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DEPARTMENT OF EDUCATION AND SPECIAL EDUCATION

INVESTIGATING TEACHERS' USE OF ASSISTIVE TECHNOLOGY FOR TEACHING CHILDREN WITH LEARNING DISABILITIES IN GOTHENBURG, SWEDEN

Assessing AT Availability, Teachers Attitudes and
Pedagogical Competence

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Abstract

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Aim: The purpose of this study was to investigate teacher's use of Assistive Technology (AT) to teach children with learning disabilities (LD) in elementary classrooms in the Gothenburg Municipality of Sweden. This thesis assessed classroom availability and use of 16 AT tools for teaching children with learning disabilities, teacher's attitudes and teacher's level of pedagogical competence in using AT to teach children with LD in the areas of reading, writing, mathematics and memory / organization disorders.

Theory: The Technological Pedagogical Content Knowledge (TPACK) framework by Mishra and Koehler (2006) and the ABC Model of Attitudes provided the theoretical framework for investigating teacher's use of AT devices for teaching children with learning disabilities.

Method: This study was informed by the quantitative approach and a descriptive structured questionnaire for both special education and regular education teachers was used as the main instrument for collecting data. A total of (n=52) regular and special education teacher purposively selected from five different elementary schools in the Gothenburg municipality participated in the study which investigated their classroom availability and use of AT devices for teaching children with learning disabilities, their attitudes towards using AT and level of pedagogical competence.

Results: Findings show that elementary classrooms in the Gothenburg Municipality of Sweden are equipped with the necessary AT tools for teaching children with learning disabilities. However; three important high-tech devices for teaching children with LD which are talking calculators, pen scanners and paper-based computer pens were almost missing in elementary classrooms. Findings also indicate that teachers have positive attitudes towards using AT tools but some teachers are not fully equipped with the necessary pedagogical skills / competencies on how to identify, plan, evaluate and assess AT lessons for children with learning disabilities and opted for more training.

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Abbreviations

AT	Assistive Technology
LD	Learning Disabilities
TA	Teachers Attitude
PC	Pedagogical Competence

NJCLD	National Joint Committee on Learning Disabilities
HAAT	Human Activity Assistive Technology

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CHAPTER ONE

INTRODUCTION

Introduction

In recent years, many institutions have emerged with diverse definitions for learning disabilities (LD) and the most conventional definition of LD is from the National Joint Committee on Learning Disabilities (NJCLD). According to the (NJCLD, 2016, p. 1):

“Learning disabilities is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical skills. These disorders are intrinsic to the individual and presumed to be due to a central nervous system dysfunction. Even though a learning disability may occur concomitantly with other handicapping conditions (e.g., sensory impairment, mental retardation, social and emotional disturbance) or environmental influences (e.g., cultural differences, insufficient/inappropriate instruction, psychogenic factors), it is not the direct result of those conditions or influence”

The International Organization for Standardization (2011) defines Assistive Technology (AT) as “any product (including devices, equipment’s, instruments, and software’s) especially produce or generally available, used by or for persons with disability, for participation, to protect, support, train, measure, or substitute for both functions / structures and activities, or to prevent impairments, activity limitations of participation restrictions.” According to Wood, et.al (2017) most children with learning disabilities are educated in the general education classroom and they often experience difficulties in comparison to their peers and the use of assistive technology is one of those instructional or learning tools that many educational researchers have become increasingly interested in investigating it use in enhancing the academic achievement of children with learning disabilities in inclusive classrooms, (Wood, et.al, 2009). Findings from most studies show that assistive technology is vital to increasing the efficiency of learning among children with learning disabilities (Starcic &Istemic, 2010).

Furthermore, managing instruction for children with learning disabilities in an inclusive classroom setting might pose a big challenge to both the regular and special education teachers and to overcome these challenges, assistive technology is one of those teaching resources that are often adopted into the school curriculum or Individualized Educational Plan (I.E.P) to facilitate classroom lessons for learners with learning disabilities. However, the successful implementation of assistive technology in the classroom largely depends on the knowledge, and attitudes of teachers (Cope & Ward 2002). Also,

teacher's attitudes and lack of sufficient knowledge or skills towards using AT are also the most considerable barriers in the effective integration and implementation of assistive technology (Alper & Raharinirina, 2006). Findings from previous research works also indicates that most teachers of students with disabilities described themselves as being insufficiently prepared to use assistive technology (Alsalem, 2010)

Background to the Study

The Swedish National Agency for Education (Skolverket, 2011) gave Information Technology (IT) the status of an important component in learning for the future. The use of speech synthesis or e-books in reading pictures as a support in writing and books gathered in one place in an e-reader or tablet are examples of such supportive IT applications that helps promote a good learning situation in Swedish schools. Also, it is the school responsibility to ensure that pupils have access to modern educational tools in their learning and for children and young people in need of support IT in the form of modern, up to date tools is often a prerequisite for good learning. According to The National Agency for Special Needs Education and Schools (2011) the policy in Sweden regarding modern educational tools and digital skills makes it necessary for schools to also have proper skills and all teachers in the schools of today and the future must know how education can be provided using IT and other up-to-date educational tools. All school administrators and IT departments must be able to provide the basis for such education in the form of time, organization, skills development and technology. In connection to this, a recent study was recently carried out in Sweden by Svensson et-al (2021) to investigate the effect of assistive technology (AT) for children with reading and writing disabilities and they discovered that the use of AT seems to have transfer effect on reading ability and to be supportive especially for students with most learning difficulties. In this same study, they concluded that AT can be useful for children with reading disabilities to assimilate text as well as boosting their reading and children and adolescent's motivation for schoolwork can be boosted when using AT as a complement for those with reading and writing disabilities.

Other factors such as attitudinal disposition of teachers can also make a difference when it comes to using AT to teach children with learning disabilities. A study carried out by the Swedish National Agency for Education (Skolverket, 2013) cited in Charlotta, Gunnar and Jonas (2017) indicated that a vast majority (97%) of teachers in general including technology teachers consider themselves to have enough subject knowledge which can be considered to be an aspect of perceived control but a lack of confidence in technology teaching may nevertheless be a problem, related to the effective state component of teachers attitudes.

Also, teacher's level of pedagogical competence / knowledge is another key factor influencing teacher's ability in the implementation of AT for children with disabilities. Pedagogical competence

can be defined as the ability of teachers in managing learning that includes the ability to plan a learning program, the ability to interact or manage the learning process and the ability to perform an assessment (Akhyak, et.al, 2013). Teacher's pedagogical competence in this study involves the ability of teachers to manage learning with the use of assistive technology for children with learning disabilities which includes planning, implementation and evaluation of the learning outcomes of learners (Rahman, 2014). Despite the importance of teachers attitudes and competence in relation to the use of assistive technology, teachers attitudes and pedagogical competence are still un-explored in the area of learning disabilities and this study intent to fill this gap by focusing on investigating teachers attitudes and level of pedagogical competence in using diverse AT tools in teaching children with learning disabilities in elementary schools in the Gothenburg municipality.

Problem Statement

According to the National Center for Education Statistics report (U.S Department of Education, 2000) cited in Kimberly and Randy (2005) many teachers do not know how to incorporate assistive technology into their instruction. Many teachers do not feel like they are prepared or trained to use technology in their teaching (Lonergan, 2001). Researchers further suggest that teachers need to be trained and updated with respect to the use of technology.

Report from the Swedish Schools Inspectorate (Skolinspektionen, 2012) indicates that school administrators do not actively manage the use of Information Technology (IT) in the classrooms and schools often lack a comprehensive strategy for the use of IT in teaching. Teachers therefore need to improve their competence in using IT tools in their work. Since students with learning disabilities need instructional adaptations to effectively learn in inclusive classroom settings and teachers have the sole responsibility of using all available AT resources to educate them but most research findings shows that teachers lack the skills, knowledge and professional training to manage this group of learners.

When it comes to AT tools for teaching children with learning disabilities, innovative low tech, mid tech and high tech devices have been made available for teachers to make the teaching and learning process easier and more accessible for children with learning disabilities. At the moment, little empirical findings exist to inform us if classrooms teachers in Sweden are abreast or aware of the availability of low, mid and high AT devices and if they are equally equipped with the necessary skills and competencies to use such AT tools to effectively teach children with learning disabilities in their respective classrooms. Therefore, it will be necessary for us to find out which AT devices are available and often used by teachers for students with learning disabilities from elementary 1-9 and to also explore teacher's attitudes and level of pedagogical competence in using such AT tools. This study will investigate those matters for s schools in Gothenburg Municipality.

Purpose or Aim of the Study

The purpose of this study was to examine teacher's use of assistive technology for teaching children with learning disabilities in the Gothenburg Municipality. This study was designed to investigate AT availability in elementary classrooms, teacher's attitudes and pedagogical competence towards using AT to teach children with learning disabilities.

Research Questions

Three specific questions were set to guide this study which included:

1. What types of assistive devices are available and used by teachers to teach children with learning disabilities in elementary classrooms in Gothenburg?
2. What are teachers' attitudes towards the use of AT in elementary classrooms in Gothenburg?
3. What are teachers' levels of pedagogical competence in using assistive technology?

Significance of the Study

The 21st century came with numerous advancements and innovation in assistive technological tools for facilitating learning for children with special learning needs and teachers need to be aware, equipped and trained on how to use them in-order to make classrooms inclusive for all learners especially those with disabilities. There are numerous reasons why this study is relevant especially at this time when schools in Sweden are driving towards providing a more inclusive and sustainable education for all. This study might benefit children with disabilities especially those with learning disabilities, regular and special education teachers, curriculum planners and other educational stakeholders directly involved in the provision of education for children with disabilities in the Gothenburg Municipality.

Students: The very first and most beneficiaries of this study might be students with special learning needs (learning disabilities) in different elementary classrooms in the Gothenburg Municipality of Sweden since raising teachers and school administrators awareness of the available low tech, mid tech and high tech AT tools for teaching children who have difficulties in the areas of reading, writing, mathematical and memory/organization disorders might go a long way to enhance classroom instruction, interaction and classroom support during the teaching and learning process for children with LD.

Teachers: The findings obtained from this study are intended to inform and provide vital information that will assist teachers (both the regular and special education teachers) of the availability of modern AT tools for teaching students with learning disabilities.

Curriculum Planners: Curriculum planners and other educational stakeholders in the education sector of the Gothenburg Municipality of Sweden might benefit from the finding of this study by making

decisions to either add different types of AT devices for teaching children with learning disabilities or to implement more training in their teachers' preparation program.

Contribution to the body of knowledge: The researcher also anticipates that findings obtained from this study will add to existing literature concerning the use of Assistive technology for teaching children with disabilities in Swedish elementary schools.

Limitations and Delimitation of the Study

Geographically, this study was limited to the municipality of Gothenburg which is just one municipality out of 290 municipalities in Sweden. The study was also limited to just five elementary schools (public and private Schools) in Gothenburg with a sample size of 52 participants or teachers who took part in the study. This sample size was relatively very small for the generalization of results to all teachers and elementary schools in Gothenburg. Therefore, the data collected from the regular and special education teachers is relatively a small representation of the total number of elementary school teachers in the entire Gothenburg Municipality.

The time set to carry out this study also a limitation for the researcher and this greatly limited the outcome of the study. Three months was relatively very small for the researcher to carry out this study and this greatly affected or limited the study especially during the stage of data collection. Also, because of limited time the study was limited only to one type of disabilities (learning disabilities) from grade 1-9.

Thesis Overview

In summary, chapter one provided an explicit background of the study and a detail overview of how this study will look like. Chapter two examines previous studies which were used to inform this study. This chapter therefore brings out a systematic literature review of existing and most recent studies which looks at teacher's attitudes and pedagogical competence in using AT for children with learning disabilities. Chapter three clearly identified and in details and explains the theoretical and conceptual framework of the study. Chapter four provided a detail account of the methodological framework used in carrying out the study. Chapter five provides the analysis and presentation of results by summarizing the key findings of the study using both descriptive and inferential methods of analysis. Chapter six examines and discusses in details the results of the study according to each research question and chapter seven draws necessary conclusions and recommendations for further study.

CHAPTER TWO

Literature Review

The main goal of this section was to write a systematic review of studies related to teachers' attitude and pedagogical competence towards using assistive technology for children with learning disabilities.

Search Method

To identify research studies investigating teacher's attitude and pedagogical competence towards using assistive technology for students with learning disabilities a systematic review was used. A systematic review is a comprehensive research method used to establish the extent to which existing research has progressed towards clarifying a particular problem. (Jesson, Matheson & Lacey 2011)

Search Procedure

Relevant studies were identified from different databases via Google scholar, Eric, Sage Journal and Scopus. These four databases were purposely selected because they are connected to the field of special education, teachers' awareness, attitude, pedagogical competence, assistive technology and learning disabilities.

Keys words were helped to locate studies published in peer-reviews journals such as assistive technology, learning disabilities, teachers' attitude, awareness, and pedagogical competence. Initially, a total of 120 abstracts were downloaded and later read to determine if they center on evaluating teachers' awareness, attitude and pedagogical competencies and use of assistive technology for students with learning disabilities in different countries in the world. A total of 20 scholarly literatures were finally selected.

Selection Criteria

This systematic review was centered only on children with learning disabilities and studies focusing on students with other kinds of disabilities such as Autism, ADHD, Physical impairments were not included in this review. The table below show the inclusion and exclusion criteria that were considered in selecting the articles for this study

Table 1: Inclusion and Exclusion Criteria

Inclusion	Exclusion
Publication Type <ul style="list-style-type: none">• Peer reviewed journal articles, text	Publication type <ul style="list-style-type: none">• Newspapers, magazines

books, dissertations. <ul style="list-style-type: none"> • Mostly publications from 2000-2022 • English as the language of publication Type of disability <ul style="list-style-type: none"> • Learning disabilities Design <ul style="list-style-type: none"> • Quantitative • Survey design 	<ul style="list-style-type: none"> • Articles published prior to 2000 • Articles published in other languages like French, Swedish etc. Type of disability <ul style="list-style-type: none"> • ADHD, Autism, Physical Impairments etc. Design <ul style="list-style-type: none"> • Qualitative • Mixed methods
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Recent findings indicates that teachers attitude and pedagogical competence has a role to play when it comes to using assistive technology towards teaching students with disabilities and this review will specifically focus on reviewing passed studies that have been carried out for those with learning disabilities. Most recent studies are quantitative and have tried to bring out different findings and recommendations (Sydeski, 2013; Obidike, Anyikwa, Ngozi, & Enemou, 2010; Garcia & Seevers, 2005; Alper & Raharinirina, 2006 Olanrewaju, Abubakar & Patricia, 2015; Mudasiru & Ayodele, Almethen, 2017; Wood et-al, 2017; Susan, 2009; Anderson & Petch-Hogan, 2000; Onivehu, Ohawuiro & Oyeniran, 2017; Starcic & Istenic, 2010; Adebisi, Liman & Longpoe, 2015; Madhavaram & Laverie 2010; Lee, 2000; Lee & Vega, 2005; Olsson and Karin, 2010; Gliga, 2002, Rahman, 2014; Michael & McDermott, 2003; Jesson, Matheson & Lacey 2011.

Studies related to teachers attitudes and use of AT

Previous studies indicate that the successful implementation of different assistive tools depends enormously on the attitudes of classroom instructors who are the main actors to determine when these devices can be used in their classrooms.

Charlotta, Gunnar and Jonas (2017) investigated Swedish technology teacher's attitude towards their subject and how these attitudes may be related to background variables. In this quantitative study, technology teachers in Swedish compulsory schools responded to a questionnaire about teacher's attitudes, experience and background. The results of this study suggested that efforts to increase technology teacher's qualifications and establishing a fixed number of teaching hours and overall teaching for the subject of technology may yield more positive attitudes among teachers towards technology teaching.

Obidike, Anyikwa and Enemou (2010) also examined the awareness of teachers of nursery and

primary schools on the existence of technological resources that could be used to support children's literacy instruction. The study was carried out in the Awka local Government Education Zone in Anambra State, Nigeria. The focus of this study was to determine the extent to which teachers of young children in the public school system are aware of the existence and use of technological resources to promote children's literacy instruction. Specifically, the study tried to ascertain if any difference exists in the nursery and primary school teachers' awareness as to the existence and the use of technologies to promote children's reading and writing. Furthermore, two research questions guided the study and a total of 500 teachers were randomly selected as the study sample. A questionnaire with a four point rating scale was used for data collection which was analyzed using mean scores. Findings from this study revealed that both nursery and primary school teachers were able to identify the technology tools that could be used to enhance literacy instruction in children but were not aware of how such resources could be used. Based on the findings of this study, it was further recommended that technological training needs of nursery and primary school teachers should be identified. Obidike, Anyikwa and Enemou concluded in this study by insisting that teachers need to be trained on how to manage and use technologies to promote literacy instruction.

Randal (2013) when further to investigate high school special education teachers knowledge of assistive technology for students with reading difficulties in Southwestern Pennsylvania. The purpose of this research study was to identify the level of AT knowledge among special education teachers with respect to reading and to determine if they are receiving or have received professional development in this area. Her study was guided by three research questions and a quantitative approach was used as research methodology with a cross-sectional survey questionnaire. To gather data for this study a survey was send through e-mail using the survey monkey online survey tool to 201 special education teachers. The results from this study indicated that almost all of teachers (98.8%) had at least some knowledge of the definition of AT. Also, the findings further shows that professional development is needed for advancing teacher knowledge of AT.

In connection to increasing teacher's awareness on the use of AT for students with learning disabilities a study conducted by Anderson and Petch-Hogan (2001) to measure pre-service teachers' awareness of technology for students with disabilities. A pre-test survey was administered before each candidate's field experience and a post-test survey was completed following the field experience. As part of their field experience, students developed and taught lessons to learning disabled or behaviorally challenged classrooms and were strongly encouraged to use AT for a minimum of two hours during the field experience. There was statistical significance reported in students' perceived abilities following the use of assistive technology during the semester. The teachers also became more aware of the software and hardware available for students with disabilities and how they could be utilized as instructional tools. This study indicated that exposure to AT was beneficial as a training practice during teacher

preparation. However, not all teacher preparation programs are providing students with essential AT skills to be successful.

Garcia & Seevers (2005) examined general teachers' attitude regarding the use in their classes of assistive technology by students with learning disabilities, in this study, a total of 29 teachers from a suburban school in the southwest region of the Gulf Coast of Texas participated in the study and a total of four schools were included in the study. A teacher-researcher developed questionnaire survey was used as an assessment instrument with 20 questions asked about the use of assistive technology. The main findings from this study show that general education teachers have a positive attitude needed to successfully implement assistive technology in their classes for students with learning disabilities.

Studies related to teachers pedagogical competence and use of AT

Almethen (2017) in a master dissertation assessed Saudi Arabian Special Education teachers' perceptions about their competencies and professional development needs on Assistive Technology. To gather data for the study, the researcher developed an online self-administrated 27 question survey in order to evaluate special education teachers' perceived knowledge regarding assistive technology as well as to investigate their needs for professional development. The survey webpage link was sent via email to 110 special education teachers and a total of 37 teachers participated in this study. The overall findings in this study indicate that special education teachers in Saudi Arabia were not sufficiently prepared to choose and implement assistive technology in a classroom with students with disabilities. Another quantitative study carried out by Onivehu, Ohawuiro & Oyeniran (2017) examined teacher's attitude and competence in the use of assistive technologies in special needs schools. The focus of this study was to investigate teacher's attitude and competence in the use of assistive technology in special needs schools in Osun State, Nigeria. The study used a descriptive survey method and 100 teachers were drawn using the purposive sampling technique from special needs schools in Osun State, Nigeria. In this study six research questions were generated while four hypotheses were tested.

A researcher constructed questionnaire tagged Teachers Attitude and Competence in the Use of AT questionnaire (TACUATQ) was used for data collection. The instrument was administered on 20 selected teachers outside the sample location through test and retest method and it yielded a reliability coefficient of 0.85 through Pearson Product Moment Correlation statistics. Data for this study was analyzed with percentages, mean and rank order, t-test and ANOVA statistical tools. The findings revealed that teachers have a positive attitude towards the use of assistive technologies. Gender and teaching experience did not influence teachers' attitude and competence in the use of assistive technologies. It was recommended among other things that teachers should be trained and retrained on the use of assistive technology for students with disabilities.

Michael and McDermott (2003) cited in Randal (2013) conducted a study on the importance of pre-

service preparation with respect to assistive technology implementation, integration and continued support of students. In this quantitative study they surveyed 143 graduate special education programs and asked questions related to knowledge, skills, dispositions, the understanding of AT, Use of AT, making AT decisions, the program integration for institutions with respect to their teacher education programs. The result from this study suggest that current graduates are leaving these special education teacher preparation programs without the critical competencies to be successful in the prospective teaching positions.

Lee and Vega (2005) studied 48 school districts in California to assess the perceived knowledge, attitude and challenges of AT use by 154 special education personnel (teachers, specialist and coordinators). While it was encouraging that 22% did not receive any training, the result showed that almost half (48.7%) of the participants received almost no or very little AT training which indicated that A.T training for special education personnel is minimal.

Assistive technology (AT) has been identified as an important tool that teachers can use for teaching students with learning disabilities and through the different assistive technological devices, teachers can easily use them to facilitate classroom lessons for children with disabilities. However the implementation and integration of these devices greatly depends on teacher's attitude which can be negative or positive and awareness (background knowledge). As a way of raising teachers awareness of the different technological devices available and often used for children with learning disabilities in inclusive classrooms Adebisi, Liman, & Longpoe (2015) identified different types of AT devices for teaching children with learning disabilities for example low tech devices to high tech devices.

Therefore, this systematic literature review was aimed at methodologically reviewing studies related to teacher's attitude and pedagogical competence towards using assistive technology for students with learning disabilities. Search criteria were put in place in harvesting and systematically analyzing relevant corpus from four different search engines. The findings from this literature review portrayed that assistive technology is an important tool for teaching children with learning disabilities. Aspects of teacher's attitude, and pedagogical competence formed the variables and most of the sample studies used the quantitative research approach with survey instruments for data collection with the findings was equally reported.

CHAPTER THREE

Theoretical and Conceptual Framework

Theoretical Framework

According to Creswell (2018), a theory in quantitative research is an interrelated set of constructs (or variables) formed into propositions, or hypothesis that specify the relationship among variables (typically in terms of magnitude or direction). Labovitz and Hagedorn (1971) added that a theory might appear in a research study as an argument, a discussion, a figure, a rationale, or a conceptual framework, and it helps to explain (or predict) phenomena that occur in the world.

The Technological Pedagogical Content Knowledge (TPACK) framework by Koehler and Mishra (2006) and the ABC Model of Attitude and the key components of both models were used to guide this study by informing and designing the research instrument and further used to discuss the study findings to further elucidate the place of assistive technology in the lives of children with learning disabilities.

Technological Pedagogical Content Knowledge (TPACK) Model

The Technology Pedagogical Content Knowledge (TPACK) model framed by (Koehler & Mishra, 2008; Mishra & Koehler, 2006) and it was introduced to the educational research field as a theoretical framework for understanding teacher knowledge required for effective technology integration. This framework describes the kinds of knowledge that teachers need in order to teach with technology and the complex ways in which these bodies of knowledge interact with one another. Therefore, TPACK is a framework that introduces the relationships and the complexities between all three basic components of knowledge (Technology, Pedagogy and Content (Koehler and Mishra 2008, Mishra and Koehler, 2006) cited in (Schmidt et-al, 2009) at the intersection of these three knowledge types is an intuitive understanding of teaching content with appropriate pedagogical methods.

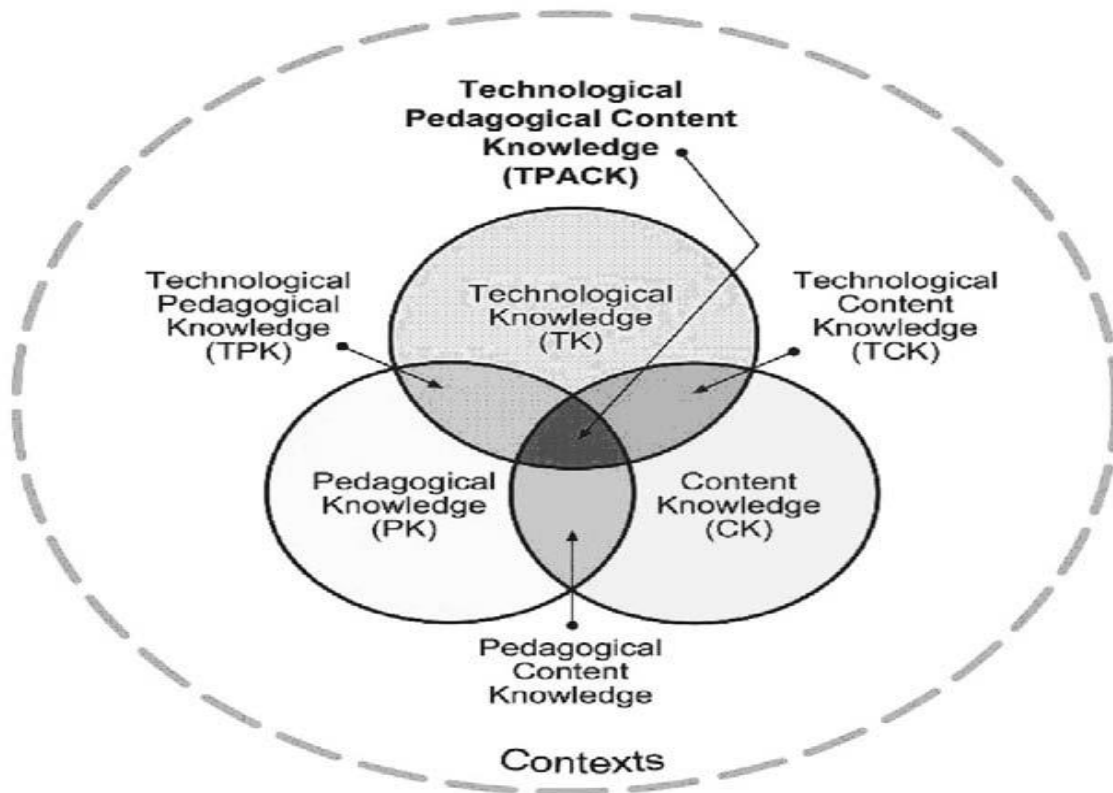
Overview of the TPACK Model

Mishra and Koehler (2006) cited in Schmidt et.al (2009) suggest that in the TPACK framework, what teachers need to know is characterised by broad knowledge base on technology, pedagogy and content and the interactions between and among these knowledge bases. In this approach, technology in teaching is characterised as something well beyond isolated knowledge of specific hardware or software but rather technology that is introduced into teaching context causes the presentation of new concepts and requires developing sensitivity between all three components. Therefore, Koehler and

Mishra (2006) in the TPACK model assert that good teaching with technology cannot be achieved by simply adding a new piece of technology upon exiting structures but requires a shift in existing pedagogical and content domains.

Components of the TPACK Model

According to Schmidt et-al (2009) TPACK is a framework that introduces the relationship and the complexities between all three basic components of knowledge (technology, pedagogy and content) the intersection of these three knowledge types is an intuitive understanding of teaching content with appropriate pedagogical methods and technologies. Seven components are included in the TPACK framework and they include the following: Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content knowledge (PCK), Technology Content Knowledge (TCK), Technology Pedagogical Knowledge (TPK) and Technology Pedagogical Content Knowledge (TPACK) (Koehler and Mishra 2008, Mishra and Koehler, 2006)



The TPACK Model

Technological Knowledge (TK)

According to Koehler and Mishra (2006) TK refers to the knowledge about various technologies, ranging from low-tech technologies such as pencil and paper to digital technologies such as the

Internet, digital video, interactive whiteboards, and software programs. In the TPACK model, TK includes an understanding of how to use computer software and hardware, presentation of tools such as document presenters and project and other technologies used in educational contexts. TK therefore covers teacher's ability to adapt to and learn new technologies.

Content Knowledge (CK)

CK is the second component of the TPACK model and it refers to the knowledge or specific nature of a discipline or subject matter. CK, according to Koehler and Mishra (2006) varies greatly between different educational contexts for instance, the differences between the content of primary school math and graduate school math and teachers are expected to master the content they teach. Content knowledge is also important because it determines the discipline specific modes of thinking unique to each field (Koehler et-al, 2013).

Pedagogical Knowledge (PK)

According to Koehler et-al (2013) PK describes the "general purpose" knowledge unique to teaching. It is the set of skills that teachers must develop in order to manage and organize teaching and learning activities for intended learning outcomes. This knowledge involves, but is not limited to an understanding of classroom management activities, the role of student's motivation, lesson planning and assessment of learning (Mishra & Koehler 2006, p. 1026).

Pedagogical Content Knowledge (PCK)

Pedagogical Content Knowledge refers to the content knowledge that deals with the teaching process. PCK is different for various content areas, as it blends both content and pedagogy with the goal being to develop better teaching practices in the content areas. PCK means going beyond being a content expert or just knowing general pedagogic guidelines, to understanding the unique interplay between content and pedagogy.

Technology Content Knowledge (TCK)

According to Schmidt et-al (2009), Technological Content Knowledge refers to the knowledge of how technology can create new representations for specific content.) It suggests that teachers understand that, by using a specific technology, they can change the way learners practice and understand concepts in a specific content area.

Technology Pedagogical Knowledge (TPK)

Schmidt et-al (2009) suggest that Technological pedagogical knowledge refers to the knowledge of how various technologies can be used in teaching, and to understanding that using technology may

change the way teachers teach. Therefore, TPK identifies the reciprocal relationship between technology and pedagogy. This knowledge makes it possible to understand what technology can do for certain pedagogic goals, and for teachers to select the most appropriate tool based on its appropriateness for the specific pedagogical approach.

Technology Pedagogical Content Knowledge (TPACK)

Technological pedagogical content knowledge refers to the knowledge required by teachers for integrating technology into their teaching in any content area (Schmidt, 2009). Teachers have an intuitive understanding of the complex interplay between the three basic components of knowledge (CK, PK, TK) by teaching content using appropriate pedagogical methods and technologies. The TPACK framework focuses on designing and evaluating teacher knowledge that is concentrated on effective student learning in various content areas (AACTE Committee on Innovation and Technology, 2008).

Therefore, Mishra and Koehler (2006) visualize the TPACK model as a useful frame for thinking about what knowledge teachers must have to integrate technology into teaching and how they might develop this knowledge. Using TPACK as a framework for measuring teaching knowledge could potentially have an impact on the type of training and professional development experiences that are designed for both pre-service and in-service teachers. Hence, there is a continual need to rethink our preparation practices in the teacher education field and propose new strategies that better prepare teachers to effectively integrate technology into their teaching. (Koehler and Mishra, 2008; Mishra and Koehler, 2006)

ABC Model of Attitudes

According to the ABC model cited in Amitkagri (2019) attitudes can be defined as evaluation of ideas, events, objects, or people. Therefore, attitudes are generally positive or negative, but they can also be uncertain at times. For example, sometimes we have mixed feelings about a particular issue or person. Every attitude has three components that are represented in what is called the ABC model of attitudes: A for affective, B for behavioral and C for cognitive. Although every attitude has these three components, any particular attitude can be based on one component more than another (Amitkagri 2019).

Affective Component

The affective component is the emotional response (liking/disliking) towards an attitude object. Most of the research place emphasis on the importance of affective components. According to the ABC model of attitude cited in Vishal (2014) an individual's attitude towards an object cannot be determined by simply identifying its beliefs about it because emotion works simultaneously with the

cognitive process about an attitude object. Agarwal & Malhotra (2005) express that the affect (feelings and emotions) and attitude (evaluative judgment based on brand beliefs) streams of research are combined to propose an integrated model of attitude and choice.

Behavioral Component

According to Wicker (1967) the behavioral component is a verbal or overt (nonverbal) behavioral tendency by an individual and it consists of actions or observable responses that are the result of an attitude object. It involves person's response (favorable/unfavorable) to do something regarding attitude object. Attitudinal responses are more or less consistent. That is, a series of responses toward a given attitudinal stimulus is likely to show some degree of organizational structure, or predictability (Defleur & Westie 1963).

Cognitive Component

The cognitive component of the ABC model refers to the beliefs, thoughts, and attributes that we would associate with an object. It is the opinion or belief segment of an attitude. It refers that part of attitude which is related in general knowledge of a person.

Conceptual Framework

Assistive Technology (AT)

The Individuals with Disability Education Act (IDEA) in 2004 defines the concept of assistive technology (AT) as:

“Any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain or improve functional capabilities of individuals with disabilities”. Meanwhile, The Convention on the Rights of Persons with Disabilities (CRPD) also defines AT as technology designed or adapted to improve the performance and quality of life for individuals with disabilities” (United Nations, 2004).

Ganschow, Philips & Schneider (2004) as cited in Alkahtani (2013) grouped AT tools into three categories (low-tech, mid-tech and high-tech). According to these researchers the low-tech devices are usually non-electronic and easy to use as it involves little or no training. Low-tech devices are widely available with low cost and little if any maintenance for example pencils grip, manipulative blocks. Mid-tech devices are easy to operate electronically with minimal training and require basic maintenance. Mid-tech devices are commercially available and generally moderate priced for example adapted keyboards, electronic dictionaries and tape or digital recorders. High-tech devices involve complex electronics and usually contain microcomputer components for storage and retrieval of information. High-tech devices are expensive and require ongoing maintenance and extensive training for instance, word prediction software, talking calculators, and hearing aid or assistive listening

device.

Assistive technology allows students with disabilities to increase their accessibility to the curriculum and the quality of the learning experience (Alkahtani, 2013). Starcic & Istenic (2010) also remark that many assistive technology devices are available to assist teachers in improving the functional capabilities of their students by increasing their participation in the learning opportunities and involvement in activities. Furthermore, Adebisi, Liman, & Longpoe (2015) in their study discusses the various types of assistive technology devices for children with learning disabilities and explains that 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 checkers and math software are found to be effective in catering to the needs of children with learning disabilities.

Kosakowski (1998) further opined that it is important for teachers to utilize devices to help students with learning disabilities, including assistive technology to compensate for their specific learning disabilities. It is essential for teachers to know how to use technology and how to use technology and how to integrate it into the curriculum meanwhile, Bryant & Bryant (1998) concluded that teachers must select technology adaptations appropriately, monitor and evaluate the use of these adaptations in classrooms activities to determine their educational benefits for students with learning disabilities.

AT Tools for Children with Learning Disabilities

AT for kids with learning disabilities is defined as any device, piece of equipment or system that helps bypass, work around or compensate for an individual's learning deficits. AT does not cure or eliminate LD but it can help a child reach her potentials because it allows her to capitalize on her strengths and bypass areas of difficulty. For instance a child struggling with reading problems but good in listening can benefit from listening to audio books (Stanberry & Raskind, 2009)

Stanberry & Raskind (2009) also clearly identify a comprehensive list of assistive technological tools teachers can use to facilitate and support learning for children with learning disabilities and can be categorized in the area of reading, writing, mathematics, listening and organization / memory.

Reading AT Tools

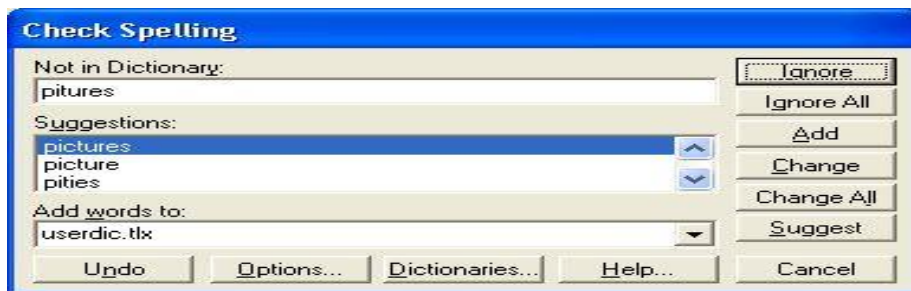
According to Stanberry & Raskind (2009) these AT tools are available to help individuals who struggle with reading. Even though each of these tools works a little differently, all of these tools help by presenting text as speech. These tools help teachers to facilitate decoding, reading fluency, and comprehension. Some of these reading tools that can assist children with reading disabilities are:

Tape Recorder



This AT device is used to play audio taped text for children with reading disabilities and the child listen to the recorded rather than reading it.

Spell Checkers



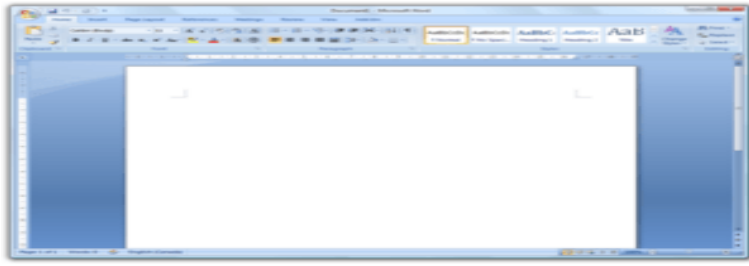
This software is used for identifying or locating misspelled words in a sentence and allowing students to make necessary corrections.

Electronic Books



Electronic talking books can also be available in CD-ROM, the internet or special disks visually presented for readers. They provide embedded speech and according to Leu (2000), the speech components offers a digitalized reading of general sections as well as pronunciation of specific words within the text, it further supports and coaches students as they read the text of the story.

Microsoft Word



When using the Microsoft word program smaller reading passages can be copied and pasted into this program and can be easily enhanced and aid comprehensive standard formatting features within the program and using the highlighting feature can help students focus on particular aspects of a text like parts of speech, literacy devices or key elements of a paragraph.

Speech Synthesis



This tool can serve the purpose of reading and it could be available on computer disc and loaded to the computer and then the child back by the speech synthesizer.

Writing A.T Tools

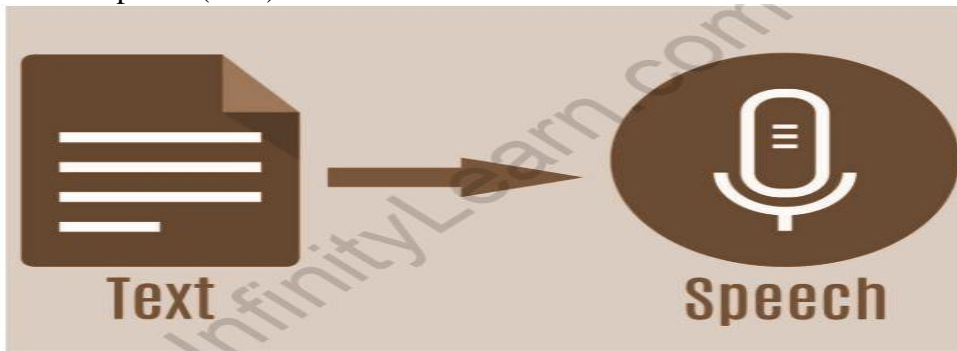
These are assistive technology (AT) tools available to help children who struggle with writing. Some of these tools help students circumvent the actual physical task of writing, while others facilitate proper spelling, punctuation, grammar, word usage, and organization.

Pencil Grips



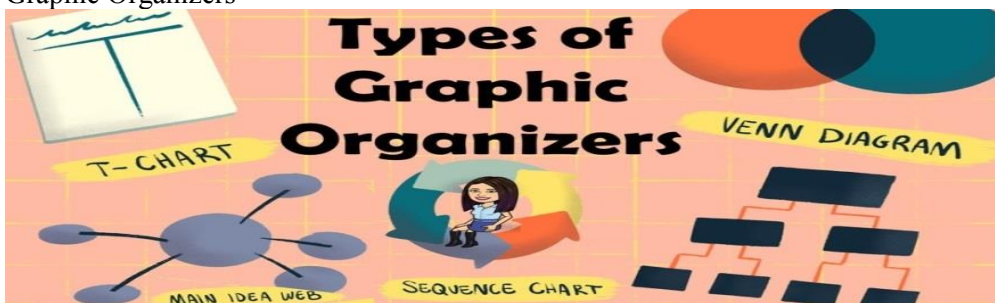
This writing device can be a great tool for helping children to hold a pencil more naturally. It is usually used for students who have dysgraphia with other fine motor issues.

Text to Speech (TTS) Software



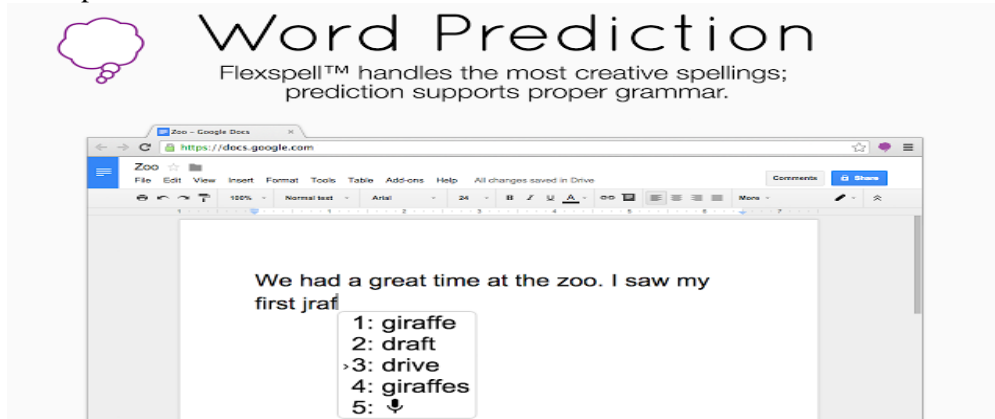
TTS can be helpful for kids with writing issues. That's because it can be used to read aloud what kids have written, so they can check for mistakes. Some TTS tools can also read words aloud as they're typed. This gives kids real-time feedback on what they're writing.

Graphic Organizers



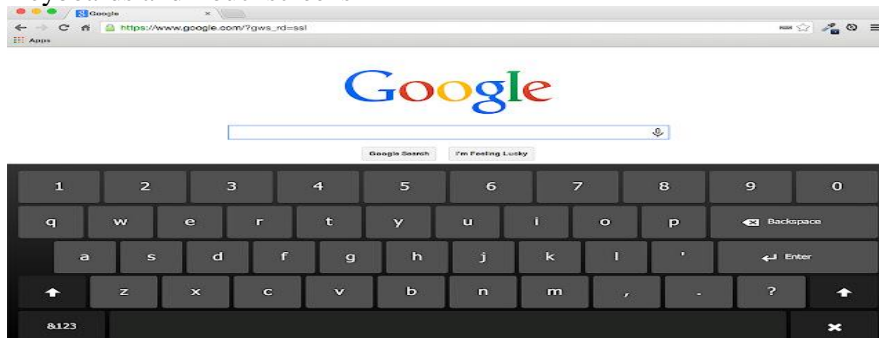
This is visual tools that can help to break down ideas and projects into smaller parts. Kids can use these tools to brainstorm and plan what they want to write. Graphic organizers come in many forms, from mind maps to diagrams to flow charts and they can be digital or pen and paper.

Word prediction



This software suggests correct spellings of words after only a few letters are typed. Word prediction sometimes uses “word banks” (commonly used words in a topic area) to help kids come up with words and complete their sentences.

Keyboards and Touchscreens

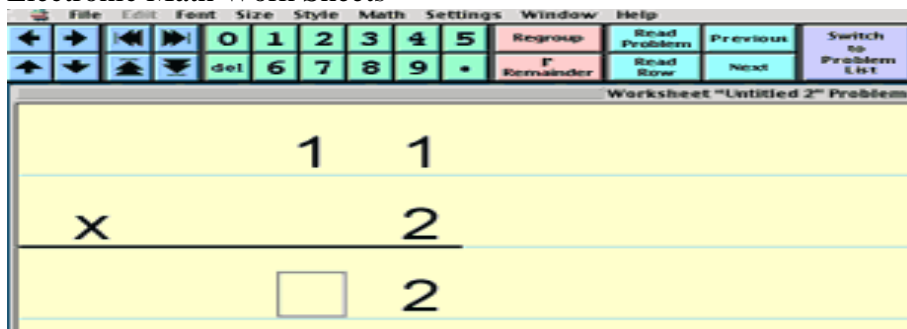


This software device can also help children who struggle with handwriting since it allow children to input letters and words through typing or touching the screen, rather than using a pen or pencil.

Mathematical A.T Tools

AT tools for math are designed to help people who struggle with computing, organizing, aligning, and copying math problems down on paper. With the help of visual and/or audio support, users can better set up and calculate basic math problems

Electronic Math Work Sheets



This program can help a child to organize, align and work through math problems on computer screen and numbers that appear onscreen can also be read aloud via a speech synthesizer.

Talking calculators



Talking calculators have a built-in speech synthesizer which reads aloud each number, symbol, or operation key a user presses; it also vocalizes the answer to the problem, this auditory feedback may help him check the accuracy of the keys he presses and verify the answer before he transfers it to paper.

Manipulative blocks

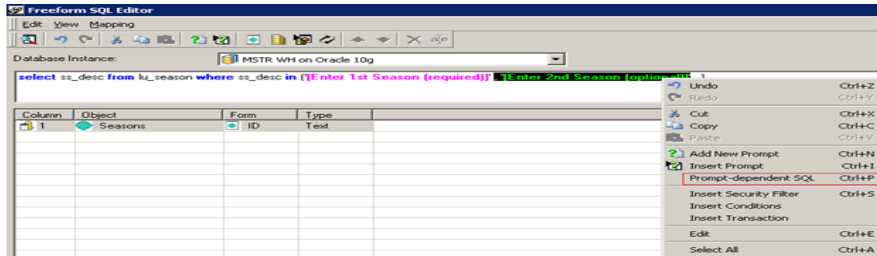


These are concrete materials like algebra tiles, snap cubes and colored rods can help students at all grade levels improve their counting and problem-solving.

Organization and Memory

These tools can help a person plan, organize, and keep track of his calendar, schedule, task list, contact information, and miscellaneous notes. These tools allow him to manage, store, and retrieve such information with the help of special software and hand-held devices.

Free-form database software



This software allows the user to create and store electronic notes by “jotting down” relevant information of any length and on any subject. The student can later retrieve the information by typing any fragment of the original note.

Information/data managers



This type of tool helps a person plan, organize, store, and retrieve his calendar, task list, contact data, and other information in electronic form.

Paper-based computer pen



This technology records and links audio to what a person writes using the pen and special paper. It enables the user to take notes while simultaneously recording someone (e.g., a teacher)

speaking. The user can later listen to any section of his notes by touching the pen to his corresponding handwriting or diagrams.

Teachers Attitudes

A recent definition put forward by Van Aalderen-Smeets et-al (2012, p. 161) defines attitude as a “psychological tendency to evaluate an object in terms of favorable or unfavorable dimensions such as good/bad or positive/negative. According to the ABC Model (2013) attitudes can also be defined as the evaluations of ideas, events, objects, or people and they are general positive or negative attitude. This model conceptualized attitudes into three main components which are affective, behaviour and cognition. The Affective component of attitude refers to the emotional reaction one has towards an attitude object, while behavioral component of attitude refers to the way one behaves when exposed to an attitude object while the cognitive component of attitude is what we think about something, it simply means what happens when we pause and really think well about the thing or issue. (The ABC Model of Attitude: Affect, Behaviour and Cognition, 2013)

Adegunju, Onivehu, Odetunde & Oyeniran (2017) assert that teacher’s attitudinal disposition towards the use of AT plays an essential role and when teachers have a positive attitude towards a specific form of AT; there is a greater likelihood that they would make significant efforts to effectively integrate such technology into the teaching learning process. Meanwhile, when teachers have a negative attitude towards any form of AT, they tend to shy away from integrating such technology into the teaching learning process. Therefore, the positive or negative attitude may also have a direct effect on their level of competence in the use of assistive technology.

The Concept of Pedagogical Competence

Pedagogical competence has been defined as the ability of teachers in managing learning that includes the ability to plan a learning program, the ability to interact or manage the learning process and the ability to perform an assessment (Akhyak, et-al, 2013). Therefore, teacher’s pedagogical competence is the ability to manage learning which includes planning, implementation and evaluation of the learning outcomes of learners (Rahman, 2014). Meanwhile, Madhavaram & Laverie (2010) in their approach also regards pedagogical competence as “the ability of an individual to use a coordinated, synergistic combination of tangible resources (for example instruction materials such as books, articles, and cases and technology such as software and hardware) and intangible resources (e.g. knowledge, skills, and experience) to achieve efficiency and or effectiveness in pedagogy.

Gliga (2002) as cited in Andreia and Liliana (2011) assert that the concept of pedagogical competence also tends to be used with meaning of minimum professional standards, often specified by law, which should raise a person in fulfilling a particular role of the teaching profession. She continued by stating that the emphasis in understanding pedagogical competence should thus fall on the integration features

which outline the ability to solve pedagogical problems and typical pedagogical activities by applying knowledge, professional and life experiences, values and talents in a creative manner so to obtain appropriate and effective results. According to Olsson & Karin (2010) the following assessment areas used to assess pedagogical competence are teaching skills, theoretical knowledge attitude characterized by willingness and ability to develop. Furthermore, Andreia & Liliana (2011) affirm that pedagogical competences have been regarded either as an ensemble of potential behaviours, capacities allowing for efficient manifestation of an activity, or as a minimum professional standard, often specified by law, which professionals should reach.

According to Onivehu, Ohawuiro & Oyeniran (2016) teachers level of competence in the use of AT could either make or mar the process of technological integration in the field of education. Competence in this sense definitely means the knowledge, skills and proficiency in the use understanding and pedagogically using AT. They insist that teachers competence in the use of AT entails what a teacher know and be able to do with any form of AT in the special education pedagogical setting at any given point in time

CHAPTER FOUR

Methodological Framework

This chapter discusses the method that was adopted by the researcher to investigate teacher's use of AT devices for teaching children with learning disabilities. This chapter comprise of the study design, the population of study, the sample population and sampling technique, instrument of data collection, validity and reliability, pilot testing. Teachers were the main participants or subjects used for collecting data in this study and different ethical considerations to protect them were considered as well as the suitable methods of data analysis.

Research Design

A quantitative approach was employed for collecting data in this study and the descriptive survey design was the plan used. The survey design provides a quantitative description of trends, attitudes, and opinions, or test of for associations among variables of a population, by studying a sample of that population (Creswell, 2018). A descriptive survey approach was the most preferred and suitable for this study because it was economical to use and a large amount of data could be collected within a short time frame.

Population of Study

All elementary classroom teachers (regular and special education teachers) actively teaching from grade 1-9 in the Gothenburg Municipality for the 2021/2022 academic year were used as the population of the study. The researcher requested a list of all elementary schools from the Gothenburg Municipality in charge of Education prior to the data collection process.

Sampling

Creswell (2013), insist that a researcher's choice of a sample is dependent on how adequate it is answering the research questions. A convenience sampling was used for selecting the schools in this study which included, Frolundaskolan, the International School of the Gothenburg Region (ISGR), Backaskolan, Innovitaskolan and Internationalla Engelskaskolan. These five elementary schools are well centralized in the city of Gothenburg and were easily accessible to the researcher. A Purposive sampling technique was also applied in selecting the 52 participants or respondents who took part in the study. The selection criteria of the participants were as follows:

1. They were all certified elementary teachers in the Gothenburg Municipality.
2. The teachers had at least one child with a learning disability in their respective classroom.

3. They were regular or special education teachers with at least one year experience teaching between grades 1- 9.

Procedure for Data Collection

Letters of permissions via emails were sent to a total of 10 randomly selected school head teachers in the Gothenburg Municipality outlining the purpose of this study and why their schools were selected for the study. After waiting for one week, the researcher made follow-up calls to confirm school participation and head teachers authorization to allow their teachers participate in the study. Finally, a total of five (5) schools heads finally responded and accepted to allow their teachers to voluntarily take part in this study. A total of 100 copies of in-person or face to face questionnaires and consent forms were handed to the heard teachers of the five schools in the Gothenburg Municipality that is, three Swedish elementary schools (Frolundaskolan, Backaskolan and Innovitaskolan) and two International schools (The International School of the Gothenburg Region (I.S.G.R) and Internationalla Engelska Skolan. A period of one week was allowed for teachers to complete the questionnaires and hand them over to the school administration. Finally, 53 copies of this survey instrument were answered and return and 47 copies were not returned.

Instrument for Data Collection

The instrument used for data collection in this study was based on teachers designed closed ended questionnaire. According to Amin (2012) a questionnaire is a carefully designed instrument for collecting data in accordance with specifications of the research questions and hypotheses. Therefore, it is a self-report instrument used for gathering information about variables of interest in an investigation.

Teachers Questionnaire

In this study, a researcher made structured questionnaire with closed ended questions investigating AT availability in classrooms, teacher's attitudes and pedagogical competence in using assistive technology tools for teaching children with learning disabilities. This data gathering instrument was structured into four main sections and the items were guided and informed by the main concepts of the TPACK framework (technology, pedagogy and content) and elements of the ABC Model (Affection, Behavior and Cognition) which are the two theoretical frameworks used in this study.

The first section of this instrument sought demographic information of the respondents such as their ages, gender, years of teaching experience, level of education and number of children with learning disabilities in their classrooms.

In the second section, sixteen different categories of assistive technology tools ranging from low, mid and high tech adapted from Stanberry and Raskind (2009) for teaching children with learning disabilities (reading problems, writing difficulties, mathematical disorders and memory/organization). These AT devices were listed and participants were asked to identify the devices they have available and often used during classroom instruction for teaching children with learning disabilities. The answer options were either “Available” or “Not Available” and participants were instructed to circle the best answers that accurately reflect them.

The third section of this instrument had a total of 10 descriptive items focusing on investigating teachers’ attitudes and all items were informed by using the three domains of the ABC Model of Attitudes ranging from affective, behavioral and cognitive. Participant’s attitudes were either perceived to be negative or positive towards using assistive technology for teaching children with learning disabilities. The questions were further patterned into five point Likert scales format with teachers’ responses from strongly agree (1), agree (2), neutral (3) disagree (4) and strongly disagree (5) and teachers were instructed to indicate their reactions to each of the statements by circling the number that represents their level of agreement with it.

The fourth section of this instrument had a total of 10 items focused on assessing teacher’s level of pedagogical competence in the use of assistive technology and the first 7 items were patterned in a five point Likert scale format ranging from no competence (1), little competence (2), moderate competence (3), much competence (4) and fully competent (5). While question 8, 9 and 10 were non-Likert question with nominal response options. The three basic components of knowledge from the Technology Pedagogical Content Knowledge (TPACK) framework by Koehler and Mishra (2006) which are Technology, Pedagogy and Content were used to inform the questionnaire items.

A final gratitude or thank you message of appreciation was extended to all respondents at the end of the questionnaire.

Validity and Reliability

Amin (2002) refers to validity as the appropriateness of the instrument while reliability refers to its consistency in measuring whatever it is intended to measure. In this study, two steps were taken to validate or to check the appropriateness of the teachers questionnaires that is; content and construct validity. The first step was to ensure content validity, this instrument was handed to my supervisor and two other research experts in the Department of Education and Special Education, Gothenburg University who went through to cross-check and gives their opinions and remarks concerning this instrument. Necessary corrections and adjustments were made and the final copy was produced.

A pilot testing was also carried out in-order to further establish both content and construct validity of the instrument and to also provide an initial evaluation of the internal consistency of the questionnaire

items (Creswell, 2018). A total of four teachers who met the participation criteria's (2 special education teachers and 2 general education teachers) from one elementary school in Gothenburg out of the sample were used to test the survey instrument and final adjustments were made prior to data collection.

According to Devaus (2001), reliability simply means the indicators consistently come up with the same measurement. Therefore, reliability looks at the degree of consistency of the research instrument in measuring whatever it is supposed to measure.

Reliability Statistics

Cronbach's Alpha	N of Items
.641	36

To further check for the reliability of the 36 items on the teacher's questionnaire used for data collection, a Cronbach Alpha Co-efficient was applied using SPSS and a value of .641 was obtained which was considered reliable for carrying out the study.

Ethical Considerations

Creswell (2018), insist that attention needs to be directed towards ethical issues prior to conducting a research study, beginning a study, during data collection, data analysis, reporting, sharing and storing the data. Two most important ethical issues to adhere while conducting a quantitative survey study are confidentiality and informed concerned and to ensure that all ethical standards are maintained in this study, key identical issues were ensured at each stage of the research study. Prior to gathering data for this study, the researcher obtained all necessary permission from the five sampled schools in Gothenburg and during this process all school norms and regulations were equally respected.

Confidentiality

When collecting data for this study, all participants' right to privacy was fully respected and all legal requirements on data protection adhered to. Therefore, to ensure confidentiality of the respondents in this study, the demographic data collected avoided any personal identification of the subjects, information such as their names, and date of birth were completely excluded from the survey item.

Anonymity

Anonymity simply means that during the data collection stage subjects or participants' personal information such as their names, phone number, email address, physical characteristics, photos and videos were excluded from the questionnaire. This ethical issue was carefully considered in this study since the identities of all 52 respondents were excluded from the demographic section of the questionnaires.

Informed Consent

Informed consent means all subjects received and understood all the information they needed to know before deciding to participate in the study. Amin (2012) suggests that for an informed consent to be ethically valid there must be elements of disclosure, understanding, voluntariness, competence and consent. Prior to collecting data from all 52 participants (teachers) they were fully informed about the purpose of the study and they were all assured that their information would be treated with confidentiality and only for research purpose. Participants were also given an informed consent form explaining that their participation in the study was fully voluntary and they had the rights to decide either to participate or not. Also, participants were made to understand that their decision would not negatively affect the study. The informed consent forms further described the study purpose, objectives, procedures, and benefits of the study.

Voluntary Participation

Voluntary participation means all subjects or teachers used for this study had the right to choose if they will participate in the study or not without any pressure from the researcher. Therefore, all participants had the right to withdraw their participation from this study at any time and I went further make it clear to them that they had the right to decline their participation without any negative consequences or repercussions. Other ethical issues were also considered in this study which included avoiding plagiarism, communication of research results, avoided from collecting harmful information and lastly issues of deception of participants were be totally avoided.

Method of Data Analysis

Quantitative data collected in this study was analyzed based on the types of research questions. The IBM 26 Statistical Package for Social Sciences (SPSS) Statistics for windows with descriptive statistics presented in percentages and mean scores was used to present the findings in this study.

Descriptive statistics gives us a way to accurately describe and summarizing large datasets quickly and the most common descriptive statistics used are the Measures of central tendency (mean, median and mode) and measures of dispersion (the range, standard deviation, standard error and variance (Perry, Isabella and Charlotte, 2014). Therefore, a descriptive analysis was provided for all variables which

indicated the means, standard deviations, and range of scores of all variables presented in frequencies, and percentages.

Sustainability Statement

The United Nations (2015) Sustainable Development Goal 4 (SDG-4) is the educational goal which aims at ensuring inclusive and equitable education and promote lifelong opportunities for all irrespective of sex, age, race, colour, language, religion, political, or other opinion, national or social origin, property or birth, as well as persons with disabilities, migrants, indigenous peoples, and children and youth, especially those in vulnerable situations or other status, should have access to inclusive, equitable quality education and lifelong learning opportunities. Vulnerable groups that require particular attention and targeted strategies include persons with disabilities, indigenous peoples, ethnic minorities and the poor. Another main target of this goal is to substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries. Since teachers are the fundamental condition for guaranteeing quality education, teachers and educators should be empowered, adequately recruited and remunerated, motivated, professionally qualified, and supported, within well-resourced, efficient and effectively governed systems. (United Nations, 2015)

Therefore, two important aspects of Education for Sustainability (ESD) goal 4 are clearly envisaged from the findings of this study that is, teachers use of AT tools for children with learning disabilities will increase classroom inclusivity, interaction and instructional participation for children with learning disabilities in elementary classrooms and also enhance teachers by promoting innovative teaching styles for children with learning disabilities.

Firstly, since the findings of this study are intended to inform teachers and educational stakeholders in the Gothenburg Municipality on the availability of different AT low tech, mid tech and high tech tools that can be incorporated into classroom lessons and activities for teaching children with learning disabilities. Teacher's effective implementation of these different AT tools will further promote inclusive classroom practices for children with learning difficulties and enhance teacher's pedagogical competencies on how to use AT tools to teach children with learning disabilities and also lead to an increase in classroom interaction for children with learning disabilities in Swedish classrooms.

Secondly, the ability for teachers to effectively use innovative teaching resources such as assistive technologies to teach children with disabilities will definitely promote varieties of teaching methods for teachers and further ensure a more sustainable learning environment for all learners in elementary classrooms in Sweden.

CHAPTER FIVE

Presentation of Results

This chapter presents the findings obtained from investigating teacher's use of assistive technology for teaching children with learning disabilities in the Gothenburg Municipality of Sweden. This chapter presents the demographic data of the respondents and results were presented in percentages and mean scores to answer the three research questions and all missing values were also given a value.

A total of 52 teachers responded to the questionnaire out of the 100 copies that were sent to the five elementary schools in the Gothenburg Municipality of Sweden, making a 53% response rate and all questions in the questionnaires were fully answered with no missing item. The demographic data comprised of participants ages, gender, level of education, years of teaching experience, specific teaching role, the type of school they are teaching either an international school or a Swedish school and teachers were also asked to identify the specific types of learning disabilities cases in their classrooms.

Demographic Findings

A total of seven (7) demographic variables for both special and regular teachers relating to their background were analyzed using descriptive statistic in percentages and results of their responses were presented on table one below.

Table 1: Summary of respondents' demographic information

Variables	Response	Frequency (n)	Percentage (%)
Gender	Male	14	26.9%
	Female	38	73.1%
Age	21-28	7	13.5%
	29-35	14	26.9%
	36-42	12	23.1%
	43 and over	19	36.5%
Level of Education	Bachelor's degree	33	63.5%
	Master degree	19	36.5
	Doctoral	0	00.0

Teaching Experience	1-2 years	3	5.8%
	3-5 years	13	25 %
	6-10 years	15	28.8%
	11 years and above	21	40.4%
Teaching Role	General Education Teacher	38	73.1%
	Special Education Teacher	14	26.9%
School Type	Swedish School	29	55.8%
	International School	23	44.2%
Types of L.D	Reading Disorder	7	13.5%
	Mathematical Disorders	7	3.8 %
	Writing Disorders	2	9.6%
	Organization and Memory	1	1.9%
	Multiple learning disabilities	37	71.2%

In terms of participants ages, 19(36.5%) of the respondents were between the age of 43 and above, 14 respondents were between the ages of 29-35 years making (26.9%). Also, 12 (23.1%) of the respondents indicated to fall between 36-42 years and just 7(13.5%) were between 21-28 years old which is the least of the four categories. Furthermore, with regards to gender, most of the participants were female 38 (73.1%) and just 14 (26.6%) males. With regards to their educational background, majority of the respondents indicated to have a bachelor degree 33(63.5%) and 19(36.5%) had earned themselves a master degree and none of them holds a doctorate degree.

21(40.4%) of the respondents had been teaching for 11 years and above. 15(28.8%) have 6-10 years of teaching experience. 13(25.0%) had been teaching for 3-5 years and 3(5.3%) have just 1-2 years of teaching experience. In connection to participants teaching responsibilities, majority of the respondents were general education teachers making a total of 38 (73.1%) and 14 (26.9%) were working as special education teachers. 29 (55.8%) of the respondents were teachers from Swedish schools and 23(44.2%) were from international schools in the Gothenburg Municipality.

Participants were also asked to identify the types of specific learning disability cases in their respective classrooms. A hand-full of them indicated to have children with multiple learning disabilities making a total of 37(71.2%) and 7(13.5%) respondents had children with reading disorders (dyslexia,), 5(9.6%) had children with writing disorders (dysgraphia) and just 2(3.8%) indicated to have children with mathematical learning disorders (dyscalculia) and just 1(1.9%) respondent had a child with organization and memory disorder.

Research Question One

What types of AT tools are available and often used for teaching children with learning disabilities in elementary classrooms in Gothenburg?

Sixteen (16) AT devices generally used for teaching children with learning disabilities were listed on the survey instrument and participants were asked to identify which one they have available and often use in their classes to teach children with learning disabilities and the result was presented in percentages and mean as shown on the table below.

Table 2: Summary data analyses of teachers responses to 16 AT tools used for teaching children with learning disabilities in elementary classrooms in Gothenburg.

Items	Percentage (%) Available	Percentage (%) Not-Available	Mean
A.T devices for teaching children with learning disabilities			
1. Spell Checkers	98.1%	1.9%	1.01
2. Speech recognition software	100%	000%	1.00
3. Graphic Organizer and Outlining	50.0%	50.0%	1.50
4. Text to Speech(TTS) Software	61.5%	38.5%	1.38
5. Audio Books	63.5%	36.5%	1.36
6. Electronic Math Work Sheets	92.3%	7.7%	1.07
7. Pencil Grips	61.5%	38.5%	1.38
8. Wide Ruled Notebooks	98.1%	1.9%	1.01
9. Pen Scanners	000%	100%	2.00
10. Manipulative Blocks	100%	000%	1.00
11. Microsoft Word	84.6%	15.4%	1.15

12. Word Prediction Software	96.2%	3.8%	1.03
13. Talking calculators	5.8%	94.2%	1.94
14. Free-form Database Software	36.5%	63.5%	1.63
15.Information/Data Managers	53.8%	46.2%	1.46
16. Paper-based computer pen	000%	100%	2.00

Note. 1(available) and 2 (not-available)

The findings from this research question indicate that speech recognition software's and manipulative blocks are the most available AT tools generally used by teachers in the Gothenburg municipality of Sweden to teach children with learning disabilities in elementary classrooms since all 52 respondents (100%) agreed that they have these two devices in their classrooms. These two items scored the lowest mean score of 1.00 indicating the highest rate of classroom availability.

According to the research findings, 98.1% of the respondents accepted that they have spell checkers and wide rule notebooks and just 1.9 % of the participants didn't have these devices in their classrooms for teaching children with learning disabilities. This AT tools scored a mean score of 1.00 signifying a high availability rate.

96.2% of the respondents accepted to have word prediction software are which scored a low mean (m) score of 1.03 and just 3.8% of the participants don't have this software.

Furthermore, 84.6% of the respondents often use Microsoft Words programs in their classrooms for teaching children with learning disabilities and 15.4% said they don't have this AT tool.

The availability of audio books scored 63.5% with a 38.5% non-availability rate followed by both text to speech (TTS) software and pencil grips and result shows that 61.5% of the participants accepted to have them available.

Information / Data Managers scored a 53.8% availability rate and 46.2% non-availability rates. On an average note, two devices scored an average rate of 50% that is graphic organizers and outlining devices and 50% also indicated that these software's don't exist in their respective classrooms.

On the other hand, there was a low availability rate of 35.5% for free-form database software and a majority of the respondents 63.5% said they don't have these tools in their classrooms. A higher mean score of 1.46 indicating a low rate of classroom availability

Last but not the least, just 5.8% of the respondents had talking calculators as an AT tool used for managing lessons for children with mathematical problems in their classrooms and surprisingly, the result revealed that a total of 94.2% don't have this AT tool for teaching children with learning disabilities in their classrooms. Therefore, a high mean score of 1.94 indicate one of the lowest rates of AT availability in classrooms.

Lastly, two AT tools (pen scanners and paper-based computer pen) scored a 00% availability rate and the highest mean score of 2.00 as all 52 participants indicated that they don't have these AT tools.

Summarily, the above findings shows that most elementary classrooms in the Gothenburg municipality are equipped with the necessary AT tools prescribed by (Stanberry & Raskind, 2009) for teaching children with learning disabilities. Even though some high tech AT tools such as pen scanners and paper-based pen were not found in all classrooms as they scored 000% availability rates with the highest mean score of 2.00.

Research Question two

What are teachers' attitudes towards the use of AT in elementary classrooms in Gothenburg?

For this research question data was also analyzed using descriptive statistics presented in percentages and mean scores to determine teachers (general and special education teachers) attitudes towards using these assistive technological devices for teaching children with learning disabilities.

The summary table below represents the frequencies of teachers Likert responses of the 10 items ranging from Strongly Agree (S.A) Agree (A) Neutral (N), Disagree (D) and Strongly Disagree (S.D), the means scores (M) were also listed.

Table 3: Summary of rank items of teacher's attitudes towards using assistive technology for teaching children with learning disabilities in percentages and mean score

Descriptive Statistics

Items	% (SA)	%(A)	% (N)	% (D)	% (SD)	Mean Score
1	57.7	36.5	5.8	0	0	1.48
2	59.7	36.5	3.8	0	0	1.44
3	46.2	44.2	9.6	0	0	1.63
4	28.8	57.7	9.6	3.8	0	1.88
5	36.5	55.8	7.7	0	0	1.71
6	25.0	50.0	21.2	3.8	0	2.03
7	51.9	42.3	5.8	0	0	1.53
8	1.9	9.6	17.3	51.9	19.2	3.76
9	5.8	7.7	15.4	42.3	28.8	3.80
10	32.7	59.6	7.7	10.3	0	1.75

Item 1: Assistive technology helps to facilitate classroom instruction for children with learning disabilities?

Based on teacher's responses to this item, 30 (57.7%) strongly agreed that using AT tools helps to facilitate classroom instruction for children with learning disabilities and 19 (36.5%) agreed while only 3 (5.8%) of the respondents were neutral. This question had a low mean score of 1.48 meaning majority of the participants strongly agreed. Most of the participants indicated a strong positive attitude that using AT can help facilitate classroom instruction for children with learning disabilities.

Item 2: A.T devices can improve academic performance for children with learning disabilities?

From table three above findings indicate that most of the participants strongly agreed 31 (59.6%) that using AT devices can improve academic performance for children with learning disabilities and 19 (36.5%) also agreed and 2 (3.8%) were neutral. This item also had a lower mean score of 1.44 meaning majority of the respondents strongly agreed to this question.

Item 3: The availability and use of assistive technology in my class is very relevant for children with learning disabilities?

24 (46.2%) of the respondents strongly agreed that the availability and use of AT devices is very relevant for children with LD in their classrooms, 23(44.2%) also agreed while 5 (9.6%) were neutral to this item. With a low mean score of 1.63, it means majority of the participants strongly agreed that using AT in their classes is very relevant for children with LD.

Item 4: Using AT devices in my class can facilitate presentation of the subject matter to children with LD?

30 (57.7%) of the respondents agreed that using AT helps in presenting the subject matter and 15 (28.8%) also strongly agreed to this item while 5 (9.6%) were neutral and 2 (3.8%) disagreed to this question. The mean score for this question was 1.88 meaning most of the participants agreed.

Item 5: AT tools can facilitate communication in the classroom for children with learning disabilities?

For this item, 29 (55.8%) of the respondents agreed that using AT tools can facilitate communication and 19 (36.5%) also strongly agreed that AT tools can facilitate communication and just 4 (7.7%) were

neutral with their responses. For this question the mean score was also 1.71 which indicates that most participants agreed

Item 6: I am satisfied when I use AT in the classroom for children with LD?

Half of the respondents 26 (50%) agreed and 13 (25%) strongly agreed that they are satisfied when they use AT devices in their classrooms to teach children with LD while 11 (21.2%) were neutral and just 2 (3.8%) disagreed to this question. A mean score of 2.03 predict that majority of the participants agreed to this question.

Item 7: I believe that using AT devices have an overall benefit for children with learning disabilities? More than half of the respondents 27 (51.9%) strongly agreed that using AT devices has an overall benefit for children with LD, while 22 (42.3%) also agreed to this item, on the other hand, just 3(5.8%) were neutral towards this question. A low mean score of 1.53 shows that majority of the participants strongly agreed to this item.

Item 8: I feel Assistive Technology is very complicated and difficult to use?

27 (51.9%) disagreed to this item making it more than half of the participants, while 10(19.2%) strongly disagreed 9(17.3%) participants were neutral and 5(9.6%) agreed and just 1 (11.9%) person strongly agreed. The mean for this question was 3.76. Hence, majority of the participants disagreed to this item.

Item 9: The use of AT for children with L.D can frustrate me and takes much of my personal time?

Most of the respondents 22(42.3%) disagreed that using AT can frustrate them and take much of their time and 15(28.8%) strongly disagreed. Meanwhile, 8 (15.4) were neutral, 4 (7.7%) agreed and just 3(5.8%) strongly agreed to this item. This item also scored a high mean score of 3.80 indicating a high level of disagreed responses

Item 10: I am convinced that A.T plays an indispensable role in teaching children with learning disabilities?

For this last item, majority of the teachers 31(59.6%) agreed that AT devices play an indispensable role in teaching children with L.D and 17(32.7%) also strongly agreed to this and just 4(7.7%) respondents remained neutral to this item.

Summarily, all 52 participants who responded to this 10 survey items were generally positive in their attitudes in using AT tools. A lower mean score represented a positive attitude of teachers towards using AT. Therefore, item 2 with the lowest mean score of (1.44) meaning the most strongly agreed response. Meanwhile, the item with the highest mean score was item 9 with a mean score of (3.80) which reflects the most strongly disagreed item of participants towards using AT for children with learning disabilities.

Research Question Three

What are teachers' perceived levels of pedagogical competence in using assistive technology?

The third research question sort to find out teacher's perceive level of pedagogical competence in using assistive technology to teach children with learning disabilities and a series of questions were asked to assess their skills and knowledge in the use of AT. Participant's responses for item one to seven were Likert-scale questions ranging from no competence, little competence, moderate competence, and much competence and fully competent while the last three questions (8,9,10) were non-Likert questions. A summary of findings for this question indicate that most of the participants perceived themselves as possessing moderate pedagogical competence level in their abilities to identify and operate software programs that meets the learning needs of children with learning disabilities while majority of them 48% rated themselves as having little competence in assessing LD learners to determine what kind of AT devices are appropriate for teaching them. The table below was used to provide numerical data of participant's responses to research question three: "What are teachers' perceived levels of pedagogical competence in using AT for students with learning disabilities?"

Table 4: Summary responses of participant's perceived levels of pedagogical competence in using AT devices

Items	No. competence (%)	Little competenc e (%)	Moderate competence (%)	Much competence (%)	Fully Competence %	Mean (M)
1	00	32.7	51.9	9.6	5.8	2.88
2	00	36.6	53.8	7.7	3.8	2.80
3	1.9	48.1	32.7	17.3	00	2.65
4	3.8	36.5	44.2	13.5	1.9	2.73
5	5.8	28.8	38.5	23.1	3.8	2.90
6	11.5	30.8	44.2	9.6	3.8	2.63
7	9.6	7.7	44.2	28.8	9.6	3.21

This section assessed teacher's perceived level of pedagogical competence in using AT to teach children with learning disabilities. The first question was asked to assess teachers knowledge of the concepts and terms related to AT for teaching children with learning disabilities and a total of fifty two (52) participants responded to this question.

27(51.9%) participants rated themselves to be moderately competent in understanding the concepts and terms regarding AT for children with learning disabilities, followed by 17(32.7%) who said they have little competence. Meanwhile, 5(9.8%) indicated to have much pedagogical competence and just 3(5.8%) said they are fully competent. Therefore, this finding indicates that most of the participants have moderate knowledge in understanding the concepts and terms relating to AT for children with learning disabilities.

The next item assessed teachers abilities to identify and operate software's and programs that meet the learning needs of children with learning disabilities and all fifty-two (52) teachers responded to this question. Almost the same number of participants as in the first question 28(53.8%) believed they have moderate pedagogical competence in identifying and operating software's that meet learning needs for children with learning disabilities. Also, 18(36.6%) indicated to have little pedagogical competence in this area, 4(7.7%) said they have much competence and only 2(3.8%) accepted to be fully competent in exhibiting this pedagogical activity.

The third question was related to teacher's perceived skill and knowledge in assessing children with learning disabilities to determine appropriate AT, more of the respondents 25(48.1%) indicated a little pedagogical competence while 17(32.7%) have moderate competence and 9(17.3%) agreed to have much competence and just 1(1.9%) accepted to have no competence in carrying out this activity.

In the fourth question, teachers were asked to determine their competence in evaluating if AT is effective for children with learning disabilities. All 52 teachers responded to this item and (44.2%, n=23) indicated a moderate competence level follow by 19(36.5%) with little competence, 7(13.5%) accepted to have much competence in carrying out this pedagogical activity and just 1(1.9%) said he or she is fully competent.

Teachers were also ask if they understand that AT devices for children with learning devices range from low tech - high tech. findings to this question indicates that this item had the highest mean score of 2.90 and 20(38.5%) respondents claim to have moderate competence level while 15(28.8%) said they have little competence, 12(23.1%) were sure to have much competence level and 3(5.8%) have little level of competence in this activity.

In next question, teachers were also asked if they are confident in their knowledge in identifying, planning, and using a variety of A.T devices to teach and support children with learning disabilities. Results shows that majority of the respondents 23(44.2%) indicated a moderate competence level and 16(30.8%) with little competence. 5(9.6%) indicated much competence and only 2(3.8%) are fully competent. Surprisingly 6(11.5%) respondents said they have no competence in identifying, planning, and using a variety of AT devices to teach and support children with LD.

Participants were also asked to indicate their level of pedagogical competence in using spell checkers to assist children with reading disorders which is one of the devices used for children with reading disabilities. Most of the teachers 23(44.2%) said they have moderate skills in using this program and 15(28.8%) indicated to have much competence, 5(9.6%) teachers are fully competent while 4(7.7%) also said they have little competence in using spell checkers and a total of 5(9.6%) said they have no competence in this teaching task.

Item 8: Are you interested in receiving more knowledge and training on how to use AT tools for teaching children with LD?

Table 5: Frequencies of teacher's responses to receiving more AT training

Item	Responses	Frequency	%
Interest in receiving more A.T Training	YES	48	92.3%
	No	2	3.8%
	I don't know	2	3.8%
Total		52	100%

This question was asked to find out teachers interest in receiving more knowledge and training on how to use different AT tools to teach children with learning disabilities. A total of 52 participants responded and result shows that a majority of 48(92.3%) indicated YES and interested to receive more pedagogical training on how to use AT for children with learning disabilities. 2(3.8%) said No and not interested and two also said they don't know. The diagram below was included to further illustrate this result.

Item 9: In which area of learning disabilities would you like to see more AT options in your classroom?

Table 6: Frequency of teacher's responses to functions for which they wish to see more A.T devices in their classrooms

Item	Response	Frequency	%
Areas to see more A.T options in your Classroom?	Math's disorders	9	17.6 %
	Reading difficulties	5	9.6%
	Writing disorders	7	13.5%
	Memory / Organizational	1	1.9%
	All Areas of LD	51	55%

Participants were also asked to identify which areas of learning disabilities they would like to see more AT options or devices for children with learning disabilities. A total 51 participants responded to this question with one missing or omitted item and 29(55.8%) indicated that they need AT devices for teaching children in all areas of learning disabilities while 9(17.3%) said they need AT devices for children with Mathematical disorders, 7(13.5%) for children with writing disorder and 5(9.6%) indicated interest for more devices in the area of memory and organization

Q 10: Based on your preferred learning style, please indicate your preferred method for AT training?

Table seven: Frequency distribution of respondent responses to preferred methods for receiving more A.T training

Item	Response	Frequency (N)	Percentage (%)
Please select your preferred Methods for more A.T training?	One on one or Individual instruction	10	19.2%
	Conference/workshops	32	61.5%

Online module	9	17.3%
Others	1	1.9%
Total	52	100%

This last question asked teachers to select their preferred method for AT training majority of the teachers 32(61.5%) prefer more training through conferences and workshops, while 10(19.2%) participants indicated a One on one (Individual instruction) while 9(17.3%) prefer online modules and just 1 one person opted to other options of training.

CHAPTER SIX

DISCUSSION

This chapter discusses the findings of this study which seeks to investigate teacher's use of AT devices for teaching children with learning disabilities in Gothenburg. A total of 52 teachers responded to the questionnaire and result of AT availability in classrooms, teacher's attitudes and pedagogical competence towards using AT for children with learning disabilities. The results from each research question were discussed as follows:

Research Question One (RQ1)

What types of A.T devices are available and often used for teaching children with learning disabilities in elementary classrooms in Gothenburg?

In this research question, a total of sixteen (16) AT tools prescribed by Stanberry and Rankind (2009) for teaching children with learning disabilities which included spell checkers, speech recognition software, graphic recognition and outlining, text to speech (TTS) software, audio books, electronic math work sheets, pencil grips, wide rule notebooks, pen scanners, manipulative blocks, microsoft word, word prediction software, talking calculators, free-form database software, information/ data managers and paper-based computer pen for supporting learning for children with learning disabilities in the areas of reading, writing, mathematics and memory and organization were presented to participants for them to identify which ones they have available in their classrooms. The main purpose of this question was to find out if elementary classrooms in Gothenburg are equipped with the necessary AT devices used for teaching children with learning disabilities and to also identify which devices were missing.

The findings of this question indicate that teachers have most of the AT software's and programs but surprisingly two AT tools were completely absent in all classrooms. The most available AT tools often used by teachers for teaching children with learning disabilities are speech recognition software's (100%, n=52), manipulative blocks (100%, n=52) spell checkers (98.1%), word prediction software's (96.2%) electronic math work sheets (92.3%) and microsoft word (84.6%).

Furthermore, six other AT tools were found to be averagely available in classrooms which include audio books (63.5%), text to speech (TTS) software (61.5%), pencil grips (50%), graphic organizers and outlining (50%) and information/data managers (53.8%). On the other hand, two other devices

scored a below average availability rate which are free-form database software (36.5%) and talking calculators (5.8%). Lastly, this result also show that two devices scored a 00% availability rate and were completely absent in all classrooms which are pen scanners and paper-based computer pens. According to Ganschow, Philips & Schneider (2004) high-tech devices are expensive and require ongoing maintenance and extensive training for instance, word prediction software, talking calculators, and hearing aid or assistive listening device and this definitely explains the reason why some high tech devices were totally absent in all elementary classrooms in the Gothenburg Municipality.

Research Question 2 (RQ2)

What are teachers' attitudes towards using AT for teaching children with learning disabilities?

The second research question investigated teacher's attitudes towards using AT devices for teaching children with learning disabilities and 10 items informed by the affective, behavioral and cognitive domains of the ABC model of attitude. Participant's responses to all 10 items in the section two of the research instrument and their responses were ranked in percentages and means score. Findings revealed that all 52 participants indicated to have positive attitudes towards using AT tools to teach children with learning disabilities. According to the ABC model, someone's attitudes can either be negative, positive or neutral towards an object. The behavioral tendency by an individual consists of actions or observable responses that are the result of an attitude object and this involves a person's responses either favorable or unfavorable to do something regarding the attitude object by an individual consist. Also, the positive attitude indicated by the participants of this study might be due to the fact that all the regular and special education teachers in the Gothenburg municipality of Sweden have accessibility to most of the AT devices used for teaching this group of learners and also because they possess moderate levels of pedagogical competence skills on how to use these devices in their respective classrooms.

This finding further relates to that of Garcia and SeEVERS (2005) who examined general teacher's attitudes regarding the use in their classes for AT by students with learning disabilities and found out that general teachers have a positive attitude needed to successfully implement AT in their classes for students with learning disabilities. Also, Oyeniran (2017) assert that teacher's attitudinal disposition towards the use of technology plays an essential role and when teachers have a positive attitude towards a specific form of assistive technology; there is a greater likelihood that they would make significant efforts to effectively integrate such technology into the teaching learning process.

Therefore, this finding conforms to the ABC Model of Attitude that is used as the theoretical framework in assessing participant's attitudes. Even-though the finding only represents the perceived attitudes of a small fraction of special and regular classroom teachers in the Gothenburg municipality

of Sweden, it might also be that only teachers with positive attitudes towards using AT decided to complete and return the survey instrument.

Research question 3 (RQ3)

What are teachers' levels of pedagogical competence in using assistive technology for children with learning disabilities?

The level of pedagogical competence covered in this study assessed participants perceived abilities in understanding the different concepts and terms in AT for children with learning disabilities, their confident and abilities to identify and operate software programs that can meet the learning needs of children with learning disabilities and also their knowledge and skills to assess learners with disabilities to determine what kind of assistive technology, their abilities to evaluate if AT is effective in meeting the learning needs of children with learning disabilities. The findings were presented on table 4 above in percentages and means rating.

Thus, 52% of the participants rated themselves as being moderately competent in understanding the concepts and terms regarding the use of AT for teaching children with learning disabilities. According to the TPACK model (2006), teacher's technological knowledge (TK) includes an understanding of how to use computer software and hardware and it also covers teacher's ability to adapt and learn new technologies. Koehler and Mishra (2006) in the TPACK model further suggest that good teaching with technology cannot be achieved by simply adding a new piece of technology upon existing structures but requires a shift in existing pedagogical and content domains.

54% of the participants also rated themselves as possessing moderate competent in identifying and operating software's and programs for teaching children with learning disabilities. Participants were also asked to rate their knowledge in assessing children with learning disabilities to determine what kind of AT would be appropriate and 48% of the respondents said they have little competence in carrying out this task. According to Bryant & Bryant (1998) teachers must know how to select technology adaptations appropriately, monitor and evaluate the use of these adaptations in classrooms activities to determine their educational benefits for students with learning disabilities and majority of the participants (42%) also rated themselves as moderately competent in their knowledge in identifying, planning, and using a variety of AT tools such as spell checkers to assist children with reading disabilities in their respective classrooms. This finding relates to that of Randal (2013) who found out that special education teachers had an average knowledge of AT and determining their use to assist students. Nevertheless, findings also show that the weakest area of teacher's perceived pedagogical competence was in assessing children with learning disabilities to determine appropriate AT as 25(48%) respondents indicated a little pedagogical competence and this finding is consistent with the study of Almethen (2017) who found out that teachers in Saudi Arabia were not fully

competent and sufficiently prepared to choose and implement assistive technology in a classroom with students with disabilities.

According to Rahman (2014) teacher's pedagogical competence involves teachers being able to effectively manage learning with the use of AT for children with learning disabilities which includes identifying, planning, implementing and evaluating of the learning outcome. Also, in the TRACK Model of knowledge, Pedagogical Knowledge (PK) is the set of skills that teachers must develop in order to manage and organize teaching and learning activities for intended learning outcomes and this knowledge involves understanding of classroom management, lesson planning and assessment of learning. The last section of this research question also asked participants if they were interested in receiving more knowledge in using AT, they were also asked to select a preferred learning style on how to use AT tools for teaching children with learning disabilities and almost all participants said yes and were interested in receiving more AT knowledge either through conferences / workshops or online modules.

CHAPTER SEVEN

Conclusion and Recommendations for Further Research

Conclusion

This study investigated teacher's use of AT tools for teaching children with learning disabilities in elementary classrooms in the Gothenburg Municipality of Sweden. This study was worth carrying out especially now that schools in Sweden are striving towards a more inclusive and sustainable classroom environment and also equitable education to children with disabilities. The study started by giving some background information on learning disabilities, assistive technology usage in schools in Sweden and the policy put in place by the National Agency for Special Needs Education and Schools in terms of using educational tools and digital skills for teaching children with special learning needs. Teacher's attitudinal dispositions and pedagogical competence in the use of AT were also clearly identified and explained as key factors influencing teacher's capacities in using AT to support learning for children with learning disabilities.

A systematic literature from previous studies relating to teachers use of AT for children with disabilities were presented according to each variable under investigation in the study and they were mostly quantitative studies. The theoretical lens of this study focused on the TPACK Framework by Mishra and Koehler (2006) and the ABC model of Attitudes which are one of the most recent research models in the application of AT for children with disabilities and they were employed to discuss and better understand the main variables and findings of the study.

The study used a quantitative descriptive survey method to investigate the research questions and a questionnaire for teachers informed by the conceptual and theoretical framework with a total of 36 close ended items was used to gather data from 52 participants (general and special education teachers) from five randomly selected elementary schools in the Gothenburg Municipality. Descriptive statistics presented in percentages and mean scores were used to report the findings in the study. Findings revealed that most AT devices are available in elementary classrooms in the Gothenburg Municipality of Sweden for teaching children with reading, writing, mathematic disorders and memory and organization problems. Also, two high-tech AT tools (pen scanners and paper-based computer pen) for teaching children with LD are completely missing in all classrooms. Also, teachers rated themselves as having positive attitudes towards using AT for supporting classrooms activities for children with learning disabilities but most participants (teachers) rated themselves as moderately competent and not fully equipped to pedagogically use AT tools to teach children with learning disabilities and requested for more AT training.

Recommendations for Further Research

This study serves as an eye opener to classroom teachers and educational stake-holders in the Gothenburg Municipality of Sweden as it contributes in bringing out quantitative findings concerning AT for children with learning disabilities in elementary classrooms and this study could be further expanded to other municipalities in Sweden. Therefore, based on the findings of this study some vital recommendations were made.

Based on the findings of this study, more high-tech AT tools used for teaching children with learning disabilities need to be added in elementary classrooms in the Gothenburg municipality of Sweden especially talking calculators for learners with mathematical difficulties, pen scanners for those with writing disorders and paper-based computer pens for learners with memory and organization problems.

Furthermore, Teacher's especially regular education teachers need more professional training and knowledge on how to pedagogically identify suitable AT devices use for teaching children with learning disabilities, how to also plan, evaluate and assess AT lessons for children with learning disabilities. Therefore, there is a high need for more in-service training for teacher through conferences/workshops and online modules for teachers to further impact teachers.

This study can be expanded by other researchers in other areas of disabilities like Attention Deficit Hyperactive Disorders (ADHD), Autism Spectrum Disorders, Emotional and Behaviour Disorders.

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Appendices

Appendix A: Letter to Head Teachers

Good morning Vanessa,

My name is Njikem John, a final year Master student at the department of Education and Special Education at the University of Gothenburg. I'm delighted to send you this email soliciting your assistance to enable me to collect data for my research titled "Investigating Teachers Used of Assistive Technology for teaching children with Learning Disabilities in Gothenburg, Sweden"

I am soliciting for your full support by allowing me collect data from teachers at ISGR. The main purpose of my thesis is to find out from teachers (General and Special Education) the kind of Assistive Technological (A.T) tools that are available and often used for teach children/students with Special Learning Needs (Learning Disabilities) and to also find out Teachers Attitudes and level of Pedagogical Competence towards using these AT tools.

I am kindly demanding your guidance and support to enable me to collect this data from your teachers (both regular and special education).

The findings of this study will be used only for scholarly purposes and only aggregate results will be reported in my master thesis in May, 2022.

I have attached my survey instrument and consent form for teachers; I also have the hard copy of my Introductory Letter from the Department of Education and Special Education which grants me permission to collect data. Thank you Vanessa and hope to hear from you soon. John

Appendix B: Informed Consent Form

Study Title: "Investigating Teachers Use of Assistive Technology for teaching Children with Learning Disabilities in Gothenburg, Sweden"

The study in which you have been asked to participate in is designed to investigate Swedish teacher's attitudes and level of pedagogical competence in using different assistive technological tools in teaching children with learning disabilities in elementary schools in the Gothenburg Municipality. This study is conducted by Njikem John, a master student under the supervision of Professor Girma Berhanu from the Department of Education and Special Education, University of Gothenburg, Sweden.

PURPOSE: The purpose of the study is to investigate and assess teacher's attitudes and level of pedagogical competence towards using different assistive technological tools when teaching children with learning disabilities.

DESCRIPTION: Participants will be asked questions relating to the availability and use of different A.T tools, attitudes and level of pedagogical competence relating to the use of different assistive tools when teaching children with learning disabilities. Teacher's demographic information will be equally collected.

PARTICIPATION: Your participation in this study is totally voluntary and you do not have to answer any questions you do not wish to answer. You are free to skip or not respond to any questions and you can freely withdraw from participating at any time without any charges or penalty.

ANONYMOUS: Your responses will remain anonymous and the data collected will be highly confidential and used only for the purpose of this study and stored in group form only.

DURATION: It will take 15-20 minutes to complete the questionnaire

RISKS: Participating in this study does not bring any possible and identifiable risks to the participants. However, when filling out the survey any participant who becomes uncomfortable can freely withdraw their participation with no charges.

Benefits: There are no direct benefits to the participants in this study. However, the findings from this study might be beneficial to the education of children with learning disabilities. Also, educational stakeholders in the Gothenburg municipality might also benefit from the findings of this study. Also, elementary schools in Gothenburg might also find useful information that will assist them to decide to either add more assistive technological tools for children with learning disabilities or provide more in service training programs for their teachers.

CONTACT: If you have any questions regarding this study, please free to contact Professor Girma Berhanu on +46704731818 or at girma.berhanu@ped.gu.se

RESULTS: Please contact the Department of Education and Special Education library at University of Gothenburg for the results of the study by June 2022

YOU ARE MAKING A DECISION WHETHER OR NOT TO PARTICIPATE IN A RESEARCH STUDY. YOUR SIGNATURE BELOW INDICATES THAT YOU HAVE DECIDED TO PARTICIPATE IN THE STUDY AFTER READING ALL OF THE INFORMATION ABOVE AND YOU UNDERSTAND THE INFORMATION IN THIS FORM, HAVE HAD ANY QUESTIONS ANSWERED AND HAVE RECEIVED A COPY OF THIS FORM FOR YOU TO KEEP.

Signature

Research Participant

Appendix C: **Teachers Questionnaire**

Research Topic: “Investigating Teachers Use of Assistive Technology for teaching Children with Learning Disabilities in Gothenburg, Sweden”

This survey is divided into four main sections and you are required to read each statement and answer the questions as they relate to your availability and use, attitudes and pedagogical competence in using assistive technological tools for children with learning disabilities.

Part I: Demographic Information

1) What is your age?

- ☐ 21-28
- ☐ 29-35
- ☐ 36-42
- ☐ 43 and over

2) What is your gender?

- ☐ Male
- ☐ Female
- ☐ Other (Please Specify).....

3) What is your highest level of education?

- ☐ Bachelor degree
- ☐ Master degree
- ☐ Doctoral
- ☐ Other (please specify).....

4) Years of Teaching Experience

- ☐ Less than one year
- ☐ 1-2 years
- ☐ 3-5 years
- ☐ 6-10 years

- More than 11 years
- 5) What is your specific job position or role?
 - General education teacher
 - Special education teacher
 - Other (specify).....
- 6) Type of school?
 - Swedish School
 - International School
- 7) Type(s) of learning disability in your classroom?
 - Reading Disorder (Dyslexia)
 - Mathematical Disorders (Dyscalculia)
 - Writing Disorders (Dysgraphia)
 - Organization and Memory
 - Diverse Learning Disabilities

Part II: Classroom Availability and Use of Assistive Technology

Please answer the following questions by circling the best answers that most accurately reflect the availability and use of different assistive technology tools for children with learning disabilities in your class.

Available and Use (1): I know this assistive device and often use it in my class

Not-Available (2): I don't know this assistive device

16 A.T items assessing classroom availability adapted from Stanberry and Raskind , (2009)	Available	Not Available
1. Spell Checkers: This software is used for identifying or locating misspelled words in a sentence and allowing students to make necessary corrections.	1	2
2. Speech Recognition Software: This program allows learners to dictate or talk to a computer that uses software to convert this to a written text	1	2
3. Graphic Organizer and Outlining This program helps users who have trouble	1	2

organizing and outlining information as they begin writing	
4. Text to Speech (TTS) Software: This software allows users to understand written materials they are presented with and to proof-read or check their own work	1 2
5. Audio Books: (Recorded books allow students to listen to text and are available in a variety of formats, such as audiocassettes, CDs, and MP3 downloads	1 2
6. Electronic Math Work Sheets: This program can help a child to organize, align and work through math problems on computer screen and numbers that appear onscreen can also be read aloud via a speech synthesizer	1 2
7. Pencil Grips: This device can be a great tool for helping students to hold a pencil more naturally. It is usually used for students who have dysgraphia with other fine motor issues.	1 2
8. Wide Ruled Notebooks: This tool is used for students who have trouble writing on small line; it has high-contrast lines that students can easily follow.	1 2
9. Pen Scanners: This is a scanning device students with writing problems can use when copying down information and it allows them to scan in handwritten or typed text when copying down information	1 2
10. Manipulative Blocks: These are concrete materials like algebra tiles, snap cubes and colored rods can help students at all grade levels improve their mathematical reasoning and problem-solving.	1 2
11. Microsoft Word: One of the easiest differentiation tools for a reading passage is a software program that most teachers have readily at hand. Smaller reading passages copied and pasted into Microsoft Word, can be easily enhanced to aid comprehension using standard formatting features within the program. Using the highlighting feature can help students focus on particular aspects of a text like parts of speech, literary devices, or key elements of a paragraph (Stanberry and Raskind (2009)	1 2
12. Word Prediction Software: Word prediction software can help a user during word processing by "predicting" a word the user intends to type. Predictions are based on spelling, syntax, and frequent/recent use. This prompts kids who struggle	1 2

with writing to use proper spelling, grammar, and word choices, with fewer keystrokes	
13. Talking Calculators: A talking calculator has a built-in speech synthesizer that reads aloud each number, symbol, or operation key a user presses; it also vocalizes the answer to the problem	1 2
14. Free-form Database Software: According to Stanberry and Raskind this tool allows the user to create and store electronic notes by “jotting down” relevant information of any length and on any subject. The student can later retrieve the information by typing any fragment of the original note.	1 2
15. Information/ Data Managers: This type of tool helps a person plan, organize, store, and retrieve his calendar, task list, contact data, and other information in electronic form.	1 2
16. Paper-based Computer Pen: This technology records and links audio to what a person writes using the pen and special paper. It enables the user to take notes while simultaneously recording someone (e.g., a teacher) speaking. The user can later listen to any section of his notes by touching the pen to his corresponding handwriting or diagrams	1 2

Part Three: Teachers Attitudes towards Using Assistive Technology

Please indicate your reaction to each of the following statements by circling the number that represents your level of agreement with it. Please make sure you respond to all the statements. (Strongly Disagree (S.D), Disagree (D), Neutral (N), Agree (S.D), Strongly Agree (N))

Items assessing teacher's attitude towards using A.T for children with L.D's.	Strongly Agree (1)	Agree (2)	Neutral (3)	Disagree (4)	Strongly Disagree (5)
1. Assistive technology helps to facilitate classroom instruction for children with learning disabilities.					
2. Assistive technology can					

improve academic performance for children with learning disabilities such as dyslexia, dysgraphia, dyscalculia etc.					
3.The availability and use of assistive technology in my class is very relevant for children with learning disabilities					
4.Using assistive technology in my class can facilitate presentation of the subject matter to children with learning disabilities					
5. Assistive technology tools can facilitate communication in the classroom with children with learning disabilities.					
6. I am satisfied when I use assistive technology in the classroom for children with learning disabilities.					
7. I believe that assistive technology has an overall benefit for children with learning disabilities.					
8. I feel assistive technology is very complicated and difficult to use					
9. The use of assistive technology for children with learning disabilities can frustrate me and takes much of my personal time					

10. I am convinced that assistive technology plays an indispensable role in teaching children with learning disabilities					
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Part four: Teachers Pedagogical Competence in Using Assistive Technology

Please kindly indicate your level of pedagogical competence (knowledge and skills) in using Assistive Technology for children with learning disabilities. Indicate by circling the right option that is best appropriate for you.

No Competence (1)

Little Competence (2),

Moderate Competence (3),

Much Competence (4),

Fully Competent (5)

Items assessing teachers level of pedagogical competence	No Competence	Little Competence	Moderate Competence	Much Competence	Fully Competent
1). I know the concepts and terms regarding assistive Technology for children with learning disabilities.	1	2	3	4	5
2). I am confident in my abilities to identify and operate software's, programs that meet learning needs of children with learning disabilities.	1	2	3	4	5
3). I have the knowledge and skills to assess learners with learning disabilities to determine what kind of assistive technology would be appropriate for teaching them.	1	2	3	4	5

4). I know how to evaluate if Assistive Technology is effective in meeting my learners with learning disabilities.	1	2	3	4	5
5). I know that the A.T options for learners with learning disabilities range from low tech to high tech.	1	2	3	4	5
6). I am confident in my competencies in identifying, planning and using a variety of A.T devices to teach and support learners with learning disabilities.	1	2	3	4	5
7). I know how to use a spell checker to assist children with dyslexia spell well"	1	2	3	4	5

8). Are you interested in receiving more knowledge and training on how to use Assistive Technological tools for teaching children with learning disabilities?

- ☐ Yes
- ☐ No
- ☐ I don't know

9). in which area of learning disabilities would you like to see more assistive technology options in your classroom?

- ☐ Mathematics
- ☐ Writing
- ☐ Reading
- ☐ Speaking
- ☐ Other (Please Specify).....

10). Based on your preferred learning style, please select your preferred method for assistive technology training.

- ☐ One on one individual instruction

- Conferences and workshops
- Online Modules
- Others (Please specify).....