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A Scoping Review of Interventions Delivered by Occupational Therapists in School Settings

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ABSTRACT

This review describes available research on interventions delivered by Occupational Therapists (OTs) in schools to identify the outcomes addressed and in which tiers of support (universal, focalized or intense) the interventions are situated. Previous reviews focus on the effectiveness or efficacy of OT school interventions, but the participation of OTs has not been considered. Electronic database searches were conducted to locate eligible journal articles published in any language and using any methodology. The population were students aged 3 to 16 years, and interventions required to be delivered by OT practitioners targeting any outcome expected from an OT intervention. We identified 50 studies since 1990, the majority of which were pre-post studies addressing mostly school performance and conducted with students aged five to eight years old, with difficulties primarily in fine motor skills and diagnoses such as autism. Interventions were provided across all three tiers of support, but most were focalized interventions addressing academic tasks, particularly handwriting. OTs and researchers should reflect on the outcomes from OT addressed in the published interventions and the tiers of support these interventions have taken. This is vital for the school practice as it is constantly evolving and requires research that considers its reality.

Introduction

The role of Occupational Therapists (OTs) in schools is to support children whose needs cannot be met solely by their teaching team, focusing on their role as students (Bock & Borders, 2015). The student role is characterized by children's participation in academic (e.g. math) and nonacademic activities (e.g. recess, sports, prevocational and vocational activities) (AOTA, 2020). Therefore, OT services include academic support, and assistance with play and leisure, social participation, self-care skills and transition.

There is evidence of the vital role OTs play in providing a flexible and diverse support to students with Special Educational Needs (SEN) or disabilities (Landor & Perepa, 2017; Symes & Humphrey, 2018). However, OTs have begun to include a broader range of

students to promote early identification of possible difficulties, and provide interventions to help all students succeed in their educational activities (Cahill et al., 2014). This expansion implies a change from individual pull-out services (outside classrooms) with a deficit-based approach toward inclusive practices that support promotion and prevention strategies (Ball, 2018; Garfinkel & Seruya, 2018). These strategies emphasize the use of multi-tiered service models that include universal, focalized and intense support depending on the response of students to the strategies used (Bissell & Cermak, 2015; Chu, 2017; Missiuna et al., 2012).

This shift has not been reflected in research, as evidence shows that SBOT services have primarily focused on restoring function to individual students, particularly those with SEN or disabilities, and primarily provided outside of general classrooms (Bolton & Plattner, 2019; Maia et al., 2016; O'Donoghue et al., 2021; Rodrigues & Seruya, 2019; Spencer et al., 2006; Watt et al., 2021). Evidence also shows that these services have focused primarily on addressing school performance issues, particularly fine motor skills and handwriting, and sensory and behavioral processing problems (Beck et al., 2006; De Oliveira Borba et al., 2020). Only a few studies have identified services more focused on environmental constraints and provided to all students in natural settings (e.g. general classrooms) (Jasmin et al., 2019; Kaelin et al., 2019).

This suggests that the support of OTs in schools has been limited to achieving specific outcomes, mainly when there is a limitation in the performance skills of the students. This limited scope represents a potential hazard for OTs, as they may be failing to consider all the occupations and activities in which students are involved (Bonnard & Anaby, 2016). This could result in students with difficulties in other areas being left without the support they need to develop their role as students.

This limited scope is also evident when examining systematic reviews of SBOT interventions, which have commonly been focused on academic activities (Grajo et al., 2020) and on motor and handwriting skills (Eddy et al., 2019; Engel et al., 2018). Furthermore, as these studies have been conducted following an effectiveness or efficacy-based approach aiming to find the best evidence to inform practice, studies were excluded due to methodologies concerns. Some methodologies, however, respond to the complexity of OT practice in school settings due to the variability in the way services are delivered and the influence of factors such as institutional and organizational policies and structures (Silverman & Bourke-Taylor, 2009).

Scoping review methodology aims to identify all types of research yet does not evaluate the quality of evidence or the effectiveness or efficacy of interventions (Arksey & O'Malley, 2005; Colquhoun et al., 2014; Daudt et al., 2013; Levac et al., 2010). The review by De Oliveira Borba et al. (2020) took this approach but did not focus on the participation of OT practitioners (OT and/or OT assistants) in the service provided. This methodology allowed for the examination of various school interventions delivered by OTs in multiple research designs to comprehensively map various sorts of evidence. The main research questions were: (i) what is known from scientific studies on school interventions delivered by OTs for children with and without special educational needs or disabilities? (ii) which OT outcomes are targeted and assessed? (iii) which tiers of support do the interventions described correspond and what are their components?[1]

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[1]Questions adapted from the protocol to the final article to ensure their clarity.

Methods

The review was conducted following a protocol published online (Salazar Rivera et al., 2020), and written considering the PRISMA Extension for Scoping Reviews (Tricco et al., 2018) and PRISMA-P checklist (Shamseer et al., 2015).

Search Strategy

To cover main topics, the concepts *school** OR *education** AND *occupational therap** OR *school health services* AND *disabilit** OR *support** were indexed through MeSH (Medical Subject Headings). Supplementary concepts were also included. Appendix 1 contains an example of the search strategy conducted in Medline, and the adjustments applied for other databases are publicly available in FigShare (https://figshare.com/s/6a67d34dcda1ef04bb77).

   The following electronic databases were searched in April 2020 and June 2021[2] CINAHL, AMED, Education Research Complete, British Education Index, Medline, Embase and PsycINFO, Otseeker. Forward and backward citation searching was carried out by examining the references of included articles, and handsearching relevant websites such as *CanChild* (https://www.canchild.ca). The search strategy was developed with experienced university librarians and information specialists.

Eligibility Criteria

The elements of the Population-Concept-Context (PCC)[3] framework suggested by Peters et al. (2020) were considered for the inclusion criteria: a) Population: children from three to 16 years of age[4] (studies that included participants beyond 16 years were also included if deemed relevant); b) Concept: any school intervention explicitly delivered by OTs that tackled formal education activities and targeted any outcome resulting from an OT intervention; c) Context: scientific journal articles[5] published between 1975 and 2021, based on any design and written in any language (English, Spanish, Portuguese and Arabic was covered by the review team, and google translator was used for other languages). The interventions had to have been provided inside a school. Articles in which OTs acted only as researchers were excluded, as well as those that referred to the school only to reach the target population (school-age children).

Identification and Selection of Articles

Rayyan[6] was used to select sources of evidence, where the following steps were carried out: a) Search results were merged from different sources and duplicates were removed (JSR); b)

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[2]These databases were searched for updates because of the delay in the finalization of this review due to Covi-19-time constraints for all the reviewers.:

[3]As part of the learning process behind this study, the elements of the PICO format described in the protocol were adapted to the PCC framework, to align with scoping review methodologies.

[4]During the review process it was decided not to limit the criteria only to children with SEN/disabilities, according to multitiered models.

[5]Grey literature was excluded due to the extensive number of papers found.

[6]Before conducting the review, the EndNote software package was selected. However, this was not accessible for all the reviewers during the COVID-19 pandemic. In response to this, Rayyan was used.

Titles and abstracts were screened by two reviewers (JSR/NA); and c) Full texts of potentially relevant studies were retrieved (JSR). Then, d) full texts were examined to ensure studies met the eligibility criteria (JSR/NA and JSR/EP).

Data Extraction and Analysis

Data extraction processes were based on the descriptive analytical method recommended by Arksey and O'Malley (2005). This method involves a review of studies based on a common analytical framework that locates key issues and summarizes them (Pawson, 2002). This requires creating a data matrix containing the critical elements selected. For this review, standardized data extraction tools were designed, and the most frequent characteristics within each of the elements were analyzed based on a simple frequency approach (Bazeley, 2018). Data were extracted in two distinct levels (JSR): studies and interventions (Table 1), and second reviewers checked the accuracy (NA and EP).

(1) Studies: data about the characteristics of the studies were extracted based on the recommendations made by Arksey and O'Malley (2005) and Levac et al. (2010). Studies were then grouped according to the OT outcomes embraced. The outcomes considered here were those listed in the OT Practice Framework from the American

Table 1. Elements extracted at study and intervention levels.

Element extracted	Description
Study level	
Reference	Authors, article title and journal title
Year of publication	Year in which the article was published
Language	Language in which the article was written
Country	Country where the study was conducted
Aim	Objectives of the study
Outcome measures	Instruments used to gauge the outcomes
School characteristics	Context of the school in which the study was conducted
Sample	Who and how many people were involved
	Students' diagnoses or difficulties
	Students' age (in years)
	Students' sex (male of female)
Intervention level	
Intervention name	Name or phrase that describes the intervention
Rationale or goal (why)	Rationale, theory, or goal of the elements essential to the intervention
Materials (what)	Physical or informational materials used in the intervention, including those provided to participants, in intervention delivery or in training of the intervention providers. Provides information on where the materials can be accessed
Procedure (what)	Procedures, activities and/or processes used in the intervention, including any enabling or supporting activities
Who provided	Identification of the provider and their expertise, background and specific training needed
Modes of delivery (how)	Modes of delivery of the intervention (e.g., face-to-face or by some other mechanism, such as the Internet or telephone), and whether it was provided individually or in a group
Location (where)	Type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features
When and how much	Number of times the intervention was delivered and over what period, including the number of sessions, their schedule, duration, and intensity

Occupational Therapy Association (AOTA, 2020), which were clustered into three groups for practical and educational purposes[7]

- School participation: studies that aimed to increase access and levels of participation in school activities (occupational justice). Studies that aimed to adapt the physical or social environment required to carry out school activities; increase access to educational resources, parents' and teachers' knowledge of the child's strengths and weaknesses; and support the school system.
- School performance: studies that aimed to improve or enhance performance skills (motor, process, and social interaction skills), and competence for the development of students' roles.
- Health and wellness: studies that aimed to identify, reduce or prevent the appearance of unhealthy conditions, risk factors, diseases or injuries; promote healthy lifestyles; improve or enhance health and wellness and quality of life.

(2) Interventions: data were extracted based on their components. Therefore, key elements were broken down using the Intervention Description and Replication Checklist (TIDieR) that contains the minimum recommended elements to describe an intervention (Hoffmann et al., 2014).Interventions were then classified according to the types of intervention described in the OT Practice Framework (AOTA, 2020), and the tiers of support described in multi-tiered models such as Partnership for Change (P4C) models. These models focus on providing services to struggling students early on to facilitate school success and emphasize the partnership between therapists, families, and teachers to facilitate participation of all children (Basham et al., 2010; Campbell et al., 2012; Fuchs & Fuchs, 2006; Missiuna et al., 2012). These models consider three tiers of support:

- Universal tier (T1): OTs collaboratively support the school system, teams, or classroom using Universal Design for Learning (UDL). They enhance the ability of teachers, parents/caregivers, and peers to understand the range of students' needs and abilities. OTs also support teachers' ability to teach skills through curriculum-based activities for all.
- Focalized tier (T2): OTs help modify teaching practice to support those students whose needs could not be met through UDL strategies. They work collaboratively to find ways to adapt assignments and instructions and identify students who may need individualized support.
- Intense tier (T3): OTs provide direct and intense services to individual students and introduce changes to the activity or environment to maximize their performance and participation. This tier is considered when a student is unable to meet general learning and curriculum demands.

OT outcomes groups were further analyzed during the execution of this review and it was decided to reduce the number of groups to three.:

Results

Selection of Sources of Evidence

There were 4,447 articles screened by title and abstract after removal of duplicates, of which 81 were selected for full text examination. The citation searching conducted in these studies, and the studies found in websites and review updates allowed to identify another 206 articles based on their title and abstract, which then underwent full text examination. After examining 287 full texts, 50 studies were included (Figure 1). The list of studies included and the data supporting the findings of this review are openly available in FigShare (https://figshare.com/s/6a67d34dcda1ef04bb77).

Characteristics of Sources of Evidence

Regarding the timing of the selected articles, their years of publication ranged between 1990 and 2021 (Figure 2).

In the first decade of this period, four articles (8%) written in English were identified, all produced in the USA (Case-Smith, 2013; Kemmis & Dunn, 1996; Kiendl et al., 1997; Oliver, 1990). In the second decade, 10 articles (20%) written in English and conducted primarily in the US were identified. However, two of these articles were conducted in Israel (Gophna, 2009; Ratzon et al., 2009), one in Australia (Zwicker & Hadwin, 2009), one in South Africa (Van Niekerk, 2007), and one in Canada (Leew, 2001). In the decade between 2010 and 2020, the number of articles increased to 36 including one study in 2021 (72%), all written in English except for one written in Portuguese (Barba & Minatel, 2013). Most of these studies were also conducted in the USA. However, four were developed in Australia (Challita et al., 2017; Mills & Chapparo, 2017; Mills et al., 2021; Richmond et al., 2014), and further four in
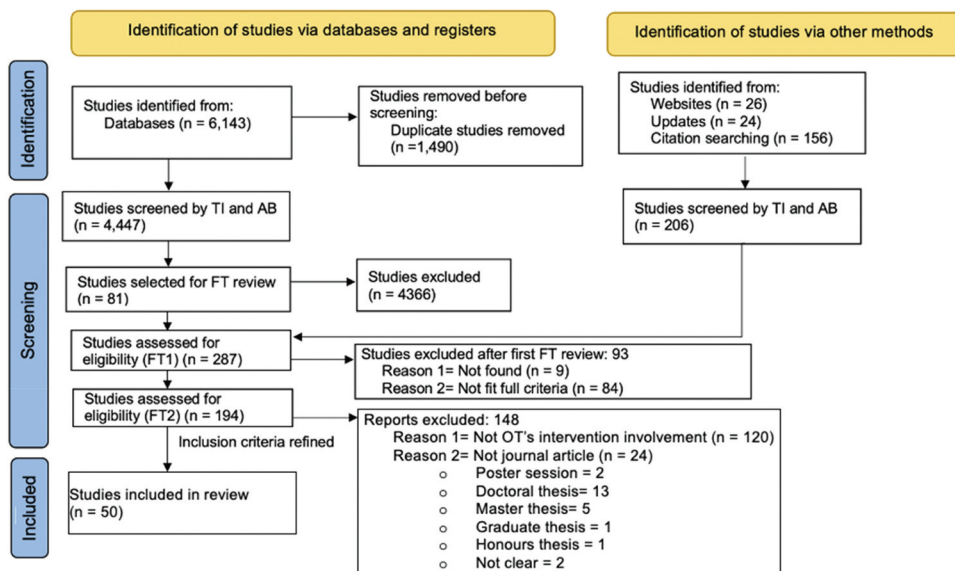
Figure 1. PRISMA Flow Diagram depicting the selection process of the Scoping Review. Diagram adapted from Page et al. (2021).
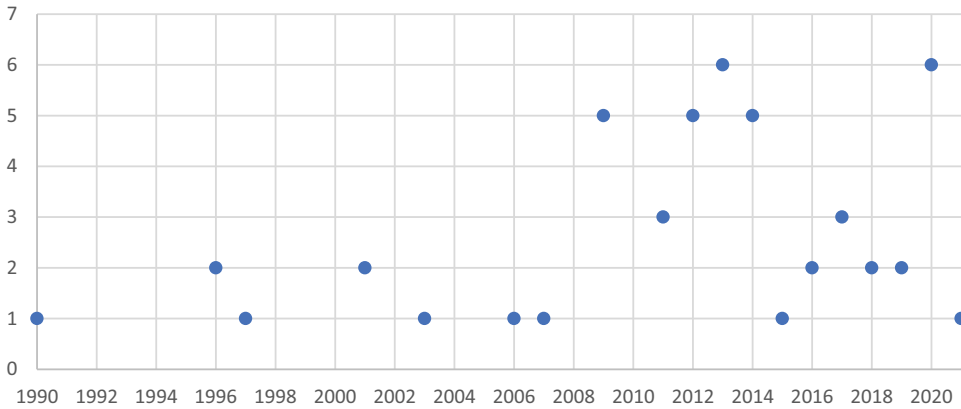
Figure 2. Publication Dates of Studies included.
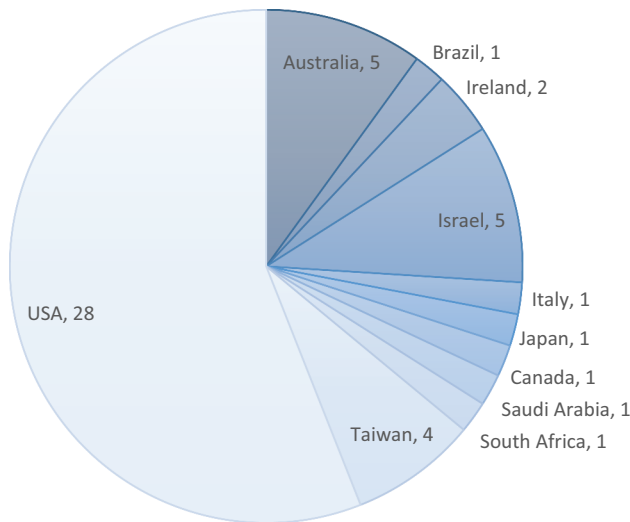
Figure 3. Countries in which the Studies were conducted (N/S= Not specified).

Taiwan (Chang & Yu, 2013b, 2014;, 2017; Lin et al., 2012). Three were conducted in Israel (Golos et al., 2011; Selanikyo et al., 2017, 2018) and two in Ireland (MacCobb et al., 2014; undefined). The rest were conducted in diverse countries, as illustrated in Figure 3.

Methodology Designs

The most common design was pre-post tests ($n = 33$; 66%), which were implemented by various means, including quasi-experimental and non-equivalent pre-post tests with randomized, semi-randomized and non-randomized samples. A further seven studies used case series designs (14%) and two were case studies (4%) (Barba & Minatel, 2013; Benson et al., 2019, 2020; Cox et al., 2009; Kemmis & Dunn, 1996; MacCobb et al., 2014; undefined; Van Niekerk, 2007; Vandenberg, 2001). A further four conducted a randomized controlled

trial (RCT) (8%) (Chang & Yu, 2013b, 2014, 2017; Zwicker & Hadwin, 2009), and one was defined as a static group comparison (D. K. Donica et al., 2013). Three studies either did not specify the design or were defined as a qualitative description (Gophna, 2009; Kiendl et al., 1997; Leew, 2001).

All these studies were conducted in schools ranging from preschool, primary, and secondary, although most commonly in preschool and primary. Schools were in rural, suburban, and urban areas and were governed by public and private organizations. One was an international school (Alhusaini et al., 2016) and another was a virtual school where students attended remotely (Criss, 2013). As for the type of education provided, most of the studies do not specify this, although special schools were specified in five of the pre-posttest (Koenig et al., 2012; Mills & Chapparo, 2017; Mills et al., 2021; Selanikyo et al., 2017, 2018). Special schools were also identified in three other studies: in a RCT (Chang & Yu, 2017), in a case study (Van Niekerk, 2007), and in a qualitative description (Gophna, 2009).

Participants

Students' ages in the research covered in this analysis should have ranged from three to 16 years of age based on the eligibility criteria, but in two studies, students were up to 20 years (Selanikyo et al., 2017, 2018). Because the data supplied was judged useful, this research were not excluded. Generally, the students who took part in these studies were mostly between the ages of five to eight, and most studies included both males and females. Only males were involved in three studies (6%) (Benson et al., 2020; Golos et al., 2011; Van Niekerk, 2007), while the sex of the students was not explicitly indicated in another six (12%). All these students were described as having various difficulties, although students without difficulties were also included. The most frequent difficulty was related to handwriting, followed by fine motor and visuomotor difficulties. Autistic Spectrum Disorder (ASD) was the most common diagnosis, and Attention Deficit Hyperactive Disorder (ADHD) was also regularly reported. Sensory modulation problems, behavior problems, Down Syndrome, developmental delays and learning problems were also named.

OTs not only delivered the interventions but were also considered participants in eight studies (16%) (Barba & Minatel, 2013; Bazyk et al., 2018; Kemmis & Dunn, 1996; Ohl et al., 2013; Pierce et al., 2020; Schneck et al., 2013; Selanikyo et al., 2017, 2018). Teachers were considered participants in 11 studies (Barba & Minatel, 2013; Bazyk et al., 2018; Golos et al., 2011; Kemmis & Dunn, 1996; MacCobb et al., 2014; Mills et al., 2021; Alisha; Ohl et al., 2013; Schneck et al., 2013; Selanikyo et al., 2017, 2018; Yamaguchi et al., 2020). And others, such as OT assistants and monitors also participated in a fewer number of studies.

Synthesis of Results

Studies and OT Outcome

Table 2 shows the studies included in this review depending on the OT outcomes addressed in them. Some of the studies are repeated as they addressed more than one group of outcomes. Of the 50 studies included, 32 were focused on improving school performance, with the majority focused on handwriting and motor and visuomotor skills, and a few on performance skills as a whole, on social skills and on task performance. Most of these

Table 2. Studies categorized by OT Outcomes.

Reference	Aims	Outcome measures
School performance		
Alhusaini et al. (2016)	Evaluate the additive effects of sensorimotor interventions on the child's handwriting	MHA. Handwriting Proficiency Screening Questionnaire
Bazyk et al. (2009)	Document and describe integrated OT services and measure fine motor and emergent literacy outcomes	PDMS −2. VMI. Five small pegs from a nine-hole pegboard (Case-Smith, 2013). Developmental sequence. OSELA (Clay, 1993). Approximations to Text (Pappas, 1993)
Case-Smith et al. (2011)	Develop and pilot an integrated handwriting program Write Start	ETCH – M. MHA (Reisman, 1993, 1999)
Case-Smith et al. (2012)	Evaluate the effects of the Write Start program	ETCH – M (Amundson, 1995). WJ-III (McGrew et al., 2007)
Case-Smith, Weaver, et al. (2021)	Compare Write Start with a standard handwriting program	ETCH M (Amundson, 1995). WJ-III (Woodcock et al., 2001)
Case-Smith, Holland, et al. (2014)	Examine the effectiveness of Write Start program	ETCH – M
Case-Smith (2013)	Research the degree and type of change in fine motor skills and functional performance	Motor Accuracy Test of the Southern California Sensory Integration Test. Five small pegs and a nine-hole pegboard
Challita et al. (2017)	Investigate the impact of a playground social skills program	GAS. PRPP
Chang and Yu (2013b)	Test how advanced digital technology enables a more effective training on handwriting	The elementary reading and writing test. Computerized handwriting movement analysis
Chang & Yu, 2014	Compare a computer-assisted feedback training with the traditional sensorimotor program of handwriting	The elementary reading and writing test. Computerized handwriting movement analysis
Chang and Yu (2017)	Investigate whether a program addressing visual – perceptual and haptic – perceptual skills can improve handwriting performance	TVPS −3. TPT. BCBL
Criss (2013)	Discus the use of telerehabilitation in the areas of fine motor and/or visual motor skills that impact handwriting	The Print Tool™
Dankert et al. (2003)	Evaluate the assumption that OT provision will significantly improve visual-motor skills	VMI
Denton et al. (2006)	Investigate the effectiveness of two different handwriting intervention approaches	THS. DVTP −2. TMP. IHM
Golos et al. (2011)	Evaluate the efficacy of a multidisciplinary and multimodal early intervention program in improving children's performance skills and participation	VMI. MABC. MAP. SPO
Gophna (2009)	Present an intervention program to improve prewriting skills and performance skills necessary for writing	VMI-Revised, VPT-Revised
Howe et al. (2013)	Examine the effectiveness of two approaches used to improve children's handwriting	MHA. VMI
Mills et al. (2021)	Evaluate a classroom-based SAS and its impact on cognitive strategy use (behaviour?) could be participation instead?	PRPP
Mills and Chapparo (2017)	Determine the impact of a classroom SAS on cognitive strategy use during task performance	PRPP
Ohl et al. (2013)	Examine the efficacy of a Tier 1 RtI program to improve fine motor and visual – motor skills	BOT 2. VMI . Developmental Scale of Pencil and Crayon Grips
Oliver (1990)	Describe and pilot a writing readiness program to teach writing readiness skills	VMI
Pfeiffer et al. (2015)	Determine whether SMHP is effective in improving handwriting legibility	THS-Revised. MHA
Ratzon et al. (2009)	Evaluate the efficacy of various short term service delivery methods on the visual-motor skills	VMI (Beery & Buktenica, 1997). DTVP-2 (Hammill et al., 1993)

(Continued)

Table 2. (Continued).

Reference	Aims	Outcome measures
Richmond et al. (2014)	Determine if the ABSS is an effective therapy tool in developing bilateral and spatial skills	VMI. SASP. SFA. Fine-motor speed was measured by the children's speed of placing pegs in a board
Schneck et al. (2013)	Investigate the effectiveness of HWT when delivered through a consultative model	MHA
Taras et al. (2011)	Evaluate the effectiveness of the Write Direction handwriting skill development program implemented as a part of the general curriculum	Routine district-level functional measurement tool (own creation)
Taverna et al. (2020)	Examine the effectiveness of activities and games to stimulate and improve visual-motor integration and manual dexterity skills	VMI. MABC-2
Vandenberg (2001)	Measure on-task behaviors while wearing a weighted vest in classroom fine motor activities	N/A
Zwicker and Hadwin (2009)	Compare the effectiveness of cognitive versus multisensory interventions in improving handwriting legibility	ETCH
Donica et al. (2013)	Determine if students educated in the classroom using the HWT curriculum would demonstrate better handwriting skills	THS-Revised
Zylstra and Pfeiffer (2016)	Examine the effectiveness of an occupational therapist – led handwriting intervention	THS – Revised. North Dakota Title I Kindergarten Reading Standards Assessment
Arnaud and Gutman (2020)	Assess the effectiveness of an occupational therapy reading program that targeted foundational reading skills and reading participation	BAS. DIBELS. DSWL. TOWRE. ROHQ (authors' creation)
School participation		
Benson et al. (2020)	Explore sensorimotor strategies embedded in the classroom on attention and in-seat behaviors	N/A
Benson et al. (2019)	Determine the effects of alternate seating on increasing the attention and in-seat behaviors	N/A
Cox et al. (2009)	Evaluate the impact of weighted vests on the amount of time engaged in appropriate in seat behaviors	N/A
Golos et al. (2011)	Evaluate the efficacy of a multidisciplinary and multimodal early intervention program in improving children's performance skills and participation	VMI. M – ABC. MAP. SPO
Lin et al. (2012)	Determine how sensory processing strategies in the curriculum could reduce excessive activity levels	Test of Sensory Integration Function: User's Manual. The Actical® physical activity monitor (Mini Mitter Company, Bend, OR)
MacCobb et al. (2014)	Report on the first phase of a pilot alert program on self-management of behavior	Questionnaire for teachers and students (own creation)
undefined	Support learning and school participation for students with significant challenging behaviors	N/A
Selanikyo et al. (2018)	Corroborate the effectiveness of Co-PID for enhancing participation in classroom-related activities	SOSPiC (Selanikyo et al., 2017). SFA. GAS
Selanikyo et al. (2017)	Investigate the effectiveness of the Co-PID for enhancing participation	SOSPiC
Kiendl et al. (1997)	Describe a project which provided art and assistive technology for children with disabilities in inclusive settings, primarily schools.	N/A
Leew (2001)	Describe a short-term program (Passport to Learning) that address difficulties with organization and task completion	N/A
Koenig et al. (2012)	Examine the effect of the GRTL program among children with ASD on decreasing maladaptive behaviors	ABC – Community to assess challenging behavior. VABS – II
Arnaud and Gutman (2020)	Assess the effectiveness of an occupational therapy reading program that targeted foundational reading skills and reading participation	BAS (Fountas & Pinnell, 2017). DIBELS (Good, Kaminski, Simmons, & Kame'enui, 2001). DSWL (Dolch, 1936). TOWRE (Torgesen, Wagner, & Rashotte, 2012). ROHQ (authors' creation)

(*Continued*)

Table 2. (Continued).

Reference	Aims	Outcome measures
Barba & Minatel (2013)	Report the experience of OTs based on the theoretical reference of Collaborative Consulting	N/A
Kemmis and Dunn (1996)	Explore the success of collaborative intervention and therapist-teacher consultation choices	N/A
Yamaguchi et al. (2020)	Examine the effect of collaborative consultation with teachers using iPad application for goal setting	COPM. GAS
Health and wellness		
Bazyk et al. (2018)	Evaluate the meaning and impact of the Comfortable Cafeteria program	VAS
Van Niekerk (2007)	Report on a unique career exploration program	N/A
Onwumere et al. (2020)	Examine the effectiveness of the Independence Curriculum intervention	GAS. VABS-II. American Institute for Research Self-determination Scale. Middle School Checklist
Pierce et al. (2020)	Examine the effectiveness of OT transition readiness services	SIB-Revised. Arc's Self-determination Scale

Notes: N/A= Not Applicable; MHA= *Minnesota Handwriting Assessment; PDMS= Peabody Developmental Motor Scale; VMI= Visual-Motor Integration; OSELA= Observation Survey Early Literacy Achievement; ETCH – M= Evaluation Tool Children Handwriting Manuscript; WJ-III= Woodcock-Johnson; PEDI= Pediatric Evaluation Disability Inventory; GAS= Goal Attainment Scaling; PRPP= Perceive Recall Plan Perform; TVPS= Test Visual Perceptual Skills; BCBL= Battery Chinese Basic Literacy; THS= Test Handwriting Skills; DVTP= Developmental Test Visual Perception; TMP= Test Manual Pointing; IHM= In-hand Manipulation; MABC= Movement Assessment Battery Children; MAP= Miller Assessment Pre-schoolers; SPO= Structured Preschool Observation; VPT= Visual Perception Test; BOT= Bruininks Oseretsky Test of Motor Proficiency; SFA= School Function Assessment; SOSPiC= Structured Observations of Students' Participation in Classroom; VAS= Visual Analogue Scale; VABS= Vineland Adaptive Behavior Scale; SIB= Scale of Independent Behavior; COPM= Canadian Occupational Performance Measure; ABC= Aberrant Behavior Checklist; BAS= Benchmark Assessment System; DIBELS= Dynamic Indicators of Basic Early Literacy Skills; DSWL= Dolch Sight Word List; TOWRE= Test of Word Reading Efficiency; ROHQ= Reading Occupations and Habits Questionnaire..*

studies used a mix of assessment tools to measure outcomes, including the Minnesota Handwriting Assessment, the Evaluation Tool Children Handwriting Manuscript and the Visual-Motor Integration test.

The studies focused on participation were 16, mainly designed to improve students' attention and behavior, and balance their activity levels to participate in school activities. A few were focused on art and assistive technology to increase participation or collaborative consultation, and on adaptation of the physical environment. In eight of these studies tools to measure outcomes were mentioned, including the School Function Assessment, the Vineland Adaptive Behavior Scale and the Scale of Independent Behavior.

Four other studies addressed health and well-being outcomes, primarily related to mental health, psychological adjustment and self-esteem, independence, and transition, with three of these studies mentioning the use of outcome measure tools. These tools included Visual Analogue Scale and the Goal Attainment Scaling to measure how objectives were reached.

Interventions and Tiers of Support

Among the included studies, 48 interventions were examined (Table 3). Twenty-eight interventions used occupations or activities as intervention strategies, mostly focused on handwriting and visual and fine motor skills. Eight were universal interventions, ten were

focalized, five were intense, and three crossed T2 and T3. Another 11 interventions employed occupation-supporting methods and tasks. The majority were self-regulation interventions largely focused on student behavior, with the remainder utilizing assistive technology and environmental adjustments. Four of these interventions were universal, three were targeted, one was intense, and three spanned multiple tiers.

Four interventions focused on collaborative consultation and mental health through education and training. Two of these interventions were universal, one was targeted, and the third covered both T2 and T3. Two others were advocacy interventions aimed at empowering students to seek help as they transitioned from school to work. The first was a universal intervention, whereas the second was in line with T2 and T3. Two group interventions addressed behavior and social participation; one was a focalized intervention, while the other addressed T2 and T3. Another was a virtual intense intervention centered on handwriting.

T1 interventions ($n = 16$) focused primarily on handwriting, fine and visual motor skills. Its components included integrated strategies, capacity building, a whole-class approach, and curricular activities. The processes were distinguished by education, training, and monitoring strategies, using common school materials. These interventions were delivered by OTs, but teachers were also highly involved. They were carried out in large or small groups, mainly in classrooms, over a period of 4–12 weeks, with 30–45-minute sessions planned once or twice a week.

Interventions classified in T2 ($n = 24$) also focused primarily on handwriting and visual and motor skills, but student behavior was also targeted. Remedial and compensatory approaches, and teamwork were part of their main components. Materials such as handwriting books, worksheets, and sensory resources were used. Their procedures included meetings, monitoring and modeling strategies, group activities, fostering teacher-led strategies, and providing ongoing feedback. OTs provided all these interventions, but teachers implemented one with the close supervision of the school OT. Interventions were conducted face-to-face mainly in small groups, but also in class groups and individually, delivered inside and outside classrooms, lasting 5–10 weeks, and with 10–12 sessions of 30–45 minutes once or twice a week.

T3 interventions ($n = 16$) primarily focused on handwriting and visual motor skills, but behavior was also a common focus, with sensorimotor interventions standing out. Individualized strategies and remedial programs were part of their foundation. Their materials were largely unreported, but handwriting books and weighted vests were indicated. Procedures included direct student-centered activities, individualized instructions, modeling and copying strategies, and the use of protocols. OTs provided these interventions, but OT students, experienced trainers, and teachers also participated. They were carried out face-to-face, except one that was virtual. All were individual interventions, but sometimes pairs of students or small groups were involved. The most common location was outside the classroom, although those related to behavior occurred inside. They commonly lasted 5–12 weeks, with sessions of 30–45 minutes once a week.

In almost all these interventions, a flexible approach of implementation was followed to respond to specific characteristics and needs. However, how these processes were developed was not described, so this item of the TIDiER Checklist was not considered. The same criterion was applied to the modification of interventions and their intensity.

Table 3. Interventions classified by types and tiers of support.

Focus	Name	Studies	T1	T2	T3
Occupations and activities: Designed to address the underlying needs of the person's mind, body, and spirit, considering activity demands and person factors.					
Handwriting	Write Start program	Case-Smith et al. (2011); Case-Smith et al. (2012); Case-Smith, Weaver, et al. (2021); Case-Smith, Holland, et al. (2014)	X		
	Size Matters program	Pfeiffer et al. (2015); Zylstra and Pfeiffer (2016)	X		
	Handwriting Without Tears (HWT)	Schneck et al. (2013); Donica et al. (2013)	X		
	Write Direction program	Taras et al. (2011)	X		
	Handwriting club	Howe et al. (2013)		X	
	Sensory-motor intervention	Alhusaini et al. (2016)			
	Cognitive and multisensory handwriting	Zwicker and Hadwin (2009)			X
	Visual-motor integration skills and fine motor skills	Taverna et al. (2020)	X		
	Sensorimotor groups	Denton et al. (2006)		X	
	Therapeutic practice			X	
	Visual – perceptual and visual – motor integration training	Chang and Yu (2017)		X	X
	Computer assisted instruction	Chang and Yu (2013b); Chang & Yu, 2014			X
	Sensory-motor intervention			X	
	Prewriting intervention program	Gophna (2009)		X	
	Writing readiness skills-Direct Treatment	Oliver (1990)			X
	Writing readiness skills-Supplementary program				X
Fine motor skills	Integrated OT services for fine motor and emergent literacy	Bazyk et al. (2009)	X		
	Fine motor skills	Case-Smith (2013)	X		
Visual motor skills	Anker Bilateral Spatial System's-ABSS	Richmond et al. (2014)		X	
	Specialized Teaching and Enhancement of Performance Skills for Kindergarteners STEPS – K	Ohl et al. (2013)	X		
	Visual-motor direct treatment	Ratzon et al. (2009)		X	
	Collaborative consultation treatment				X
	Combined treatment			X	X
	Visual-motor performance and academic success	Dankert et al. (2003)		X	X
	Visual and haptic – perceptual training	Chang and Yu (2017)			X
Process skills	Independence curriculum	Onwumere et al. (2020)		X	
Reading skills	Passport to Learning	Leew (2001)		X	
	Occupational therapy reading program	Arnaud and Gutman (2020)		X	
Interventions to Support Occupations: Methods and tasks that prepare the person for occupational performance are used as part of a treatment session in preparation for or concurrently with occupations and activities.					
Assistive technology and environmental modifications: Assessment, selection, provision, and training in use of high and low-tech assistive technology; application of universal design principles; and recommendations for changes to the environment or activity					
Collaborative consultation	Aid for Decision-making in Occupation Choice for School- ADOC-S	Yamaguchi et al. (2020)	X		
Participation	Empowered to Scribble	Kiendl et al. (1997)	X		
	Collaborative Consultation for Participation Students with Intellectual Disability- Co-PID	Selanikyo et al. (2017); Selanikyo et al., 2018		X	
Self-regulation: Actions the practitioner performs to target specific person factors. Intervention approaches may address sensory processing or work or leisure activities or executive functioning.					

(*Continued*)

Table 3. (Continued).

Focus	Name	Studies	T1	T2	T3
			Tiers of support		
Behavior	Alert program	MacCobb et al. (2014)	X		
	Get Ready to Learn (GRTL)	Koenig et al. (2012)	X		
	Sensory motor intervention and attention levels	Benson et al. (2020)	X	X	
	Alternate seating and attention levels	Benson et al. (2019)		X	
	Sensory processing strategies and activity levels	Lin et al. (2012)		X	
	Weighted vests	Vandenberg (2001); Cox et al. (2009)		X	X
	Noncontingent Reinforcement	Cox et al. (2009)		X	X
	Sensory Activity Schedule	Mills and Chapparo (2017)			X
Education and training: Imparting of knowledge and information to enable the person to acquire helpful behaviors, habits, and routines. Facilitation of the acquisition of concrete skills for meeting specific goals.					
Collaborative consultation	Multidisciplinary early intervention program	Golos et al. (2011)	X		
	An OT procedure proposal	Barba & Minatel (2013)		X	X
	Remedial and compensatory interventions in school	Kemmis and Dunn (1996)		X	
Mental Health	Comfortable cafeteria	Bazyk et al. (2018)	X		
Advocacy: Efforts directed toward promoting occupational justice and empowering persons to seek and obtain resources.					
Transition	Career exploration program	Van Niekerk (2007)	X		
	Ohio Occupational Therapy Transition Outcomes- OTTO	Pierce et al. (2020)		X	X
Group interventions: Use of distinct knowledge of the dynamics of group and social interaction and leadership techniques to facilitate learning and skill acquisition across the lifespan.					
Behavior/social participation	Group work and collaboration	undefined		X	X
	Perceive Recall Plan Perform PRPP (Mystery Club)	Challita et al. (2017)		X	
Virtual interventions: Use of simulated, real-time, and near-time technologies for service delivery absent of physical contact, such as telehealth or mHealth.					
Handwriting	Telerehabilitation technologies	Criss (2013)			X

Discussion

We identified 50 studies published between 1990 to 2021, the majority of which were published in the previous decade, demonstrating increasing and sustained interest in conducting studies based on school interventions delivered by OTs. These studies also show an interest in conducting research in different school environments and with a broad student population, although there was a propensity to concentrate on students between the ages of five and eight who frequently had fine motor problems or behavioral issues, particularly with handwriting. The inclusion of students with ASD, ADHD, and sensory modulation issues was also common.

The trends regarding the students included in these studies aligns with claims that OT services in schools are restricted to certain difficulties and to specific groups of students (Bolton & Plattner, 2019; Jasmin et al., 2019; Maia et al., 2016; O'Donoghue et al., 2021). Students with other types of challenges, such as those with physical or mental health conditions were, in fact, underrepresented in the studies examined here. These tendencies align with what we identified regarding OT outcomes as the studies were mainly limited to addressing school performance outcomes and aiming to improve or enhance performance skills. This finding supports what other academics have observed regarding the constrained

application of OT in schools (Beck et al., 2006; Rodrigues & Seruya, 2019; Spencer et al., 2006).

Although the AOTA practice framework states that addressing one outcome has an impact on the others, a trend toward the academic realm is shown by focusing primarily on performance skills. As evidenced by the dearth of studies concentrating on other areas, this trend may lead to a lack of understanding of interventions carried out in other domains, notably those aimed at non-academic activities, health, and well-being. Ignoring these areas does not reflect the biopsychosocial perspective of the OT profession. Indeed, this review's findings imply that the research conducted so far has not fully delved into the origins of the OT profession in fields like universal access and mental health, missing out on chances to deepen our understanding of this practice.

Despite the foregoing, the propensity to employ occupations and activities as interventions is compatible with the nature of the OT profession and implies that school settings support the use of occupations as guiding factors. This is consistent with the research by Benson (2013) which shown that interacting with students in their natural environment provided chances to address issues they could be having in the schools. However, as we found in our study, these possibilities might be diminished if research is primarily focused on focalized or intense interventions. Indeed, although the research examined here evaluated interventions at the universal, focalized, and intense tiers, focalized interventions were the most prevalent. This implies that there is still a tendency on interventions given to certain student groups, despite a movement over time toward looking at universal interventions, which reflects growing interest on research at this tier.

There were, however, a few studies that looked at various sorts of interventions, such as assistive technology strategies, environmental modifications, and teaching and training. When examined from a multi-tiered viewpoint, this situation may create issues because RtI models, such as the P4C model, emphasize the importance of factors such as knowledge sharing and capacity building, which are typically involved in these types of interventions. However, teachers were involved in several of the interventions assessed throughout the three tiers, particularly in T1 and T2, with some interventions performed collaboratively. This implies that while assessing types of interventions from an OT perspective, focus should be placed primarily on their specific components. This gives a duty on researchers to provide all pertinent details regarding the interventions being examined, which we found to be absent in some studies.

Moreover, distinguishing between the several tiers of support was challenging because the intervention components at each tier were similar, particularly in terms of timeframe. In effect, interventions at the three tiers were made up of a similar number of weeks, with sessions that were nearly equivalent in terms of schedule and length. Because of these similarities, OT practitioners may have difficulty distinguishing between, say, focalized and universal interventions. They may also struggle to differentiate SBOT from regular clinical practice, which has been considered critical for the growth of the SBOT practice (Bolton & Plattner, 2019; Silverman & Bourke-Taylor, 2009; Spencer et al., 2006). Nonetheless, these similarities may also lead to OTs realizing that universal interventions may not require large modifications to what they now provide, and they might explore giving support across all tiers of support. This notion, however, should be investigated and empirically tested.

Since studies are vulnerable to research and publication bias and this review only looked at what was available, one worry with the review's findings is that the proportion of studies classified at each tier may differ from what occurs in practice. In addition, although our results suggest that researchers have been interested in conducting studies that acknowledge multi-tier models, it appears that this knowledge has not been transferred to practitioners, as evidence suggests that they primarily offer interventions one at a time outside of the classroom (T3) (Bolton & Plattner, 2019; Maia et al., 2016; O'Donoghue et al., 2021; Rodrigues & Seruya, 2019; Salazar Rivera & Boyle, 2020; Spencer et al., 2006; Watt et al., 2021).

This review, thus, reveals a potential weakness in the relationship between research and practice, emphasizing the importance of including OT practitioners in research projects as one method to alter praxis (Coburn & Penuel, 2016; DiBona et al., 2017; Wentworth et al., 2017). Additionally, it demonstrates the urgent need to expand OTs' opportunities for action, strengthen their roles in all learning processes and school-related activities, and reflect this in research. Also, there is a need to advance the move toward universal support by fostering a better knowledge of OT support within educational communities and OT practitioners. The data presented in this review, therefore, enables reflection on these concerns with reference to both the function of research and the requirement for SBOTs to reflect in their services.

The methodological characteristics of the papers included are another pertinent finding of this review that may be helpful for the reflection of OT practitioners in school interventions. They included a range of research designs, although pre-posttest designs proved to be most prevalent. Although these techniques might restrict the development of generalizations and theories, they offer insights to SBOTs who insist that the research be in line with the realities of their own practice (Bolton & Plattner, 2019; Silverman & Bourke-Taylor, 2009; Spencer et al., 2006). Due to the complexity of working in schools, and the unique challenges that researchers encounter, this tendency emphasizes the importance of considering the characteristics of school settings within the OT profession and among the research community.

Within the same idea, it is important to consider the many studies that were excluded from this review since OTs were not engaged in the delivery of the interventions. The OT profession, in especially its school practice, requires ongoing modifications at many levels to meet the requirements of teams and schools as well as those of students (Bissell & Cermak, 2015; Garfinkel & Seruya, 2018; Stephenson, 2019). Research participation by OTs may be essential for these changes to occur (Coburn & Penuel, 2016; Wentworth et al., 2017). Moreover, the absence of OT participation in the research has been cited as one of the weaknesses of other reviews (Grajo et al., 2020). This suggests an effort on the part of the educational system and the wider OT profession to consider the involvement of practitioners that work in real-world settings, like schools, in research. This would be in line with numerous of the World Federation of OT's international research priorities, including professional OT concerns (WFOT, 2016).

The fact that most of the studies under consideration were conducted in the USA raises further pertinent questions because it suggests that our findings may more accurately reflect the characteristics of research in this country than in others. Previous systematic reviews have not given attention to study's locations (Eddy et al., 2019; Engel et al., 2018; Grajo et al.,

2020). Yet, by analyzing international research on schools and OT, De Oliveira Borba et al. (2020) recognized this as a cause for worry as well. This is significant since contexts, educational programs, and practice restrictions vary throughout nations. As a result, additional research from other contexts is required so that SBOTs can reflect considering research that more closely mirrors their realities. In our review, one study came from South America, for instance, which highlights the necessity for this region to create knowledge that takes practitioners in SBOT into account. This holds true for other parts of the world as well.

Limitations

A topic-specific database (OTDbase) was not used due to funding restrictions, which could influence the studies we identified in this review. Not all TIDiER Checklist items were used if data were not reported in the included studies, which suggests a failure among some researchers in reporting all the elements of the evaluated interventions. Additionally, it was challenging to classify the interventions by tiers, which reflects the dynamics in which these tiers operate. However, caution should be exercised when considering them. Furthermore, as this review focused on scientific journals, there may be interventions published in the gray literature that were not considered.

Conclusion and Implications

This scoping review identified 50 studies on school-based interventions delivered by OTs, using a systematic methodological approach. It also identified the outcomes targeted from an OT perspective, which interventions were evaluated, how they were designed, and the tiers of support. SBOTs could use this information when reflecting on current claims regarding their support, and researchers when planning projects involving OTs. This is because the review raises concerns regarding trends in research to focus primarily on school performance and the academic domain, and on focalized and intense interventions.

Future research could incorporate gray literature, particularly doctoral and master's theses, as they might provide richer information that could strengthen the understanding of how OT practitioners have been involved in research. Future research could also go more extensively into the methods employed for collaboration between OT practitioners and other members of educational communities, a critical aspect that demands a deeper knowledge for its implementation. It may be also interesting to explore whether and to what extent national and local policies and other contextual factors influence SBOT practice and research participation. Evidence of the effectiveness of the full range of interventions and domains in which OTs are involved in school settings is also crucial. This would provide more accurately information for OTs to reflect on their practices, enabling them to make evidence-based decisions, a fundamental element for the school practice.

Author Contribution

Nouf Alsaadi (NA) contributed to the screening process of titles and abstracts, selecting sources, and the corroboration of data extracted.

Eliana Parra (EP) contributed to corroborating the selected sources when the selection criteria were refined.

Christopher Morris (CM) and Christopher Boyle (CB) provided methodological support throughout the project.

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Appendix 1: Medline search strategy

(1) (((school* or class*) adj3 (regular or mainstream or special*)) or "school base*").ti,ab. (20035)
(2) Schools/(36899)
(3) (education* adj3 (integrat* or inclusiv* or special*)).ti,ab. (9542)
(4) 4 1 or 2 or 3 (61250)
(5) ("occupational therap*" or OT).ti,ab. (26735)
(6) Occupational Therapy/(13018)
(7) School Health Services/(16946)
(8) Rehabilitation/(18083)
(9) 9 5 or 6 or 7 or 8 (66775)
(10) (disabil* or difficult* or "developmental disease" or disorder* or "disabled child*" or "at risk").ti,ab. (1933851)
(11) (("SEN" or "special* or additional*") adj2 (need* or support*)).ti,ab. (65)
(12) 12 10 or 11 (1933881)
(13) 13 4 and 9 and 12 (876)
(14) limit 13 to yr="1975 -Current" (869)

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