among students through individualized instruction and teaching.

Of the six articles, three studies (Chiang & Jacobs, 2010; Nordstrom, et.al. 2018 and Harper, et.al. 2016) used intervention programs to explore teacher perspectives on the effectiveness of assistive technology. The findings of these articles reflected the positive effects of different apps on students' academic self-perception and functional task performance. These articles showed clear evidence on the importance of using software in appropriate intervention plans and how it is possible to compensate for reading and writing difficulties in an inclusive school setting. The use of assistive technology as an intervention is essential for developing the academic skills and independent learning among children with specific learning disabilities. Therefore, it is important to provide suitable intervention programs, for example; short-term or long-term interventions according to the needs of the child. Furthermore, teachers not only need to know what interventions are available to them, but they need to be able to differentiate the interventions based on the individual needs of students (Lindeblad, et.al, 2016). This can be done by identifying the specific needs of their students, developing individualized education plans by using available interventions to individually address those needs, and then changing their instruction strategies to meet the needs of each student in the classroom.

8:2. Factors influence on teacher perspectives

Based on the second research question, this systematic review focused on how teacher perspectives varied based on school related factors. All the studies reflected on teachers' existing attitudes, skills, and working habits and how it influenced their acceptance, style of implementation, and outcome of using computers for teaching. Despite the positive outcomes of AT among children with SLD, most articles reported the perceptions of teachers regarding their lack of training and knowledge, lack of familiarity with AT and technical support, time constraints and limited access to technology (Ghazi Abed, 2018; Stoner, et.al, 2008 and Chiang & Jacobs, 2010).

Teachers' knowledge on software applications and professional development is essential for the successful implementation of assistive technologies (Keetam & Alkahtani, 2013). To facilitate learning, teachers need to document each child's characteristics and provide appropriate technological support to reduce or eliminate the child deficiencies in the specific learning areas (Al-Zaidiyeen, et.al, 2010). To implement this, appropriate training is necessary for teachers to optimize the needs of each child and to motivate the children for using suitable apps. In this context, professional development is an imperative and a necessity factor in implementing

assistive technologies. Through professional development, teachers can develop their confidence and knowledge regarding AT, which will enable them to support children according to their needs. The school authorities and other administrators review the extent of professional development opportunities that their schools and school districts are offering teachers who use AT in the classroom and also provide further training where they needed.

Based on the perceptions of teachers, the importance of an integral team approach might be useful for developing children's meta-cognitive study skills through assistive technology. The reflective practice of teachers and the collaboration of parents, teachers, and support providers are helpful ways to provide an insight on how to use new methods and strategies to accommodate the barriers of children with learning disabilities (Blackhurst, 2005). Therefore, for teachers, understanding the social contexts in which children live and the resources available are important for the integration of technology into learning. Teachers can understand the context of the child through regular communication with family members and other professionals. In the bioecological model, the mesosystem consists of processes and linkages taking place between two or more of the settings in which children interact (e.g., family-school, teacher-family). Teachers understanding on how mesosystem operate may be the most important application of the bioecological model for the creation of collaborative learning environments for children (Bronfenbrenner & Morris, 2006). Increase parental involvement may support teachers' practices in school and also helpful for teachers to obtain information directly from students and their parents on family relations, parental support and involvement in students' academic development.

The findings of the studies reflected teacher concerns regarding the lack of appropriate assistive technological devices in the classroom (Flanagan, et.al. 2013 and Ghazi Abed, 2018). Scarcity of resources and devices are obstacles for the teachers to use technological devices effectively. It is the responsibility of the school administrative authorities to provide all the facilities for special need children and what they require for their learning development. As stated in the Salamanca Statement on Special Needs Education (UNESCO, 1994), schools should assist children to become independently active and provide them with the skills needed in everyday life. However, the high costs of AT devices and the lack of sufficient funds to meet these costs were concerned by the teachers (Flanagan, et.al. 2013 and Ghazi Abed, 2018). To overcome these issues, equipment loan services may be useful that allow trial of equipment at minimal cost. The most effective way is the careful selection of equipments with minimum cost and that is necessary not only for student's current needs, but the forward planning of the student's future needs. Furthermore, if the government authorities can provide sufficient funding to schools that would

be useful for buying technological devices and provide training for teachers to facilitate the learning development of special need children.

Furthermore, the teachers reported, lack of technical instructors in schools that hinders the teachers ability to use assistive technology effectively (Flanagan, et.al. 2013 and Chiang & Jacobs, 2010). In the absence of effective technical support, teachers cannot be expected to solve the technology-connected issues. However, if a teacher has a strong support system, including an assistive technology team or possibly a mentor or colleague with knowledge pertaining to assistive technology, will have the opportunity to use assistive technology more effectively (Campbell, et.al, 2006). If the school administrators ensure that there is someone in their area or in each school who is technically proficient in assistive technologies and will be available on time, might be helpful for teachers when technical problems arise.

Time is a critical element for most of the teachers to implement appropriate instructions based on children's needs (Chiang & Jacobs, 2010; Stoner, et.al, 2008 and Ghazi Abed, 2018).The challenge of time to learn and effectively use technology in classrooms remains a concern for many teachers. To address this issue, researchers emphasized essential conditions for effective use of technology in classrooms, including a shared vision for integration of AT, proper individualized plan for the child, easy access to hardware, software, and other resources, teachers knowledge on how to use AT, available technical assistance and appropriate teaching and assessment approaches (Bagon, 2018 and Maur & Drewry, 2011). By gaining a better understanding of how much extra time is needed to implement AT in the classroom and how the required time varies with the kind of AT being used, it might be possible to devise strategies and techniques to reduce that time.

9. Limitations

While this research provided important information regarding teacher perspectives on assistive technology, this systematic review has several limitations. Initially, the review was focused in the field of education and learning development of disabled children; therefore, only three databases that focused on educational aspects were used for this systematic review. The final articles used for this systematic review were identified to have children with reading and writing difficulties. None of the studies focused on children with difficulties in mathematical calculations (dyscalculia). A systematic literature review is a good way to get an overview of what kind of research has been done within a certain field. However, little research has been done within the chosen field. Therefore, the age limit and the study design had to be adjusted in the inclusion criteria. The plan was originally to focus on qualitative studies and limit the age

range from 12 to 18 years. But, two articles were found based on pre-school and middle school teacher perceptions; the age limit was adjusted from 4 to 18 years. Two articles were used mixed methods for data collection and analysis, therefore, the design of the included articles were adjusted to qualitative and mixed methods. Other limitation is, the selection process, quality assessment, and analysis of results were done by one single researcher. This affects the reliability and increases the bias of the search procedure and selection process. Finally, it was difficult to establish on what grounds and from which standards the teachers made their perceptions. The level of technology competence were varied between teachers as some teachers have worked with AT for a long time and some teachers did not have experienced.

10. Future Direction

This systematic review has focused on the teacher perceptions of assistive technology for children with learning disabilities. Few research studies were focused on teacher perspectives and little is known about how pre-service teachers are being prepared for AT use. If a teacher is not adequately prepared to use and implement any type of technology, the technology may not be used to its highest advantage and possibly negatively impact learning, rather than supporting it. Teachers' use and understanding of AT may increase when provided with effective instruction during pre-service training programs. Therefore, the future research would be focus on pre-service teachers' awareness of technology and how they prepared for using it for children with special needs as a part of their training program and professional development.

11. Conclusion

Assistive technology may have a significant effect in helping students with learning disabilities in order to meet the goals of their learning development. Due to the literacy challenges, students with learning disabilities might require assistive technology devices and software for academic achievement. A number of research studies have been conducted on how information and communication technologies can influence the development of children with specific learning disabilities and how technology can develop these children's independent learning, active participation in classroom discussions and recreational activities. However, since every student with a learning disability is unique, educators need to successfully determine the needs of the student and provide the corresponding assistive technology device. In order to implement assistive technologies as learning tools to support children with special needs, teachers' views and perspectives on the effective use of assistive technology are important. The school and administrative authorities should address their needs of professional development and minimize

their challenges to making AT as a part of the learning process. This systematic review provided clear evidence on teacher perspectives that are vital for developing effective approaches for the integration of AT in the mainstream classrooms. Teacher perspectives on what strategies can be used to assist learning, which techniques are useful in which kinds of learning situations, and how to use the techniques are powerful tools that can enable students to become strategic, effective, and lifelong learners.

12. Reference:

- Alper, S. & Raharinirina, S. (2006). Assistive technology for individuals with disabilities: A review and synthesis of the literature. *Journal of Special Education Technology*. 21 (2), 47–64
- Adebisi, R. (2014). Using Information and Communication Technology (ICT) in teaching children with special needs in the 21st Century. *Journal of Research in Science, Technology and Mathematics Education*. 2(1), 129-138
- Ahmed, A. (2018). Perceptions of using Assistive Technology for students with disabilities in the classroom. *International Journal of Special Education*. 33 (1), 129-139
- Al-Zaidiyeen, N. J., Mei, L. & Fook, F. S. (2010). Teachers' attitudes and levels of technology use in classrooms: The case of Jordan schools. *International Education Studies*. 3(2), 211-218. <http://dx.doi.org/10.5539/ies.v3n2p211>
- Blackhurst, A. (2005). Perspectives on applications of technology in the field of learning disabilities. *Learning Disabilities Quarterly*. 28, 175-178. Doi: 10.2307/1593622
- Bronfenbrenner, U. & Morris, P. A. (2006). The bio-ecological model of human development. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology, Vol. 1: Theoretical models of human development* (6th ed., pp. 793–828). New York, NY: John Wiley
- Campbell, P., Milbourne, S., Dugan, L. & Wilcox, J. (2006). A review of evidence on practices for teaching young children to use assistive technology devices. *Early childhood Special Education*. 26 (1), 3-13
- Chiang, H. Jacobs, K. (2010). Perceptions of Computer based instruction system in special education: High school teachers and student views. *World Journal of Education*. 37 (4), 349–359
- Cope, C. & Ward, P. (2002). Integrating learning technology into classrooms: The importance of teacher perceptions. *Educational Technology and Society*. 5 (1), 67-74
- Creswell, J. W. (2009). *Research design: qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, California: Sage.
- Dhana, A. & Jagawat, T. (2013). Prevalence and Pattern of Learning Disabilities in School Children. *Journal of Delhi Psychiatric Society*. 16 (2), 386-390

Felicia, A., Sharif, S., Wong, K. & Marriappan, M. (2014). Innovations of assistive technologies in special education. *International Journal of Enhanced Research in Educational Development*. 2(3), 25-38

Flanagan, S., Bouck, E. & Richardson, J. (2013). Middle school Special Education Teachers' perceptions and use of Assistive Technology in Literacy Instruction. *Assistive Technology*. 25 (3), 24-30. DOI: 10.1080/10400435.2012.682697

Ghazi Abed, M. (2018). Teachers' Perspectives on surrounding ICT use amongst SEN students in the Mainstream Educational setting. *World Journal of Education*. 8 (1), 6-16.
doi:10.5430/wje.v8n1p6

Harper, K., Kurtzworth, K. & Marable, M. (2016). Assistive Technology for students with learning disabilities: A glimpse of the livescribe pen and its impact on homework completion. *Educational Technology*. 24 (22), 471–483. DOI 10.1007/s10639-016-9555-0

Hornby, G. (2015). Development of a new theory for the education of children with special educational needs and disabilities. *British Journal of Special Education*. 42 (3), 233-256. DOI: 10.1111/1467-8578.12101

Individuals with Disabilities Education Improvement Act (IDEA, 2004). P.L. 108–446.
Retrieved from: <https://cec.sped.org/~media/Files/Policy/IDEA/CRS%20IDEA%20Report.pdf>

Jesson, J., Matheson, L., & Lacey, F. M. (2011). *Doing your literature review: Traditional and systematic techniques*. Sage

Keetam, D. & Alkahtani, F. (2013). Teachers knowledge and use of Assistive Technology for students with Special Educational Needs. *Journal of studies in Education*. 3 (2), 65-85.
doi:10.5296/jse.v3i2.3424

Kumar, S. & Raja, B. (2010). Web-based Technology for children with learning difficulties. *Journal of Educational Technology*. 7 (1), 8-13.

Lindeblad, E., Nilsson, S., Gustafson, S. & Svensson, L. (2016). Assistive technology as reading interventions for children with reading impairments with a one-year follow-up. *Disability and Rehabilitation: Assistive Technology*. 12 (7), 713-724. DOI: 10.1080/17483107.2016.1253116

Letts, L., Wilkins, S., Law, M., Stewart, D., Bosch, J. & Westmorland, M. (2007). Critical review form: Qualitative studies. Retrieved April 6, 2019 from: <https://srs-mcmaster.ca/wp-content/uploads/2015/04/Critical-Review-Form-Qualitative-Studies-Version-2-English.doc>

- Maor, E., Currie, A. & Drewry, S. (2011). The effectiveness of assistive technologies for children with special needs: a review of research based studies. *European Journal of Special Needs*. 26 (3), 283-298.
- Netherton, D., & Deal, W. (2006). Assistive technology in the classroom. *Technology Teacher*. 66(1), 10-15
- Nordstrom, T., Nilsson, S., Gustafson, S. & Svenson, I. (2018). Assistive Technology applications for students with reading difficulties: Special education teachers' experiences and perceptions. *Disability and Rehabilitation: Assistive Technology*. 12 (1), 4-16. DOI: 10.1080/17483107.2018.1499142
- Paquette, D., & Ryan, J. (2001). Bronfenbrenner's Ecological Systems Theory. P: 2-12. https://dropoutprevention.org/wpcontent/uploads/2015/07/paquetteryanwebquest_20091110.pdf
- Rufus, A., Liman, O., Abubakar, N. & Kwalzoom, L. (2015). Using Assistive Technology in Teaching children with Learning disabilities in the 21st C. *Journal of Education and Practice*. 6(24), 14-20.
- Starcic, S, & Istenic, A. (2010). Educational Technology for the Inclusive Classroom. *Turkish Online Journal of Educational Technology* . 9 (3), 26-37.
- Stoner, J., Parette, H., Watts, E., & Brain, W. (2008). Pre-school teacher perceptions of Assistive Technology and Professional development responses. *Education and Training in Developmental Disabilities*. 43 (1), 77-91.
- Susan, S. (2009). The effects of Assistive Technology on students with disabilities. *Journal of Educational Technology*. 37 (4), 419-429. Doi: 10.21901ET.37.4.f
- Taylor, R. D., & Gebre, A. (2016). Teacher–student relationships and personalized learning: Implications of person and contextual variables. In M. Murphy, S. Redding, & J. Twyman (Eds.), *Handbook on personalized learning for states, districts, and schools* (pp. 205–220). Philadelphia, PA: Temple University, Centre on Innovations in Learning. Retrieved from www.centeril.org

UN Conventions on the Rights of Persons with Disabilities (CRPD, 2006). New York.
Retrieved from: <http://www.un.org/disabilities/documents/convention/convoptprot-e.pdf>

UNESCO (United Nations Educational, Scientific and Cultural Organization, 1994). *The Salamanca Statement and Framework for Action on Special Needs Education*. New York: UNESCO.

UNICEF (1989). UN General Assembly. *A summary of the rights under the conventions of the rights of the child*. Retrieved from: https://www.unicef.org/crc/files/Rights_overview.pdf

Wood, Surah, G., Moxley, Jerad, H., Tighe, Elizabeth, L. & Richard, K. (2017). Does use of text-to-speech and related read aloud tools improve reading comprehension for students with reading disabilities? A Meta-Analysis. *Journal of Learning Disabilities*. 51 (1), 73-84. doi/10.1177/002221941668817

13. Appendix

Appendix A: *The quality assessment tool used on the included articles*

Assessment	Rating (0-1)
1. Was the aim/ purpose/research question clearly mentioned in the study?	
2. Was relevant background literature reviewed?	
3. Was a theoretical perspective identified?	
4. Were the methods used described effectively?	
5. Was the design appropriate for the study question?	
6. Was the process of selection described?	
7. Were the participants recruited described in detail?	
8. Were ethical issues and procedure considered?	
9. Was informed consent obtained?	
10. Was the role of researcher and participants described?	
11. Was adequate information about data collection procedures provided?	
12. Was the process of analyzing data described adequately?	
13. Did a meaningful picture of the study emerge?	
14. Were the conclusions appropriate given according to the study findings?	
15. Was trustworthiness mentioned?	
16. Were limitations mentioned?	
17. Did the findings contribute to future research?	

Appendix: B

Extraction form used on title / abstract level

Extraction form on title / abstract level

Article (author, title, journal, volume and no: of
pages)

Article name

Clearly stated (Yes/No)

Abstract was
clear? (Y / N)

Children and/or adolescents (age 6-18)
(Y / N)

Focusing on Children with SLD?
(Y / N)

Focusing on teacher perceptions/views?
(Y/N)

Effectiveness of AT/ Children's learning development
(Y/N)

Study design? (Qualitative/Quantitative/Mixed method)

Appendix.C

Extraction Protocol for the full-text screening

General Information	Author Year Title Journal name Country
Background Information, study purpose and Research questions	Theoretical background Study rationale/purpose Research questions
Methods used	Type of study (qualitative/quantitative, Mixed) Study design
Population	Sample size Children/Adolescents Teachers Children with SLD
Results/Outcome	Data analysis Software/intervention used Teacher perspectives/experience Effectiveness of AT Factors influenced
Discussion	Limitations Practical Implications
Quality Assessment	Score on the quality assessment High/Medium

