Occupational Therapy Handwriting Practice in South Korea

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STATEMENT OF AUTHENTICATION

I, Siwon Lee, hereby declare that this submission is my own work and contains no material previously published or written by another person except, where acknowledged in the text. This thesis does not contain material which has been accepted for the award of another degree.

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Date: 4/2/2019

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THESIS ABSTRACT

Background. Internationally, handwriting difficulty is a common issue among children. Occupational therapists are involved in helping children to improve their handwriting. Previous studies have summarised occupational therapy research and practice in handwriting, but these have not included information about occupational therapy practice for children's handwriting in South Korea. To understand the nature of practice and identify the scope of evidence relating to South Korean occupational therapy for children with handwriting difficulties, a review of published literature on this topic is required.

Methods. A scoping review was conducted to identify and summarize published literature on occupational therapy paediatric handwriting practice in South Korea. A detailed context of the review was provided in a background chapter (Chapter 1 "Introduction"). The introduction provided comprehensive information about the hand, handwriting, South Korea and the occupational therapy profession in South Korea to define terms and to help provide an understanding of occupational therapy practice conducted in Korea.

- Chapter 2 "A scoping review of occupational therapy handwriting literature" is presented in the form of a manuscript for submission to a peer-reviewed journal (*Occupational Therapy International*). This background, the gap in evidence and research design used is presented. This study used a scoping review methodological framework suggested by Arksey and O'Malley (2005). This five-step framework was followed. First, the research question was identified; second, a search strategy was designed in Korean and English, and implemented in three databases which published or may have published Korean occupational therapy research. Third, after inspection a total of 22 articles were selected for inclusion from 151 sources. Fourth, a data-extraction form in Excel™ was created and this recorded the characteristics of each of these studies. At the last stage, a descriptive analysis of numerical data and thematic analysis were used to collate, summarise and synthesise the data from the 22 included papers.

Results. Key findings of the scoping review demonstrate that hospitals and school-based settings were the most commonly studied service sites. Most studies were with Korean children with cerebral palsy. Standardized assessments were predominantly used, and these measured various performance components, rather than the "task" or "activity" of handwriting. Author-designed handwriting assessments which were reported to be based on previous studies were frequently used for measurement of handwriting quality. These did not

go through standardisation or validation processes. A sensory integration approach was the most popular approach to intervention, and the most targeted performance component of handwriting was fine-motor skills. Most study designs were of low research rigour in the evidence-based hierarchy. This study highlights that there is a diverse approach to assessments and intervention in Korean occupational therapy handwriting research, indicating that there is no consensus on the best handwriting approach in Korean occupational therapy literature.

Conclusion. Most of the found evidence was focussed on clinical samples and used a sensory integrative approach. This is different to international occupational therapy research literature (which used standardised instruments) which focused mostly on typically developing children and used a wide number of conceptual approaches. Korean research was similar in the low level of research evidence generated. In the future, Korean occupational therapy handwriting research should use rigorous designs and should use assessments to accommodate the cultural and linguistic uniqueness of Korea. This will provide more opportunities to enhance the diversity of evidence on handwriting research.

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CHAPTER 1

INTRODUCTION

1.1 Introduction to Chapter

This chapter introduces the thesis study by providing background information on the hand and hand function, handwriting in children, factors affecting handwriting performance and handwriting related measurements.

Since this study investigates handwriting in Korea, introductory information will be provided as a background on: general information about the South Korean nation and official language; when and where handwriting is taught; and what happens when a child is identified to have a handwriting problem.

Since the study investigates occupational therapy handwriting practice in Korea, introductory information will also be provided as a background on: the occupational therapy profession in Korea and what is known about the scope and scale of occupational therapy handwriting practice in Korea. A gap in evidence will be demonstrated to show that to date no study has investigated what published research evidence is available on occupational therapy handwriting practice in Korea.

This thesis aims to fill that gap in evidence by conducting a scoping review. It will be the first scoping review of any field of occupational therapy practice in Korea. Chapter 1 provides the background to the scoping review.

1.2 The Hand

Hands are the most distal part of the upper limb of the human body. Using the function of the hand enables engagement in diverse activities that are meaningful to every single human being. People move their hands to perform tasks. A common task is handwriting; this is defined and described in Section 1.6 of this Chapter.

To understand how the hand is associated with handwriting performance, the International Classification of Functioning Disability and Health, known as ICF was used to frame the body part with task performance and participation in roles (such as student) that require use of the hand. The ICF is a taxonomy developed by the World Health Organisation to categorise aspects of health and wellbeing (World Health Organization [WHO], 2002). This ICF

taxonomy is arranged in domains. Definitions of each of these domains can be seen in Text Box 1 (WHO, 2002, p. 10).

Body Functions are physiological functions of body systems (including psychological functions).

Body Structures are anatomical parts of the body such as organs, limbs and their components.

Impairments are problems in body function or structure such as a significant deviation or loss.

Activity is the execution of a task or action by an individual.

Participation is involvement in a life situation.

Activity Limitations are difficulties an individual may have in executing activities.

Participation Restrictions are problems an individual may experience in involvement in life situations.

Environmental Factors make up the physical, socal and attitudinal environment in which people live and conduct their lives..

Text Box 1: Definitions of the ICF domains

Each domain in the ICF has a hierarchy of categories which are coded to enable precise identification regardless of language (WHO, 2001). An example of the hierarchy is given in Section 1.3 below. The terms and codes from the ICF are introduced and used in this thesis.

1.3 Anatomical Structure of the Typical Hand

The "Body Structures" part of the ICF names and describes "anatomical parts of the body such as organs, limbs and their components" (WHO, 2002). In the ICF, "Body Structures" is coded as 's' (WHO, 2001). Anything within this domain also has the prefix 's' (WHO, 2001).

The hand is in the body structures of "structures related to movement (code s7). It is labelled "structure of the hand" (code s7302). There are six categories in the structure of the hand: bones of hand; joints of hand and fingers; muscles of hand; ligaments and fasciae of hand; the structure of the hand specified; and then the structure of the hand unspecified. The structure of the hand will be outlined below, including nerves and skin as additional structures identified from the literature (Palastanga & Soames, 2012; Schreuders, Brandsma, & Stam, 2014).

1.3.1 Bones

The bones of the wrist and hand regions perform crucial functions such as providing support and attachment points for muscles and ligaments of the upper limb (Palastanga & Soames, 2012). It is categorised into three types: carpal, metacarpal, and phalangeal bones (Palastanga & Soames, 2012). The carpal bones are also known as “the carpus” altogether and features the bottom of the hand forming the wrist (Palastanga & Soames, 2012). These carpal bones are located in two rows, and each row consists of four individual bones: trapezium, scaphoid, lunate and pisiform in the proximal row and trapezoid, capitate, hamate, and triquetral in the distal row (Palastanga & Soames, 2012, pp. 48-49). The distal carpal rows are then connected to five long- and thin-shaped metacarpal bones that correspond to each of five digits (fingers) (Palastanga & Soames, 2012). The metacarpal bones represent the intermediate part of the hand, connecting carpal bones to phalangeal bones (Palastanga & Soames, 2012). However, this is not the case for the first finger (the thumb). Instead, it has proximal and distal phalangeal bones while the other four digits are divided into three parts called proximal, middle, and distal phalangeal bones (Palastanga & Soames, 2012).

1.3.2 Joints

To allow smooth and continuous motion of the hand, the wrist and hand regions also involve several small joints. Figure 1.2 shows examples of joints articulated by two or more bones in the wrist and hand. For the wrist, the main joints include: a radiocarpal joint (between carpal bones and the distal part of the forearm), a midcarpal joint (between two rows of the carpus), and intercarpal joints (between carpal bones) (Palastanga & Soames, 2012).

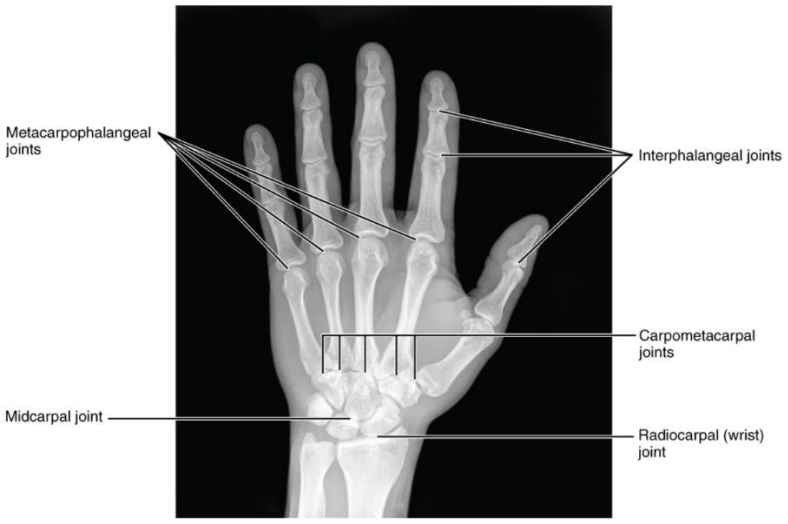


Figure 1: Radiograph of hand retrieved from https://commons.wikimedia.org/wiki/File:814_Radiograph_of_Hand.jpg#filelinks

On the other hand, the hand has other four types of the joints which exist between the carpal bones and the metacarpal bone of each digit or phalangeal bones with the metacarpal bone. This includes (Palastanga & Soames, 2012):

- Common/first carpometacarpal joints (between carpal bones and a metacarpal bone),
- Metacarpophalangeal (MCP) joint (between a metacarpal bone and a proximal phalangeal bone),
- Proximal interphalangeal (PIP) joint (between proximal and middle phalangeal bones),
- Distal interphalangeal (DIP) joint (between middle and distal phalangeal bones).

For the thumb, there is only one joint called an interphalangeal (IP) joint instead of two joints (i.e. PIP and DIP joints) (Palastanga & Soames, 2012). This feature of the thumb promotes mobility of the first carpometacarpal joint (Jones & Lederman, 2006a). When movements happen in the hand, these multiple joints allow the bones to slide over each other smoothly (Palastanga & Soames, 2012; Schreuders et al., 2014, p. 3).

1.3.3 Muscles

The muscles of the wrist and hand regions move the wrist and fingers for precise motor control of the hand. The major muscles of these regions are divided into intrinsic and extrinsic muscles, depending on whether there are attached only within the hand or both within and outside the hand (Palastanga & Soames, 2012). Intrinsic muscles which have all attachments within the hand are able to create a small range of motion in fingers, while extrinsic muscles can generate more power to move the entire hand (Drake, Vogl, & Mitchell, 2018; Palastanga & Soames, 2012). Like bones and joints, more than one muscle of the wrist and hand are responsible for the movement (Palastanga & Soames, 2012). This combination of the structure of the hand enables people to move one finger at a time, which is essential for functional hand movements such as grasping (Palastanga & Soames, 2012).

1.3.4 Ligaments

The ligaments and fasciae of the wrist and hand play an important role in stability during any hand movements. For the ligaments, it provides a strong connection between the small bones of the hand (Palastanga & Soames, 2012). This bond limits the range of joint movement in order to prevent excessive movements occurring at a joint while maintaining its structure (Jones & Lederman, 2006a; Palastanga & Soames, 2012). The ligaments are also connected with the fasciae, which encloses the muscles and tendons in the hand (Palastanga & Soames,

2012). A fascia is made of thin, fibrous tissue, and each fascia is a sheet that eventually stabilises every structure of the hand right under the skin. (Hurst, 2011, p. 270).

1.3.5 Nerves

The nerves provide motor or sensory innervations, supplying muscles and sensory receptors of the skin (Drake et al., 2018). There are three major nerves innervating the hand: the median, radial, and ulnar nerves (Drake et al., 2018; Palastanga & Soames, 2012). These nerves travel along the arm and forearm to finally enter the hand (Palastanga & Soames, 2012). The hand movements are then controlled by a network of nerve fibres (Drake et al., 2018), which collect and send the information about sensation to the brain (Tortora & Nielsen, 2017, p. 569). This enables the muscles to commence appropriate movements (Jones & Lederman, 2006b). Consequently, the nerves coordinate with the sensory receptors and adapt to changes in any types of sensation (e.g. joint position, touch or temperature) (Duff, 2005; Jones & Lederman, 2006b), which allows the upper extremity including the hand to adjust the movements more delicately and efficiently. If nerves of the hand are injured, this results in failure of receiving sufficient sensory input, causing decreased control in hand force and coordination (Duff, 2005).

1.3.6 Skin

The skin of the hand primarily protects all the above-mentioned structures that are situated underneath the skin. While there are multiple proprioceptive receptors in the joints and muscles of the hand, the skin covering the hand has rich receptors for touch sense (Pratt, 2011, Schreuders et al., 2014). These tactile sensory receptors have a function to recognise features of objects, such as identifying its shape (Pratt, 2011). Also, the palmar surface of the hand has thicker and less mobile skin than the dorsal surface (Pratt, 2011, Schreuders et al., 2014). It contains many lines, known as “creases” present in where joints of the hand and fingers meet in the hand (Schreuders et al., 2014). The major creases in the palm include one longitudinal crease and two transverse creases: longitudinal thenar crease, proximal digital crease and distal palmar crease (Schreuders et al., 2014). With the sensory function, these physical features of the palm and fingers make the hand capable of a folding motion easier and improve grasping (Park, Shin, Jung, & Chung, 2010; Pratt, 2011; Uygur, M., de Freitas, P., & Jaric, S., 2010).

1.3.7 The measurement of anatomical structures in hand

As noted above, the anatomical structure of the wrist and hand regions is complex. It contains 27 bones and more than 30 joints, muscles and ligaments (Palastanga & Soames, 2012), which works together for manipulative movements of the hand such as holding small objects (Palastanga & Soames, 2012).

Anthropometry is the measurement of dimensions of the human body in terms of bone, muscles and fat (Stack, Ostrom, & Wilhelmsen, 2016; Westat, Inc., 1988; WHO, 1995). There is an extensive body of literature about anthropometry primarily arising from work rehabilitation or ergonomic evidence relating to work (e.g., design of hand tools) (Nadadur & Parkinson, 2013; Pheasant, 1996). Various anthropometric data are also available across different countries including America, Japan and United Kingdom (de Onis & Habicht, 1996). However, the international data were generally anthropometric measures for human growth or health (e.g. obesity across the lifespan or malnutrition in children) (de Onis & Habicht, 1996; Mramba et al., 2017), which has often taken into account weight, height or arm. The hand was not included as a specific body part in both adult and child populations. This indicates that little attention was paid to the anthropometric norms of the hand.

In regard to the available information about the hand anthropometry, there is a study that measured hand circumference using male and female adult populations in United Stated Army (White, 1980). Based on a recent report (Fryar, Gu, Ogden, & Flegal, 2016, p. 37), another anthropometric data of the hand (i.e. hand breadth) was studied between 1963 and 1965 in America. More comprehensive norms for anthropometry of the hand have been collected since 2010 and over recent years (Cakit, Durgun, Cetik, & Yoldas, 2014; Khadem & Islam, 2014). These norms were gathered and studied in relation to associative factors with anthropometry. For example, Cakit et al. (2014) found differences of the hand anthropometry between people of different age or ethnic groups. Norms mean hand differences can be compared between samples in research studies and the wider population.

The following sub-headings are about methods for measuring dimensions of the hand and its components, which includes girth and circumference measurements, goniometry, and electromyography. In occupational therapy practice, body structure measures such as this can be used.

1.3.7.1 Girth/circumference measures of the hand

Girth/circumference is a measure taken by using a measuring tape with an appropriate recording of the results (e.g. a photograph) (Westat, Inc., 1988), or more recently using a technology such as X-ray and scanner (Kong, Freivalds, Kim, & Chang, 2017; Kuehnapfel,

Ahnert, Loeffler, Scholz, & Kuehnapfel, 2017). The shape or size of any parts of the hand can be measure based on anatomical sites, for example, the base creases of the fingers (Kong et al., 2017). Many studies with health adult subjects have been shown to identify a strong correlation of grip strength with anthropometric variables such as the length and width of the hand (Alahmari et al., 2017). A statistical significance was particularly found between hand length and grip strength ($p \leq 0.01$) (Alahmari et al., 2017).

1.3.7.2 Goniometry

Goniometry is a technique measuring the range of motion (ROM) at a joint with a specialised ruler for ROM measurement, known as a goniometer (Shurtleff & Kaskutas, 2018). Health care professionals commonly use the goniometric measurement in the clinical setting and share its results with each other (Szekeres, Macdermid, Birmingham, & Grewal, 2016). It requires standard approaches for accurate ROM. Many studies with adult patients investigated reliability and validity of using a goniometer in relation to the upper extremity including the forearm and fingers (Colaris et al., 2010; Gajdosik, 2001; Szekeres et al., 2016). Most of these studies reported that the goniometric measurement has good reliability, but psychometric properties of the goniometric measurement are still debatable (Szekeres et al., 2016).

1.3.7.3 Electromyography

Electromyography (EMG) is a recording method that assesses electrical activity in muscle for clinical diagnosis or training (Hu et al., 2013; Mills, 2005). To detect the myoelectric activity of movements of the body including the hand, the EMG recording can be processed using a hardware (e.g. computer) and different types of electrodes such as needles and skin surface sensors (Kauppi et al., 2015; Mills, 2005). The EMG allows assessors to identify which muscle generates greater power when performing a hand function such as a tripod pinch (Martin-Martin & Cuesta-Vargas, 2014) or whether there is muscle fatigue during the induced action (González-Izal, Malanda, Gorostiaga, & Izquierdo, 2012).

1.4 Hand Function

The ICF does not organise categories of function in relation to body structures (WHO, 2001). “Body Functions” (with the prefix code ‘b’) includes 8 chapters: “mental functions” (code b1), “sensory functions and pain” (code b2), “voice and speech functions” (code b3), “functions of the cardiovascular, haematological, immunological and respiratory systems” (code b4), “functions of the digestive, metabolic and endocrine systems” (code b5),

“genitourinary and reproductive functions (code b6), “neuromusculoskeletal and movement related functions” (code b7), and “functions of the skin and related structures” (code b8).

The lack of specified Body Functions for the hand means that clinicians and researchers need to select and justify what chapter functions they include when considering “hand function”. It has been suggested that categorising and classifying hand function is challenging due to the complex and diverse uses of the hand (Feix, Romero, Schmiedmayer, Dollar, & Kragic, 2016). However, defining and understanding what particular type of hand function is sought out is vital to ensure a clear research purpose and appropriate guide to best practice. If the terms are vaguely or comprehensively used, for example, as interchangeable words, it can cause a gap between research and real practice (Mckay & Verhagen, 2016). This is because the concept of the terms used by researchers can have different interpretations to clinicians. This means that the purpose and result of outcome measures in study could be applied to clinical situations which does, in fact, differ from contexts designed in research (Mckay & Verhagen, 2016). Thus, the definition relating to hand function is addressed below.

1.4.1 Defining hand function

Hand function can refer to “the capacity to use the hand in everyday activities depending on the anatomical integrity, sensation, coordination, strength, and dexterity” (Duruöz, 2014, pp. 41). The features of the hand function include (Case-Smith & Exner, 2014, p. 220):

- *Reach*: extension away from the body and movement of the arm for grasping or placing objects
- *Grasp*: transportation of a hand-held object from one place to another
- *Carry*: transportation of a hand-held object from one place to another
- *Voluntary release*: finger extension allowing intentional release of a hand-held object a t a specific time and place
- *In-hand manipulation*: adjustment or movement of an object within the hand
- *Bilateral skills*: coordinated use of two hands together sequentially or simultaneously to accomplish an activity

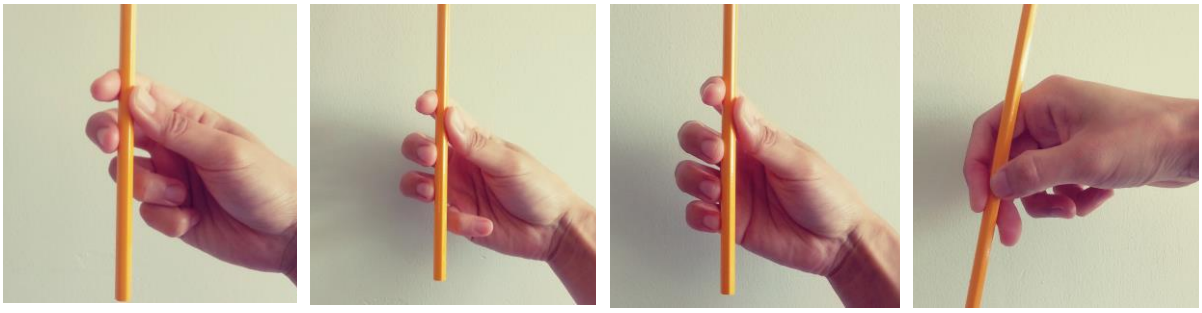
This review will particularly focus on grasp because the grasp has greater importance for handwriting as enabling the act of holding and manipulating writing tools.

1.4.2 Grasp/grip/prehension functions

The term, grasp will be used throughout this section as mentioned above. It will also include the functions of grip and prehension, as these terms can be used with grasp interchangeably in the literature (Duruöz, 2014; Palastanga & Soames, 2012, pp. 179-182). From the study (Feix et al., 2016), grasp is defined as "every static hand posture with which an object can be held securely with one hand, irrespective of the hand orientation" (p. 67). An important aspect of this definition pointed by the researcher is that grasp must be stable (Feix et al., 2016). The approach used by Feix et al. (2016) regarding the definition of hand grasp is adopted in this thesis whereby "non-prehension grasps" (e.g. hook grasp or flat hand grasp) are excluded.

Feix et al. (2016) identified 33 grasp types (excluding non-prehension grasps) by reviewing published literature and synthesising findings from 211 sources. These 33 grasp types would be characterised by the following elements: opposition type, thumb position, mass, size and compliance of an object, and force. Each of the 33 grasp types would be then categorised into "power", "intermediate", and "precision". Feix et al. (2016) presented different grasp types in visual and table forms on page 70 in the article (cannot be reproduced for copyright reasons).

Of the 33 grasps, four precision grasp were represented in the form of holding a standard pen. These were prismatic 2 finger, prismatic 3 finger, prismatic 4 finger grip and writing tripod (Feix et al., 2016, p. 70). See pictures below.



Prismatic 2 Finger | Prismatic 3 Finger | Prismatic 4 Finger | Writing Tripod

Photograph 1: Precision grasps for pen-holding (Source: Photographs taken by thesis author)

The many other grasps identified in that taxonomy could not easily be used to hold writing instrument in a stable position without considerable adaptation (e.g. if a person only has a sphere grip, an adaptation to the writing instrument could be made, for example, embedding the pen in a rubber ball so that they can use a grasp to guide the pen).

Daily activities are generally the combinations of different types of grasps (Duruöz, 2014) which become sophisticated skills over time (Schneck & Case-Smith, 2014). To hold and manipulate objects functionally, grasps take place with certain patterns of hand function which includes reach, carry, voluntary release, in-hand manipulation, and bilateral hand use (Case-Smith & Exner, 2014).

1.4.3 The measurement of hand functions

The measurement of hand functions determines how an individual demonstrates their hand use at a functional level, for example, when they have a disability (Duruöz, 2014). Duruöz (2014) identified the following areas and typical hand function assessments for each area:

- *Range of motion (ROM)* (e.g. goniometer for observation-based evaluation, computerized goniometer)
- *Grip or pinch strength* (e.g. JAMAR dynamometer and pinchmeter)
- *Person's experience using hands* (e.g. Disability of the Arm, Shoulder, and Hand Index [DASH], Australian/Canadian [AUSCAN] Osteoarthritis Hand Index)

Other aspects involved in hand function also have specific assessments. These may include dexterity defined as "a manual skill requiring rapid coordination of fine and gross movements based on a certain number of capacities developed through learning, training and experience" (Poirier as cited in Duruöz, 2014, pp. 46). Traditionally, dexterity can be assessed using several standardized tools such as the Purdue Pegboard Test (Tiffin & Asher, 1948), Grooved Pegboard, Nin-Hole Pegboard Test and Box and Block Test (Duruöz, 2014).

1.5 Hand Function and Handwriting

When children learn how to read numbers, letters and words from their parents, they may start to learn using a pencil or a crayon for writing. Through repetition, children practice holding a writing tool with stability and develop particular types of hand function such as grasp patterns (Schneck & Amundson, 2013). As the development of grasp function progresses, children exhibit various pencil grips (Schneck & Amundson, 2013; Schneck & Case-Smith, 2014). Particularly, when children are elementary school students, they are likely to use pencil grips considered to be mature (e.g. dynamic tripod and lateral tripod) (Schneck & Case-Smith, 2014). Over time, children become skilful at handwriting, being able to demonstrate the different size and form of the letter (Andersen, 1969; Schneck & Case-Smith, 2014).

Children who have a lack of handwriting skills are found to display poor handwriting at school (Schneck & Case-Smith, 2014). They are likely to have grammatical errors or low marks for poor legibility on homework paper more frequently than their peers (Feder & Majnemer, 2007; Vander Hart, Fitzpatrick, & Cortesa, 2010). If there are time constraints, children with handwriting problems may also show incomplete tasks of handwriting, as they need more time to finish it due to their slow handwriting speed (Tseng & Chow, 2000). This poor academic performance can, in turn, result in psychosocial problems among students. For instance, it is reported that children with handwriting difficulty often exhibit frustration and severely low self-esteem (Feder & Majnemer, 2007). The following two sections will review handwriting and factors that can cause handwriting difficulties.

1.6 Handwriting

The basic concept of handwriting is the ability to create a written language by hand. In 1979, Kao shared an ergonomics point of view on handwriting performance, which is based on human sensory and motor systems. Kao (1979) described that handwriting is a dynamic system which is generated by interactive feedback between movements of the hand, the writing instrument (e.g. pens and pencils), and the paper. Handwriting is further discussed in relation to its performance as well as outcome – that is, written production – below.

1.6.1 The act of handwriting

Traditionally, handwriting is a part of developmental continuum of human's hand function. Children develop a sequence of hand functions to acquire handwriting skills in early childhood (Case-Smith & Exner, 2014; Schneck & Amundson, 2013). It is seen that developing the ability to write by a hand enables children to participate in several daily activities such as writing the name, copying numbers and taking notes (Schneck & Case-Smith, 2014).

The act of handwriting can be understood more than "using skills" to children. According to the Taxonomic Code for Occupational Performance (TCOP) (Polatajko et al., 2004), using at least one tool through a series of actions of which each action is an active and voluntary movement (e.g. reaching) can be defined as a task. Given that handwriting stems from a series of actions such as grasping and in-hand manipulation and involves a writing instrument (van Hartingsveldt, de Groot, Aarts, & Nijhuis-van der Sanden, 2011), performing handwriting can be regarded as a task.

Based on consensus suggested by Creek (2010), a series of actions can also be defined as an activity. The definitions of a task and activity are suggested as follows (Creek, 2010, pp. 25-26):

- A task: a series of structured steps (actions and/or thoughts) intended to accomplish a specific goal. This goal could either be:
    1. the performance of an activity
    2. a piece of work the individual is expected to do
- An activity: a structured series of actions or tasks that contribute to occupations

Considering those concepts above, whether handwriting is defined as a task or an activity seems closely linked to how we see a child's writing behaviour in relation with occupation. Given the nature of handwriting, handwriting may generally be regarded as a task to most children. Yet, depending on social and cultural backgrounds, the same performance can have a unique meaning and interpretation to different individuals (Reed, Hocking, & Smythe, 2013). This means that if necessary, contextual aspects and the perspective of the child should be explored in order to deepen our understanding of a child's handwriting performance and the meaning of their engagement in handwriting performance.

1.6.1.1 Handwriting as an activity and participation in life situations

According to the ICF which provides a combined classification of activity and participation, handwriting is under a category named writing (code d170) (WHO, 2001). Children use handwriting to express their feelings and share opinions, to participate in written assessments, mathematical tasks, and communication activities such as letters and messages to friends (Schneck & Case-Smith, 2014). A systematic review study on 44 articles targeting children with developmental coordination disorder (DCD) found that the handwriting difficulty was the most common problem regarding children's restricted participation in classroom tasks (Magalhaes, Cardoso, & Missiuna, 2011). It can be, thus, seen that poor handwriting undermines the capability of children achieving their learning purposes and social inclusion at schools.

1.6.2 The quantity of handwriting

Even though technology such as computers and laptops are increasingly implemented in the classroom (Miranda & Russell, 2012), the amount of handwriting that children need to do at school is considerable. Evidence suggests close correlations between handwriting and

participation in classroom activities among children; it was reported that handwriting-related activity such as pencil-and-paper tasks make up for 50 to 60% of the classroom activity during a school day (Leung, Lam, Lam, Pao, & Li-Tsang, 2014; Rosenblum, 2008).

Many of handwriting tasks that children need for the completion of school are also done in a condition where they need to finish the tasks within a certain timeframe, for example, when taking an exam. This means that another quantitative aspect of handwriting is "how fast" a child can write. The speed of handwriting, therefore, is a factor of interest.

1.6.3 The quality of handwriting

Regarding handwriting performance, an attribute for "good" quality handwriting is legibility – whether written work is legible to read or not (Andersen, 1969; Feder & Majnemer, 2007). The legibility is contributing to but distinguished from readability which is defined as the level of ease with reading and comprehending written language (Dale & Chall, 1949).

Readability can be measured based on three main aspects. These aspects include how written contents are organised in a format; what level of reading proficiency a reader has; and to what degree the reader can read and understand the contents at an optimal speed (Dale & Chall, 1949). On the other hand, legibility is often evaluated with accuracy in letter formation, size of the letter, alignment and spacing (Falk, Tam, Schwellnus, & Chau, 2010; Lee, Howe, Chen, & Wang, 2016; Mackay, Mccluskey, & Mayes, 2010; Volman, van Schendel, & Jongmans, 2006). This indicates that legibility is more related to elements of letter design, which can be an objective standard for the quality of handwriting.

Additionally, there are two ways of measuring handwriting legibility, which is "rating of legibility components (e.g., slant, size, alignment) and rating of global legibility (i.e., overall readability of writing sample)" (Sudsawad, Trombly, Henderson, & Tickle-Degnen, 2001, p. 519). This means that what is measured as legibility also needs to be understood carefully by researchers and clinicians depending on the purpose of using measurements of handwriting legibility.

1.7 Factors Affecting Handwriting in Children

As briefly noted before, children perform several activities of handwriting at school for academic learning. These handwriting activities require children to use motor, perceptual, and cognitive abilities at the same time (Schneck & Case-Smith, 2014). These days, understanding the underlying factors is vitally important. Not only for children with a disability who appear

to have deficits in at least one of these abilities, children who are typically developing or do not have specific diagnoses also experience handwriting difficulty (Cusick & Elvery, 2017).

1.7.1 Motor aspects

Based on the ICF (WHO, 2001), motor functions are under the category "neuromusculoskeletal and movement related functions" (b7) which includes muscle functions such as muscle power, tone, and endurance. A wide range of evidence have suggested that motor functions of the hand are closely associated with handwriting performance (Cornhill & Case-Smith, 1996). For instance, there are studies that reported positive correlations between upper limb strength (e.g. grip force or shoulder and thumb strength) and handwriting legibility or speed in groups of children with handwriting difficulty (Alaniz, Galit, Necesito, & Rosario, 2015; Falk et al., 2010; Naider-Steinhart & Katz-Leurer, 2007).

Also, there are other specific motor factors reported as influencing children's handwriting. A study with Australian children who were diagnosed with traumatic brain injury (TBI) measured upper limb functions such as grasp and eye-hand coordination and found that children with severe TBI demonstrated poorer handwriting than other two groups, presenting with immature grasp patterns of writing during a 2-year follow up. (Wallen, Mackay, Duff, Mccartney, & O'Flaherty, 2001). Bilateral coordination and fine motor abilities such as dexterity and in-hand manipulation were also reported to have relations with handwriting performance (Bumin & Kavak, 2010; Cornhill & Case-Smith, 1996).

1.7.2 Perceptual aspects

When using hands for writing, children are required to coordinate this visual perceptual processing with their motor ability of the hand. Many studies identified that such a combined ability, also known as visuo-motor integration, had significant correlation with handwriting quality, particularly, in relation to the elements of letters such as the form and alignment (Kushki, Chau, & Anagnostou, 2011; Leung et al., 2014; Tseng & Chow, 2000; Volman, van Schendel, & Jongmans, 2006; Weintraub & Graham, 2000). However, Leung et al. (2014) who conducted a study with Hong Kong Chinese school-aged children pointed out that inconsistent findings exist between children using Chinses characters and the other using English alphabets regarding relations of visual perception ability with handwriting performance.

Also, kinesthetic perception is a factor that was investigated for its relations with handwriting performance in research (Cornhill & Case-Smith, 1996). It is a perceptual ability of the human body to be aware of weight of an object and provide the directionality of joint and limb movement (Cornhill & Case-Smith, 1996). In the past, correlations between kinaesthesia and handwriting legibility were shown as opposite across the research (Cornhill & Case-Smith, 1996). The opposite results are still being reported in more recent studies. For example, a pre- and post-test study found that a kinestheic training did not have significant impact on improving first-grade primary students' handwriting legibility, even though teachers reported that the students showed and maintained improved legibility in the classroom after the intervention and during a 4-week follow up respectively (Sudsawad et al., 2002). On contrary, Yu, Hinojosa, Howe and Voelbel (2012) found that there were significant correlations of handwriting legibility and speed with kinaesthetic and tactile perception among 177 first- and second-grade children in Taiwanese primary schools.

1.7.3 Cognitive aspects

Handwriting performance can also be affected by cognitive functions such as attention and memory. For example, children need to maintain their concentration to complete writing, and with motor functions, they also need to be able to retrieve letter form from their memory to generate a particular sequence of movement for writing (Christensen, 2005; Schneck & Case-Smith, 2014). A study conducted by Berninger et al. (2010) particularly examined the contribution of working memory to reading and writing outcomes. The researchers found that working memory was responsible for copying words but not for composing sentences.

In addition, a high level of cognitive functions categorised under mental functions in the ICF are also known as a specific contributing factor to handwriting. One of the cognitive functions at a high level is executive function which is defined as the ability to organise, plan and self-assess purposeful activity/performance within the given temporal and contextual environments (Rosenblum & Manalo, 2018; Yıldız & Yekeler, 2017). According to two studies recruiting primary school students, an organisational ability (an executive function) was found to have a strong correlation with handwriting proficiency in a group of children identified as having difficulty with handwriting (i.e. dysgraphia) (Rosenblum & Manalo, 2018; Yıldız & Yekeler, 2017). These children tend to struggle more in managing their time (Rosenblum & Manalo, 2018; Yıldız & Yekeler, 2017) and to write letters in smaller size than typically developing children (Bumin & Kavak, 2010; Rosenblum & Manalo, 2018). This

indicates that handwriting quality relating to legibility and speed should be considered with cognitive functions.

1.7.4 Emotional aspects

Emotion can be other factors affecting handwriting performance in children. Poor handwriting in children with ADHD was found to be associated with negative affect such as low motivational pattern and self-esteem (Racine, Majnemer, Shevell, & Snider, 2008). In 2003, Barnes, Beck, Vogel, Grice and Murphy conducted a survey to American occupational therapists working in public schools, and from a total of 476 respondents, 224 respondents reported that they had experience of working with children who had emotional disturbance. It was found that the children with emotional disturbance were made up for nearly 11% of each respondent's caseload, and handwriting was the most common area in intervention for those children with 91.5% of the response rate (Barnes et al., 2003). Therefore, it may be essential for occupational therapists to consider emotional aspects of children and provide emotional strategies and positive environments where children can feel emotionally supportive.

1.8 Handwriting Related Measurement

Since handwriting is both an activity and a means of participation in a life situation and it has the dimension of quantity and quality, there are a range of different assessments that aim to assess these different aspects. In addition, there are assessments that have attempted to isolate and measure factors that contributes to the quality or quantity of handwriting performance. In 2017, a comprehensive review of handwriting assessments not only used in occupational therapy and other health related handwriting research which was published in peer-reviewed journals was conducted by Cusick and Elvery (University of Sydney 2017 Honours Thesis, unpublished). This identified all instruments used in published research and using scoping review methodology it charted characteristics of studies that used standardized handwriting instruments. This scoping review found that the most common components targeted to measure were perceptual factors (e.g. visual and kinaesthetic), followed by motor factors (e.g. grasp and strength) and cognitive factors. Also, handwriting performance and/or quality were frequently investigated with its related factors. On the basis of this study, the most common handwriting assessments used were:

- Developmental Test of Visual Motor Integration (all versions) (Beery, 1989)
- digitising tablet system
- Evaluation Tool of Children's Handwriting (ETCH) (Duff & Goyen, 2010)

- Minnesota Handwriting Assessment (MHA) (Reisman, 1993)
- Bruininks Oseretsky Test of Motor Proficiency (BOT-MP) (Bruininks, 2013)

1.9 Handwriting in Korea

Recently, handwriting difficulties in children has gained attention through the mass media in South Korea. A Korean newspaper, Kook-Je Newspaper stated that Korean students struggle with pencil-and-paper tasks since they spend an increasing amount of time using electronic devices such as smartphone and computer (Min, 2015). This is supported by the fact that the frequent use of electronic devices hinders children from developing coordination skills of the small muscles in their hand, which is necessary for writing (Scientist in Neighborhood, 2015). Therefore, it is expected that there are an increasing number of Korean children who are in need of handwriting intervention programs. The following sub-sections will review a background relating to Korea.

1.9.1 The overview of South Korea

South Korea is a country located near Russia, China and Japan in East Asia (Danuri, 2018). It is officially named the Republic of Korea (ROK) with a special city, Seoul as its capital city (Danuri, 2018). Aside from the capital city, the administrative districts of South Korea include (Danuri, 2018):

- Eight provinces (Gyeonggi-do, Gangwon-do, Chungcheongbuk-do, Chungcheongnam-do, Jeollabuk-do, Jeollanam-do, Gyeongsangbuk-do, and Gyeongsangnam-do),
- One special self-governing province (Jeju-do),
- One special self-governing city (Sejong city), and
- Six metropolitan cities (Busan, Daegu, Incheon, Gwangju, Daejeon and Ulsan cities).

In 2017 (the latest figures), there were 51,466, 201 people in Korea (The World Bank, 2017a), with nearly 80% of this population living in urban areas (The World Bank, 2017b). Based on 2012 data from the Organisation for Economic Co-operation and Development (OECD), the estimate of Korean population under 18 was 9,578,186; the number of population at each age was summed from the OECD website (https://stats.oecd.org/Index.aspx?DataSetCode=RPOP#). The life expectancy of Korean population in 2016 (the latest figures) was 82.024 years (The Word Bank, 2016). South Korea is a high income country being 15th largest economy in the world (The World Bank, 2018,

para. 3). The country is recognised as technologically advanced; 90% of Korean people between 16 and 74 years old were identified as Internet users in 2016 (OECD, 2017).

1.9.2 The national language

The official language of South Korea is Korean. Since its alphabets were invented based on the sound structure in spoken language of Korean people, Korean is known as phonetic language using syllabaries (Sohn, 1999). The letters of the Korean alphabet are called "Hankul" which consists 14 consonants and 10 vowels. Similar to Chinese and English, Korean letters and words are composed from left-to-right and top-to-bottom directions (Sohn, 1999). However, the characteristics of Korean involve more circles and straight lines.

The unique characteristics of Korean characters indicate that the results of Korean handwriting research may differ from English evidence. Leung et al. (2014) had a view that given the correlation of handwriting with visual perception abilities that contribute to the form and spatial recognition, as well as visuo-motor integration, there will be different visual demands between Chinese and English-native children. Therefore, handwriting research should be encouraged to conduct in one's own nation (Leung et al., 2014), as linguistic aspects are one oy key part of multiple process on writing production (Graham & Weintraub, 1996).

Previously, Orliaguet and Boë (1993) also pointed out that letter characteristics such as size and form and the concept, frequency and phonetic nature of the word are closely linked to the movement time of linguistic tasks such as handwriting and typing. From the study that investigated the impacts of linguistic factors, particularly grammatical rules on the timing, they found that some subjects took more time to write if additional stroke is required (e.g. for plural form). Since Korean has different grammatical orders and phonetic features, it is, thus, possible that handwriting research with Korean children may result in different outcomes compared with English literature.

1.9.3 Writing in Korean education

According to a survey conducted by the OECD in 2012, the literacy proficiency of Korean people aged 16-65 year olds were just above average compared to the same aged groups of people in other OECD member countries; yet, when only young Korean people were compared (i.e. between 16 and 24 year olds), they achieved competitively high numeracy and literacy level than other countries (OECD, 2016). Given this, it is rated "among the highest-

performing countries in international assessments of numeracy and literacy" (Kim, 2014, para. 18).

The education system of Korea is mainly divided into kindergarten, elementary school, middle school, high school, and university (Ministry of Education, 2017, p. 10). The 6-year elementary and 3-year middle school education are mandatory for all eligible Korean citizen in accordance with the Article 8 of *Framework Act on Education 2017* (South Korea), and Korea, in fact, recorded a high primary school attendance between 2008 and 2012, with approximately 99% and 98% in urban and rural areas respectively (United Nations International Children's Emergency Fund [UNICEF], 2013). Children take the elementary education between the Korean ages of eight and thirteen, which is equivalent to International Years six and eleven (The UNESCO Institute for Statistics [UIS], n.d.) (note: Korean age years are different to 'international age' years – regardless of months alive, a child is deemed to turn one year old at the new year – thus, all children become a Korean year older at the new year). Children may be encouraged to learn Korean from their parents or kindergartens before entering an elementary school.

In 2017, the Korean Educational Development Institute (KEDI) identified the number of Korean elementary school children from different provinces and cities. Based on these numbers, there are 2,674,227 primary school students in Korea. Generally, Korean children are expected to finish a full course of primary and secondary education before advancing to higher level of education (e.g. college and tertiary education).

Based on the national basic curriculum (Ministry of Education, n.d.), students have Korean classes called "Korean language arts subject" from elementary and middle school to high school. Korean students receive their regular Korean classes most frequently during the elementary school, which takes up more than 200 hours for each different grade (Ministry of Education, n.d.). This means that once they become elementary school students, they are required to know how to read and write Hankul in Korean classes. Throughout their school life, they practice writing Korean letters and sentences by participating in activities, for example, dictation words and sentences as well as note taking.

The Korean education system has been criticised as being test-focused (Kim, 2014). This requires children to be able to handwrite clearly and quickly because tests are often timed. The need to write quickly and clearly continues into other tests after schools such as the highly competitive university entrance examination (Kim, 2014). In other words, there is an immense demand for handwriting among Korean children.

1.9.4 Korean children with handwriting difficulties

Handwriting difficulty is a global issue, with a prevalence of 5 to 30% in school-age children (Overvelde & Hulstijn, 2011; Volman et al., 2006). Based on a survey's data from first-to fourth-grade teachers, the estimation for children with handwriting difficulties in the USA was estimated to be an average of 23% of students in each classroom (Hammerschmidt & Sudsawad, 2004). In addition, a study conducted in the Netherlands found that compared to third-grade students, second-grade children are nearly twice as likely to be at risk of handwriting difficulty (Overvelde & Hulstijn, 2011). These findings indicate that poor performance in handwriting is, indeed, common among children.

To date, however, no study has been published which provides the population based estimate of the number of children who have difficulty with handwriting (i.e. the task of handwriting) in Korea. Using the international estimate, it could anticipate that up to 800,000 children could have handwriting difficulty. This is a gap in information about Korean handwriting. Instead, there is current evidence (Kim & Hong, 2008), about problems in a child's ability to think and creatively/fluently write from educational perspectives, for example, focusing on a student's written expression and writing flow other than handwriting performance.

1.9.5 Services for handwriting difficulty in Korean children

Korean children with disability are supported by the Korean special education law. The Article 1 of *Act on Special Education for Persons with Disabilities, Etc 2018* (South Korea) (available in English) stated that:

> The purpose of this Act is for the State and local governments to provide disabled persons and those who have special educational needs with an integrated educational environment pursuant to Article 18 of the Framework Act on Education and to provide them with education according to their life cycle considering characteristics, such as the type and level of disability so that such education may contribute to their self-realization and integration into the society.

To achieve this ultimate goal stated above, special education-related services are part of available support in accordance with the Article 28 of *Act on Special Education for Persons with Disabilities, Etc 2018* (South Korea). This includes a service named "therapeutic support" which involves relevant health professions such as occupational therapy and

physiotherapy. In other words, children who have difficulty in academic activities in their classroom may be identified and referred to services by teachers.

On top of that, from an internet search conducted by the thesis author, it was identified from a Korean search engine (https://www.naver.com/) that there are some of the parent community blogs and websites of private service centres which contain online information about available services regarding children's handwriting difficulty. However, most results of this internet search were a form of advertisement about clinical services that parents may want for their child's health conditions to be diagnosed or treatments for children having difficulty in performing everyday tasks or learning activities including writing.

Given this information, it appears that children can be self- referred by parents to services or present to services that have a blanket referral for a comprehensive delay in developmental and learning outcomes by teachers.

1.10 Occupational Therapy for Children and Handwriting

Occupational therapy is a health profession which focuses on children's engagement in meaningful and relevant occupations in their childhood, for example, play and education (Case-Smith, 2014; Schneck & Case-Smith, 2014). It is well perceived that children engage in the role of students, spending a lot of time on their school activities, particularly writing (Ratzon, Efraim, & Bart, 2007, Schneck & Case-Smith, 2014). For children with handwriting difficulty, occupational therapists play an important role in assessing handwriting problems, planning interventions and following up outcomes for future plan (Rigby & Schwellnus, 1999; Schneck & Case-Smith, 2014). They also value and look at relationship between factors underlying handwriting and the natural environment where children perform handwriting (Schneck & Case-Smith, 2014). Paediatric occupational therapists eventually determine primary performance components of handwriting and specific environmental aspects that lead problems in a child's handwriting.

1.11 Occupational Therapy in South Korea

In South Korea, the nation's first licensed occupational therapist was produced in 1969, and the official association for Korean occupational therapists, named the Korean association of Occupational Therapists (KAOT), was established in 1993 (KAOT, 2015). Five years later, the KAOT joined a membership at the World Federation of Occupational Therapists (WFOT) (WFOT, 1998). As of April 2018, it is estimated that more than 16,000 occupational therapists

have obtained a national Occupational Therapist Licence (Korea Health Personnel Licensing Examination Institute as cited in KAOT, 2018a). It is also expected that there would be approximately 3,500 occupational therapists working with children (personal communication, Byeong Jin Jeon, the President of the KAOT). These paediatric occupational therapists are known as working not only in hospitals but also in rehabilitation centres as well as private clinics. The school-based setting is rare workplace, but it is reported that school-based occupational therapists worked 40 hours a week, mainly with students who have intellectual difficulties, cerebral palsy and autism spectrum disorder (Oh & Kim, 2010; Lee et al., 2015).

According to an international scoping review honours project study of health related handwriting research conducted by Cusick and Elvery in 2017, handwriting interventions and assessments were mostly conducted by occupational therapists. Another finding was that over 100 standardised handwriting assessments were used in research, identifying that performance component evaluations were the most common rather than task-focused assessments. This review did not locate any Korean occupational therapy handwriting literature, perhaps because the inclusion criteria had sources in English.

Given that there is the potential demand in children who need handwriting intervention programme, Korean paediatric occupational therapists may have been delivering handwriting practice for evaluation and intervention. However, to date, no one has summarised literature and evidence related occupational therapy handwriting practice for Korean children.

1.12 Research Question

In this study, a research question will be explored as follows:

- What published research evidence is available about handwriting practice for children within Korean occupational therapy?

To answer this research question, a scoping review methodology was selected.

1.13 Study Significance

The gap between Korean and English literature on handwriting practice in occupational therapy should be addressed in order to meet a potentially increasing demand for handwriting programme among Korean children with handwriting difficulties. Conducting handwriting research will first help to gain an understanding of the current pattern of Korean occupational therapy regarding: what assessments Korean occupational therapists use for children with

handwriting difficulties; what types of occupational therapy interventions for handwriting programme are available; and what group of children have been studied. This work will assist in defining the gap between Korean and international evidence by providing a summary of published research evidence about handwriting assessments and approaches in Korean occupational therapy. Based on this summary, recommendations on future research topics and handwriting practice can be given, which will, in turn, create an opportunity to encourage the evidence-based practice.

1.14 Outline of Thesis Structure

This thesis includes the following chapters:

- Chapter 2 “A scoping review of occupational therapy handwriting literature” which includes information about introduction, methods, results and discussion that presented based on the publication template of the international journal, *Occupational Therapy International*. It, thus, presents an Introduction, Methods, Results and Discussion section as well as ‘article’ references and figures/ tables. The Chapter is intended to be read as a stand-alone study report.
- Chapter 3 “Thesis summary, implications and recommendations” which addresses summarised results from the scoping review study and identifies practical implications and recommendations on research.

1.15 Chapter Synopsis

The current chapter introduced a background to the Masters research project, which is reported in the next chapter. The chapter presented information about the hand, hand function, measurement relating to the hand, handwriting and writing in Korea, the education context as it relates to handwriting, occupational therapy in Korea and the gap in evidence about handwriting information in Korean occupational therapy literature. The next chapter presents the stand-alone research study report in the form of a journal article.

CHAPTER 2

A SCOPING REVIEW OF OCCUPATIONAL THERAPY HANDWRITING LITERATURE

2.1 Chapter Preamble: Target Journal is *Occupational Therapy International*

This chapter is presented in a form of a journal manuscript. It is prepared using the Author Guidelines of *Occupational Therapy International*. See Appendix M: A journal submission guideline and template (*Occupational Therapy Internationa*). Please note that all in-text citations have been presented in this chapter in the APA format to comply with Faculty of Health Sciences University of Sydney preferred reference style. This is different to *Occupational Therapy International*. In future, if the paper is submitted for review to that journal, the references will be reformatted as consecutive numbers in square brackets and heading numbering will be also removed upon submission. In this chapter, appendices were used to provide the examiner with detailed information.

2.2 Abstract

Background. Handwriting difficulty in children is an established issue across the globe. However, there has been no review of Korean research literature regarding occupational therapy handwriting practice to date. *Objectives.* This study aims to summarise published literature on occupational therapy handwriting practice in South Korea. *Methods.* A scoping review methodological framework by Arksey and O'Malley was applied. From three databases JKSOT, RISS, and Google Scholar, 22 articles were included based on the face-to-face agreement by the research team consisting of a native English researcher and bilingual co-investigator. The key information was then extracted. Descriptive analysis of numerical data and thematic analysis were used to collate, summarise and synthesise the data. *Results.* All 22 research studies were quantitative studies published between 1991 and 2018. Children with medical conditions including cerebral palsy (CP) were most studied, commonly in school-based settings, followed by hospitals. A total of 41 assessments were found: 30 standardized assessments, eight non-standardized assessments, and three could not be determined due to a lack of description. Only two standardized assessments were used in Korean version (i.e. K-DTVP-2 and K-DDST-2). Standardized assessments were generally used to measure performance components, the most common being fine motor function. Task-

oriented handwriting programs were the most popular, and all interventions across the Korean literature found improvements on handwriting legibility, speed or performance components, but there were a mix of intervention outcomes that were of statistical significance. *Conclusions.* Handwriting research on Korean occupational therapy investigated various topics regarding assessment and intervention programs targeting handwriting quality and/or underlying performance components. However, comprehensive focuses on assessment and intervention and different results from each study indicates no consensus and guideline built in the Korean literature. Therefore, rigorous handwriting research with Korean standardized instruments is warranted.

2.3 Introduction

Handwriting is a crucial occupation for children to become a successful learner. To actively engage in a student role, children need to perform pencil-and-paper tasks in the classroom on a regular basis (Marr, Cermak, Cohn, & Henderson, 2003; Mcmaster & Roberts, 2016; Rosenblum, 2008). As a literacy skill, students are expected to integrate their writing ability into the broad curriculum. However, children who have difficulty in writing often produce poorer legibility and less amount of writing with more prolonged pauses compared to their peers (Barrientos, 2017; Case-Smith, 2002; Feder, Majnemer, Bourbonnais, Blayney, & Morin, 2007; Prunty, Barnett, Wilmut, & Plum, 2014). Consequently, handwriting problems can have negative impacts on child well-being, by resulting in poor academic achievement (Alhusaini, Melam, & Buragadda, 2016; Tseng & Cermak, 1993). Children who have difficulty in mastering handwriting tend to display unwillingness to write (Alhusaini et al., 2016), potentially presenting with a lack of participation in essential everyday activities (Magalhães, Cardoso, & Missiuna, 2011). In the long-term, outcomes of handwriting problems in children can lead to secondary issues such as anxiety and low self-esteem (Feder & Majnemer, 2007).

Handwriting difficulty affecting the quality of children's school life has been recently seen as more general issues worldwide. The international sources have reported continuously that between 5% and 30% of school-aged children undergo handwriting problems (Overvelde & Hulstijn, 2011; Volman, van Schendel, & Jongmans, 2006). In 2017, Cusick and Elvery conducted an extensive scoping review and assessed 178 studies of which each included at least one standardized assessment for handwriting practice (Cusick & Elvery, 2017). According to their scoping review, handwriting studies had been published from 23 countries

such as America, Netherlands and Taiwan since 1975. In other words, poor performance in handwriting among children has, indeed, become an ongoing concern across the globe.

Over decades, such common research activities have discussed various topics regarding handwriting difficulty of children. This involves performance components underlying handwriting, assessment tools for the identification of handwriting difficulty and intervention programs (Dunsmuir & Blatchford, 2004; Goldstand, Gevir, Yefet, & Maeir, 2018; Rosenblum, 2008; Van Waelvelde, Hellinckx, Peersman, & Smits-Engelsman, 2012; Wallen, Duff, Goyen, & Froude, 2013). The recent review by Cusick and Elvery (2017) reported that most studies of handwriting research targeted visual perception and grasp; the most frequently used standardized assessments included Developmental Test of Visual Motor Integration, Evaluation Tool of Children's Handwriting (ETCH) and Minnesota Handwriting Assessment (MHA); and the most frequent type of handwriting interventions was task-specific training which aims to improve handwriting quality such as legibility and speed. More importantly, Cusick and Elvery (2017) highlighted that there are over 100 standardized handwriting assessments and a variety of intervention strategies available for use, while very little duplication exists. Therefore, consensus on assessments and interventions within handwriting practice has not established yet, hence there is an urgent need for appraising the quality of evidence (Cusick & Elvery, 2017).

The need for handwriting research to reach a consensus is particularly significant in paediatric occupational therapy. As unique health professionals who focus on children's occupational engagement in major productive activities such as handwriting (Rosenblum, Goldstand, & Parush, 2006), occupational therapists are identified as the main contributors to handwriting research, assessment and treatment (Cusick & Elvery, 2017). On top of that, handwriting difficulty is one of the primary reasons for referrals to paediatric occupational therapy (Hammerschmidt & Sudsawad, 2004), mostly in school-based settings (Karlsdottir & Stefansson, 2002). Hammerschmidt and Sudsawad (2004) stated that nearly 95% of teacher referrals were made due to handwriting difficulties from students. Teachers also reported that the most common reason for the referral is because students did not show improvements in handwriting performance with the help of classroom assistance alone. Similarly, a study using semi-structured interviews found that kindergarten teachers seek for more support on handwriting instruction, perceiving occupational therapists as having a broader comprehension of handwriting and holistic view on children (Nye & Sood, 2018).

In South Korea, approximately16,737 people are nationally qualified occupational therapists (Korea Health Personnel Licensing Examination Institute as cited in Korean Association of Occupational Therapists [KAOT], 2018), and it is considered that 3,500 paediatric occupational therapists work with children in various settings including hospitals and schools. Given the great attention to handwriting research by occupational therapists, Korean paediatric occupational therapists are expected to have engaged in handwriting practice actively. However, although the Medline/CINAHL review of paediatric handwriting research was conducted recently (Cusick & Elvery, 2017), evidence on handwriting practice of paediatric care from Korea was not revealed. In the international literature (Cusick & Elvery, 2017), it was found that most studies on handwriting practice were conducted in North America, while little was done in non-English speaking countries such as China. Thus, the absence of Korean handwriting research suggests that there is a wide gap between the international and Korean literature on handwriting practice in paediatric occupational therapy.

To define gaps in research evidence, collecting and organising evidence from the Korean literature are imperative. The figure on the body of Korean handwriting research is further critical in South Korea due to a potentially large number of Korean children with handwriting difficulty. For instance, if reflecting the maximum estimation (30%) of the international prevalence of handwriting difficulty in school-aged children on the reported number of Korean elementary school students in 2017 (total = 2,674,227) (Korean Educational Development Institute [KEDI], 2017), more than 800,000 children are likely in need of handwriting intervention programs in Korea. Furthermore, understanding Korean evidence on handwriting practice can be meaningful globally. The World Federation of Occupational Therapists (WFOT) recently made a call for challenges within occupational therapy, emphasising that because of diverse population groups in the world, we as occupational therapists should also increase diversity in our professional knowledge and practice (Hammell, 2018). Therefore, sharing insights on Korean occupational therapy handwriting practice are required not only to give Korean occupational therapists recommendations, but also to connect the client-centred and evidence-based occupational therapy practice around the world (Hammell, 2018). The understanding of handwriting practice within Korean occupational therapy will, in turn, contribute to building up the evidence base for handwriting practice.

In the light of issues stated above, this study aimed to describe handwriting practice of Korean paediatric occupational therapy. The objectives of the current study were to search and

summarise published literature on occupational therapy handwriting practice for children with handwriting difficulty in South Korea.

2.4 Materials and Methods

A scoping review is a research methodology that aims to clarify the potential size and scope of existing literature on research topics (Grant & Booth, 2012; Peters et al., 2015). This methodological approach is known as a way of 'mapping reviews' by categorising the data and summarising findings (Peters et al., 2015). Scoping reviews do not necessarily require the appraisal of the quality of evidence of included studies (regarding methods and study designs). Instead, scoping reviews address broad research questions to identify the vast amount of relevant studies in an area of research (Arksey & O'Malley, 2005; Peters et al., 2015). Thus, the scoping review methodology was selected for this study to clarify the size and scope of existing literature since to date there has been no comprehensive review of handwriting practice by Korean paediatric occupational therapists.

To undertake a scoping review, the research team made a protocol based on a scoping review methodological framework proposed by Arksey and O'Malley (2005). The framework consists of the five stages listed below.

2.4.1 Stage 1: Identifying the research question

A research question was defined reflecting on the aim of the study mentioned above: *what published research evidence is available about handwriting practice for children within Korean occupational therapy?* The research question was not made any more specific so that a large body of research about Korean occupational therapy handwriting practice could be identified (Peters et al., 2015).

2.4.2 Stage 2: Identifying relevant studies

The search strategy was developed using keywords selected by the research team (See Appendix A: Search strategy). Three data sources were selected for the search:

- The Journal of Korean Society of Occupational Therapy (JKSOT) is an official peer-reviewed journal co-founded with the Korean Association of Occupational Therapists (KAOT) in 1993. The JKSOT was selected since it is the journal for the peak professional society for occupational therapy in South Korea.

- The Research Information Sharing Service (RISS) is an open research database that provides access to academic resources such as domestic and international scientific journals as well as national dissertations produced by universities. The RISS was searched to locate sources that may have been published in English and/or Korean but outside the JKSOT.
- Finally, Google Scholar was searched in English and Korean language to identify any sources not previously found in the JKSOT and RISS.

A discrete method of searching was used for each data source. For the JKSOT, the Table of Contents title of each issue available online was visually inspected (English and Korean language), and all those papers relating to paediatrics had the abstract inspected (all issues between 1993 and 2018 in both English and Korean language). Articles were excluded by consensus of the research team if the title and/or abstract in English did not include the specific search terms: hands, hand function, handwriting or writing.

For RISS, visual inspection of titles was undertaken; usually, titles were available in both Korean language and English. From the Google-Scholar results, English language search was first conducted revealing titles in English, and second, Korean language search was conducted revealing titles in both English and Korean. Visual inspection was used for these data sources because unlike proprietary indexes such as Medline/PubMed™, there is no way to structure a search with limits and qualifiers. Articles were excluded if not conducted by Korean authors OR in South Korea; a bilingual researcher determined this exclusion process by inspecting author names, titles and/or abstracts in English/Korean; by discussing reasons for proposed exclusion with the other researcher; and by reaching a consensus decision. A total of 151 potentially relevant articles were retained at this stage (See Figure 1).

2.4.3 Stage 3: Study selection

The inclusion/exclusion criteria are presented in Table 1. Out of the 151 papers, 40 articles had an English title and abstract available. Each researcher independently assessed these 40 papers. There was 100% agreement on all 40 to keep for full-text evaluation. To ensure rigorous full-text review, both researchers made a consensus decision in face-to-face meetings where each component of the article was identified and assessed through a question and answer process conducted in English about the main document written in Korean. For example, an article was inspected to reveal if original data on handwriting had been collected – the relevant text was highlighted, sentence translation was made by the bilingual researcher and was interrogated by the co-researcher, and both researchers inspected relevant

data/numerical tables and analysis. Through this process, 20 articles were retained as eligible papers. Papers were excluded because 13 studies did not have the original data on handwriting; three studies had adult participants alone; two studies had only children from countries other than South Korea; and two papers were duplicates. The reference lists of all included papers were also inspected to identify additional relevant studies for inclusion in the scoping review (Peters et al., 2015). Finally, a total of 22 articles were included for the next stage (data extraction). Each study was given a study identifier. See Appendix B: Study identifiers for the included studies (n=22).

2.4.4 Stage 4: Charting the data

A data-extraction form in Excel™ was created by the authors to record the key information from each of the final studies (Peters et al., 2015). See Appendix C: Chart for data extraction. The extracted information included: publication characteristics (author, year, article title, journal name, written language); study characteristics (purpose, research approach, study design, study location, practice setting, sample size, results, conclusion); participant characteristics (age, gender, diagnosis); assessment characteristics (name and citation details of assessments used in the study, assessment administrator discipline); and intervention characteristics (name of the intervention or program and citation details if relevant, intervention administrator discipline, type of intervention/ theoretical or other approach, procedures for the intervention).

2.4.5 Stage 5: Collating, summarising and reporting the results

A descriptive analysis of numerical data was used to collate and summarise the results. In an attempt to better understand and describe patterns of occupational therapy handwriting programs for children in South Korea, some results were synthesised and presented thematically – for example, the purposes of the studies.

2.5 Results

Results of the 22 papers included in the scoping review are presented; first as a descriptive summary and second, as an analysis of topic themes.

2.5.1 Part I: Descriptive analysis

2.5.1.1 Publication characteristics

The 22 included papers were published between 1991 and 2018. More than half of the published papers (n=12) were conducted from 2011 to present (Figure 2). Most papers came from *The Journal of Korean Society of Occupational Therapy* (n=10), followed by *The Journal of Physical Therapy Science* (n=3), *The Journal Korean Academy of Sensory Integration* (n=2), *Journal of The Korean Society of Integrative Medicine* (n=2) and *Journal of The Korean Contents Association* (n=1). The remaining four publications were thesis papers issued by four different universities. The written language of most publications (n=19) was Korean, and the rest were written in English (n=3).

2.5.1.2 Study characteristics

All papers were 12 observational cohort studies, one of which aimed to inform development of an evaluation tool and 10 intervention evaluation studies. The intervention studies used the following designs: pre- and post-test (n=4); single case ABA design study (n=3); and single experimental study (n=3).

Just over half the studies were studied in urban areas (n=11: n=6 metropolitan city, n=2 capital city, n=2 city, and n=1 capital city and city). Three studies were undertaken in the nearest province to the capital city (n=2 Gyeonggi Province, and n=1 Gyeonggi Province plus capital city). Two studies were conducted in Chonbuk Province located in the middle of South Korea. The remaining six studies did not state regional areas.

The most common study settings were educational, followed by hospitals and clinics/centre. See Table 2.

2.5.1.3 Participant characteristics

The sample sizes of the included studies varied, ranging from 1 to 326 as shown in Figure 3 (20 participants in a comparison group of a study were excluded from this sample calculation, as they were adults). Under half of the studies (n=10) had less than 20 participants.

From the 22 studies, the mean age of all child participants was estimated to be 7 years and 8 months using the international age-years rather than Korean calculated age years. The international age-years were taken as the actual years and/or months reported; 20 of the 22 studies reported this (Table 3). For the remaining two studies, no actual years and months were reported. The estimation of these two studies was made by taking the mean age of the given range. For all seven studies where years were reported in Korean ages, the following

rule was consistently applied - all Korean ages were reduced by one year to be international age-year equivalents.

In terms of gender, 16 studies involved both male and female participants. Five studies were male only, and one study did not specify.

Table 4 shows the population of the included studies according to the existence of medical conditions. More than half of the studies (n=13) targeted children with medical conditions as participants, with the remainder being typically developing children (TDC). Cerebral palsy (CP) was identified as the most common diagnosis.

2.5.1.4 Assessment type and frequency of use

The number of assessments used in each study ranged from one to 10 (Figure 4). Across the 22 reviewed studies, 41 assessments were identified, including 11 assessments that were only used for participant eligibility and/or initial measure. Eight tools of 41 were non-standardized assessments (six of these were all "writing tasks" and structured, two were unstructured, and three were not specified: sitting balance test, interview and survey). Thirty evaluation tools were standardized assessments; a technology, called "Compact Measuring System (CMS) 10 for 3D motion analysis" (zebris Medical GmbH, 2011), was included as a standardized assessment. In two studies (Kim, 2016; Seo, 2018), there were insufficient descriptions of measures and details of three assessments could not be determined (i.e. proprioception test and tactile test, and Korean visual perception screening test: no references provided by the authors of the study for this assessment). All 41 assessments are outlined in Appendix D: Lists of standardised, non-standardised and non-determined assessment reported with targeting elements (n=41).

There were three standardized assessments translated into Korean. These evaluations included "Korean version of Developmental Test of Visual Perception-2" (K-DTVP-2) (Frostig, 1972; Hammill, Pearson, & Voress, 1993; Moon, Yeo, & Jo, 2003 – translation and standardisation), "Korean version of Denver Developmental Screening Test-2" (K-DDST-2) (original DDST developed by Frankenberg & Dodds, 1967; Korean version cited as being translated by Shin, Han, Oh, Oh, & Ha, 2002), and "Korean-Intelligence Scale for Children-3" (K-WISC-3) (Jun, Hwang, & Lee cited in Hwang & Oh, 2017). There was also a task-oriented handwriting assessment developed by the study authors (Lim et al., 2018). The latter was an instrumentation study, with the largest sample size (326 school-aged TDC), exploring

assessment development and properties for item construction, rating scale, construct validation and reliability.

Across all studies, 27 of the 41 assessments had been used only once. The remaining 14 assessments were used between two and five times. Having been used 15 times in 14 studies, the most frequently used assessment was a non-standardized assessment "writing tasks" (i.e. writing "sentences" or "Korean consonants and vowels" or "Korean word/s"), and this assessment was used to measure handwriting legibility and/or speed (Appendix D). The most frequently used standardized assessments were the "Jebsen Hand Function Test" (Hong, 2000; Hwang, 2011; Hwang & Jeong, 2011; Lee, Park, Kim, & Shin, 1996), the "Bruininks-Oseretsky Test (BOT)" (different versions) (Bruninks, 1978; Kwon, 2008; Park, Lee, Noh, Lee, & Cha, 2010), and the "Developmental Test of Visual Perception-2 (DTVP-2)" (Frostig, 1972; Hammill, Pearson, & Voress, 1993; Moon, Yeo, & Jo, 2003); these assessments were all used four times. Occupational therapists were the most common assessment administrators (Table 5).

2.5.1.5 Intervention type, approach, and administrators

Out of the 10 intervention studies, eight primarily focused on intervention for handwriting improvement. In the remaining two studies conducted by Kim (1992) and Jung (2011), the handwriting was not a primary target of intervention but was reported on as a part of an outcome measurement. The most common types of intervention were task-oriented handwriting programs (n=6); three studies targeted both handwriting task and handwriting performance components and three studies targeted handwriting performance components only.

Table 6 shows the names of the programs and the different approaches used by all authors for the development of the intervention. As seen in the table, interventions based on sensory integration (SI) theory (n=4) were the most frequently studied (n=3 activities and n=1 product use), followed by visual perception training programs (n=2). The common abilities targeted in performance component/mixed interventions (n=5) were identified as eye-hand coordination (n=2), postural control/stability (n=1), visual perception (n=1), and fine motor function (n=1). According to eight studies that reported the duration of interventions, participants were on average treated for 30.63 minutes per session, with the most common frequency of interventions being three days a week (n=3) (Table 7). Intervention providers are outlined in Table 8, and intervention programs were mostly administered by occupational therapists.

2.5.2 Part II: Thematic analysis

This section summarises topics explored in the 22 studies included in this review.

2.5.2.1 Lived experience of child/caregiver

Only three studies included qualitative aspects of lives among children who had handwriting difficulty (n=2 described in method section as participant information and n=1 described in result section) (Hwang, Kim, & Jung, 2017; Jung, 2011; Shin & Park, 2016). A single case ABA study conducted by Shin and Park (2016) mentioned a child's perspective on handwriting performance, using the COPM. They identified that the child recognised handwriting problems hugely by reporting the importance, performance and satisfaction items with 10, 4 and 3 points respectively.

The lived experiences of child participants were also addressed by the information from primary caregivers. Both Jung (2011) and Shin and Park (2016) who conducted studies on children with medical conditions have stated that parents reported their child had difficulty with other occupations such as play with peers, personal hygiene and eating, while showing low self-esteem (Jung, 2011). The participant was specifically struggling with fine motor activities such as playing the recorder and folding paper (Shin & Park, 2016). According to Shin and Park (2016), a parent reported that teachers often pointed out her child's writing, while she also suspected her child having decreased abilities in fine motor control and visuomotor coordination. The parent further reported that she did not, however, seek for interventions, as the child did not have cognition and learning problems and no-one advised on the suspected abilities of the child (Shin & Park 2016). However, another study reported that a child participant with no particular diagnosis was found to have difficulty in maintaining attention span, proper sitting position and friendships, which was, in turn, a reason for referral to the developmental centre by parents and teachers (Hwang et al., 2017).

2.5.2.2 Selecting child participant for handwriting research

The topic of whom to include in handwriting research studies gives an insight into the types of children targeted in occupational therapy handwriting practice. Only 15 of 22 studies specified participant eligibility (n=9 studies involved children with medical conditions and n=6 involved children without medical conditions). Table 9 summarised participant eligibility criteria for studies with children who have medical condition and studies with children who have no medical condition.

2.5.2.3 Measuring handwriting quality and performance components

Handwriting legibility and/or speed were investigated for the correlation with several performance components (Table 10). Followed by visual perception (motor free) and visual-motor integration, fine motor skills were the most common primary measure (n=7), which used an observational assessment (i.e. writing name and colouring) and standardized assessments such as the modified versions of the Bruininks-Oseretsky Test (BOT), Grooved Pegboard Test and O'Connor Finger Dexterity Test.

According to Kim, Han, and Jang (2015), visuoperceptual and motor abilities were not correlated with handwriting legibility in 23 typically developing preschool-aged children. Although there was a similar finding to no correlation of legibility with general visual perception, legibility was identified to have a good correlation with visual motor skills, such as visual-motor speed, among 49 pre-schoolers (Min, Jung, Jung, & Kang, 2008). This study also concluded that the significant predictors for handwriting legibility were eye-hand coordination and copying skills through stepwise multiple regression analysis (Min et al., 2008). A study targeting TDC identified no correlation between legibility and joint position sense at the elbow (Hong, Jung, & Kim, 2016).

In other TDC, performance components - praxis, fine-motor precision and in-hand manipulation skills - were found to be influential factors to legibility (Seo, 2018; Yu, Kim, & Kim, 2006). However, while finger coordination, visual perception and visual motor integration had correlations (Kim et al., 2015; Lee, 2002), praxis was reported as not significantly correlated with the writing time (Yu et al., 2006). A comprehensive study found that the crucial predictors of handwriting articulation were wrist lateral deviation of muscle strength and upper extremity speed among 54 children with CP (Kim, 2016). Statistical differences on handwriting performance were also reported according to participant demographics such as education (p<0.05) and gender (p<0.05) (Kim, 2016; Yu et al., 2006). Lee (2002) found that the number of Korean letters increased as the grade level of the elementary school children increased.

2.5.2.4 Effectiveness of task-orientated handwriting interventions

Three studies of the task-oriented handwriting interventions reported positive changes in both handwriting legibility and speed (Ham, Kim, Lee, & Jeon, 2012; Hwang, 2011; Shin & Park, 2016). However, a study using ‘copying contents’ (a task-oriented intervention) identified that a significant improvement was only found in legibility (Shin & Park, 2016). Hwang (2011)

investigated the active teamwork-based intervention between special education teachers and occupational therapists to implement the low tech assistive technology; the therapists provided indirect services by making plans on handwriting programs and these were delivered by the teachers. In this study, it was noted that all three participants with intellectual disability showed fluctuations in the writing time during the intervention period. The author discussed that this is because the participants avoided writing tests since attention span became shortened as a result of physical fatigue and low motivation. However, the other study using a SI based handwriting program reported significant improvements, particularly in handwriting speed among children with ADHD (Ham et al., 2012).

2.5.2.5 Effectiveness of handwriting performance component interventions

The effects of the intervention programs on performance component with or without targeting handwriting quality were reported as all positive (Hong, 2000; Hwang et al., 2017; Hwang & Jeong, 2011; Kim, Bae, Jun, Jang, & Song, 2015; Park, 2009). One of two studies that only targeted a performance component (i.e. eye-hand coordination) reported that children with CP showed significant improvements in writing speed, particularly for the dominant hand after multisensory intervention (snoezelen) (Hwang & Jeong, 2011). The other study also identified that children with CP showed the reduction in the performance time when writing Korean sentences (almost 20% faster), hence eye-hand coordination was improved (Hong, 2000).

On the subject of intervention programs targeting both performance component and handwriting quality, a unique intervention study using the weighted vest reported that there was a substantial statistical difference in postural stability of the trunk between experimental and control groups (each consisting of eight children with DCD) (p<0.001) (Park, 2009). In this study, the intervention group was also observed to have significant improvements in their handwriting performance - legibility, letter form, letter size, errors, angles. However, a pre- and post-test study implementing a visual perception training program identified that the intervention had positive impacts only on handwriting legibility (Korean consonants), not targeting performance component (visual perception) among children with CP (Kim et al., 2015). Statistically significant changes were also only observed in a comparison group (TDC) that did not receive the intervention (Kim et al., 2015).

A study conducted by Hwang et al. (2017) implemented a proprioceptive-vestibular based sensory integrative intervention in elementary school students. To assess fine motor abilities, the authors administered the Bruininks-Oseretsky Test of Motor Proficiency (BOT-MP) and found that both response speed and visuomotor control items showed increases in the scores.

However, a statistically significant difference was found only in response speed (Hwang et al., 2017). Furthermore, this study examined legibility of Korean consonants and vowels specifically. There was a significant difference in the total score of the writing test; yet, a statistical significance was found in the score of consonant writing, while the vowel writing section showed only an increase in the score with no statistical significance (Hwang et al., 2017). Overall, all studies found positive changes, but there were mixed results in statistical significance.

2.6 Discussion

The current review has identified the patterns of handwriting practice in Korean occupational therapy by collating and summarising the existing studies from South Korea. This section discussed handwriting and occupational therapy in the context of the Korean language and international English language handwriting research.

2.6.1 Predominantly underpowered quantitative observational cohort designs

In relation to the volume of research, the number of studies from the Korean literature (22) is comparable in the same time period to that found in Israel (20), Australia (19), and Canada (19) (Cusick & Elvery, 2017). This similar volume demonstrates a sustained interest in handwriting research in Korean occupational therapy, with more activity evident in the recent 10 years. Unlike the increasing activity in South Korea, Cusick and Elvery (2017), however, reported that the volume of handwriting research had decreased internationally since 2011. This discrepancy may be associated with the special education law for people with disabilities that was enacted in Korea in 2007. In this law, occupational therapists are recognised as special education related service providers on early intervention and therapeutic support for children with disabilities in the school system (Lee et al., 2015). Given that handwriting research is generally conducted in school-aged children (Cusick & Elvery, 2017), it can be seen that handwriting research in Korea finally received attention after the year 2007.

Besides, any research design was considered in the current study, but, even so, all research studies were quantitative studies. While the international literature identified that there is the overwhelming number of observational study, followed by intervention study (Cusick & Elvery, 2017), this scoping review study found an almost equal number of observational cohort studies and intervention studies. Also, both literature identified pre- and post-test as the most common study design for the intervention, while RCT and systematic review were only found in the international evidence. As a matter of fact, two systematic

studies conducted by Korean authors (Hong & Kim, 2010; Jung, 2014) were detected as relevant articles, but, excluded at the selection stage because both studies reviewed evidence from English countries. This may reflect that there had genuinely been no review on handwriting research in Korean occupational therapy.

Also, qualitative components were found in a few single case design studies from the Korean literature. The qualitative findings were consistent with results from other international studies that children with handwriting difficulty exhibit low self-esteem and struggle to perform other daily activities such as self-care tasks (Feder & Majnemer, 2007; Magalhães et al., 2011). However, due to a small sample size of Korean studies of which half were published a decade ago, the Korean findings may have limitations to represent a valid generalisation on a wider group of Korean children with handwriting problems.

2.6.2 Study purposes either evaluated intervention impacts or explored underlying performance components

When it comes to the topics of concern in Korean occupational therapy handwriting research, the current study revealed that equal attention is paid to i) the effectiveness of handwriting interventions and ii) correlation of handwriting quality with underlying performance components. Although task-oriented handwriting interventions were the most popular type of intervention programs in both literature, the international literature found that performance components were more investigated than handwriting interventions.

Most Korean studies addressed at least one performance component relating to biomechanical, perceptual, cognitive or physical abilities (e.g. fine motor control, in-hand manipulation, eye-hand coordination, praxis, visual perception, postural stability and grasp patterns). Similarly, international handwriting studies were found to have a great focus on various performance components of handwriting (Wallen et al., 2013). As handwriting is considered as a complex process requiring a combination of those personal abilities, research on the diverse components can be thought to be reasonable and may be encouraged. Considering that Korean handwriting researchers are more likely to refer to English literature because of the small amount of the existing studies from the Korean literature, Korean handwriting research relating to performance component is expected to grow as in the international literature.

2.6.3 Occupational therapy handwriting practice settings

Both Korean and English literature found that the most common study setting was school. Although the hospital was the second most common setting in Korean studies, no studies based on hospital settings were found in the international literature. This opposite finding can be explained by societal background on which Korean occupational therapy practice is mainly developed. Based on a previous study conducted by Lee et al. (2010), the most common workplaces for a majority of Korean occupational therapists were hospitals. An analysis study using the data of the KAOT also found that while nearly 25% of the members were either unemployed, students or professors, 57% of the Korean occupational therapists who were the association members (n=2,982) worked in hospitals (Lee, Chang, Jung, Ku, & Woo, 2014). Hence, as Korean occupational therapy has largely emerged in the form of rehabilitation at hospitals, it is suggested that handwriting practice in occupational therapy are delivered based in hospital settings.

2.6.4 Children receiving occupational therapy for handwriting

Consistent with previous studies (Cusick & Elvery, 2017; Feder, Majnemer, & Synnes, 2000), Korean school-aged children are identified as the most studied participants. However, unlike the international literature where the majority of evidence relates to TDC (Cusick & Elvery, 2017), in Korean practice over half of the research studies investigated handwriting of children with diagnosed conditions, the most common being CP. As discussed earlier, Korean occupational therapy profession has significantly developed based on medical settings where it traditionally focuses on remedial occupational therapy for children who have medical conditions. Thus, it is possible that TDC who may have handwriting difficulty have not received enough attention compared to children with the diagnosis, even though Korean occupational therapy services have expanded in the educational districts such as kindergarten and school since 2007.

In this study, qualitative components from two Korean studies gave brief insights into how caregivers/children approached occupational therapy services. Although a caregiver was aware of a child's writing difficulty, it was noted that caregivers and/or teachers made referrals to occupational therapy for other reasons than handwriting difficulty. While this indicates that the primary reason for referrals to Korean occupational therapy could differ from the international literature, it is tempting to think that there may be a lack of social systems to identify and support children with handwriting problems within Korean community.

2.6.5 Non-standardized assessments in occupational therapy handwriting practice

Predominantly, non-standardized assessments – writing Korean alphabets, words, or sentences – were used in order to measure handwriting quality. There were researchers who conducted studies with non-standardized structured assessments by using a letter evaluation sheet, legibility standards and score criteria established from previous Korean studies. Structures of non-standardized assessments provide evaluators opportunities that control biases associated with a person, testing item and environment (Luebben & Royeen, 2010). Understanding that handwriting has been focused on as occupation which is central to occupational therapy profession (Cusick & Elvery, 2017), the popularity of the Korean writing assessments could be seen as positive.

However, given that there is a lack of standardized assessments available in Korean, this leads to another possible explanation regarding the use of non-standardized assessment. Since occupational therapy emerged from English speaking countries, it is clear that most occupational therapy assessments are available in English. Due to the cultural and linguistic differences between English and non-English speaking backgrounds (McDonald, 2000), it can be, therefore, considered that Korean researchers and occupational therapists might intend to use non-standardized assessments, as it allows them to gather valid results for a child client in South Korea.

2.6.6 Standardized assessments in occupaitonal therapy handwriting practice

From the Korean occupational therapy literature, standardized assessments were found more than non-standardized assessments and were most commonly used to measure performance components. However, most of the identified standardized assessments were used without local validation - for example, Korean version of assessments (e.g. K-DTVP-2 and K-DDST-2); the assessments were translated but no psychometric information was provided about translating the instrument. To obtain and compare accurate evaluation outcomes from children over time, using standardized assessments are recommended. If standardized assessments that are relevant to the Korean culture and linguistic background are not available, this will not only result in evidence-based practice being undervalued, but also prompt less motivation for Korean occupational therapists to use standardized assessments to measure both handwriting quality and performance components, increasing the use of non-standardized assessments.

Other countries where English is not their first language have been aware of issues with using English version of evaluation tools. For instance, since the characteristic features of the language are different, studies to develop handwriting evaluation tools have been focused and investigated in China (Lam, Au, Leung, & Li-Tsang, 2011; Tseng, 1998). In South Korea, the

authors who conducted an instrumentation study to develop the handwriting instrument also pointed out that the new instrument is required for cultural validity reflecting on unique characters of Korean because there is difficulty of comparing findings with established tests developed overseas that did not use Korean characters (Lim et al., 2018). Thus, it is suggested that more standardized assessments need to be more available in Korean, and further studies are needed in Korean handwriting research using the Korean version of formal assessments.

2.6.7 Studies focused on intervention

Of 22 studies, 10 explored the impact of the intervention. Most used standardized measures, but each study used a unique author designed program. There was no intervention program replication, while SI was the most popular approach. Despite various types of intervention, all showed positive changes in one or more outcome measure relating to legibility and/or speed. However, this observed change was not statistically significant in some studies. A mix of outcomes was observed across a range of measures beyond speed and legibility. For example, studies using the SI approach reported outcome measure improvement in things as different as legibility of Korean consonants but not vowels, response speed (time task) or postural stability. It should be noted the effects of the intervention on handwriting quality and/or performance components could vary depending on children's diagnosis.

The current review revealed that fine motor abilities were more investigated than other performance components in Korean correlational research, while the intervention studies most commonly targeted eye-hand coordination in the Korean literature. According to a Canadian survey, fine motor related hand function was reported as commonly and routinly assessed by Canadian occupational therapists, followed by perceptual abilities and quality of movement and motor planning (Feder et al., 2000). These inconsistent findings indicate that there is no consensus built in the literature for Korean handwriting practice nor in the international evidence.

2.6.8 Study limitations

Compared to international age, the Korean age is always one to two years older. The correct Korean age can be only calculated from the international age when the actual birth date of participants is obtainable. Therefore, the average age of all child participants in this scoping review is an estimation. Also, only a small number of studies used the evaluation tools and handwriting treatments. For instance, although eye-hand coordination was identified as the most common targeting component for the intervention, it was only studied two times

whereas other components were studied only once. Moreover, since scoping reviews do not rigorously appraise the quality of evidence, this assessment of the body of evidence was not done. Thus, interpretation of the review as evidence should be done with caution. Finally, this study only used three search databases. By including other Korean databases, it would help to find more relevant articles that might be published outside the official journal of Korean occupational therapy.

2.7 Conclusions

Handwriting research has been constantly growing in South Korea. Particular research topics were investigated in relation to the development of an evaluation tool, correlation of handwriting quality with underlying components as well as intervention programs targeting legibility, speed and/or specific performance components. With small sample sizes, however, most of the found evidence was primary and quantitative studies. Further investigation is, therefore, required to describe a current trend of Korean occupational therapy practice for handwriting. Also, like other countries, there were no consensus and gold standard guideline in the Korean literature. This highlights that high-quality handwriting research using standardized instruments in Korean is warranted not only in children with medical conditions but also in typically developing children. As diversity has become crucial in the occupational therapy profession, the summarised results of the current study have significance by introducing more evidence to the international literature. This will enrich the diversity of evidence on handwriting research and will be fundamental data that assists Korean and international occupational therapists and policymakers to promote the evidence-based handwriting program service.

2.8 Conflicts of Interest Statement

The authors declare no conflict of interest.

2.9 Supplementary Materials Index

The online Supplementary Materials are available through this link (note to examiners - the supplementary materials are the appendices in this thesis).

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CHAPTER 3

THESIS SUMMARY, IMPLICATIONS AND RECOMMENDATIONS

3.1 Introduction to Chapter

The findings of the scoping review were discussed in the previous chapter (see Section 2.6 Discussion). This chapter closes off the thesis by summarising critical findings and suggests implications and recommendations for future research and practice. Further, study limitations identified but not presented in scoping review are also included.

3.2 Summary of Key Findings from Scoping Review

Handwriting difficulty is common in both educational and health sectors. Due to complex factors associated with handwriting performance, there has been a wide range of international research activity regarding the quality of handwriting and its performance components. The scoping review on the literature from South Korea demonstrated that Korean researchers have shown sustained interest in this research area between 1991 and 2018 and that this focus has become more active in the last 10 years with more research completed. It was noted that they equally paid attention to two distinct topics of handwriting research. These topics were interventions and correlational investigations around handwriting quality with underlying performance components. All of the included studies were identified as quantitative studies such as pre- and post-test or single case ABA design studies.

Further, Korean occupational therapy handwriting research was found to differ from the international English language handwriting research as follows:

Firstly, hospitals were the second most common setting in Korean studies but not in international literature. School-based settings were the most common research settings in both Korean and international handwriting research.

Secondly, although Korean school-aged children were the most studied participants in both Korean and international literature, the children had medical or diagnosed conditions in the Korean research with CP being the most common diagnosis. In international literature the children were most commonly typically developing children.

Thirdly, informal handwriting assessments developed by the Korean authors based on previous studies were frequently used for handwriting quality measurements. On the other

hand, consistent with previous studies, standardized assessments were dominantly used to measure various performance components in Korean practice. However, the most targeting component was fine motor function in the Korean research, whereas different popularity regarding targeting components was found in the international literature (e.g. visual perception or both gross and fine motor function).

Lastly, Korean research investigated the different types of handwriting treatments which focussed on task-oriented interventions with sensory integration approaches most studied. However, unlike international literature where task-specific training was most frequently applied with the named intervention programs such as “Handwriting Without Tears”, “Write-Start” and “Size Matters”, these programs were not named and were specific to the single Korean studies in occupational therapy practice.

3.3 Implications and Recommendations

Multinational studies, including Korean research, has yielded knowledge about handwriting practice over decades. This indicates that researchers and practitioners value building a strong evidence for the best outcomes for handwriting interventions. In this regard, the high quality research evidence needs to be conducted. For instance, randomized controlled trials (RCTs) and systematic review studies are ranked at very high levels in the hierarchy of evidence (Hoffman, Bennett, & Del Mar, 2017). As the high-level studies are less likely to cause systematic error (bias) than lower levels of evidence, using these well designed studies is regarded as providing reliable and duplicable results of the study for the real world practice (Burns, Rohrich, & Chung, 2011; Hoffman et al., 2017).

However, the current scoping review identified that there were only quantitative studies, and that these used research designs that were low level of evidence (e.g. pre- and post-test and single case study) (Hoffman et al., 2017). To build up a strong evidence base, it is imperative that higher levels of evidence should be obtained (Hoffman et al, 2017). The existing lower levels of evidence may be useful. As long as the low level of evidence shows relevance to research questions and consistency of study data across research, these low quality evidence can be graded and used to provide recommendation guidelines for children’s handwriting difficulty (Burns, Rohrich, & Chung, 2011). This indicates that there is a chance that a majority of Korean studies found from the scoping review may be able to contribute to future consensus. Whether or not Korean results support previous empirical studies will suggest new directions for future research development to embrace diversity in health research.

In the future, Korean handwriting research should be introduced, using diverse research designs. Particularly, it is recommended to use RCTs and systematic review designs in order for future consensus or guideline regarding handwriting research. To more accurately integrate Korean data into international literature, different aspects between Korean and English cultures should be considered. For example, there is a different way of calculating age between Korean and English countries. Since most Korean studies rarely reported the International ages of their study participant as they tended to present their Korean ages, then this suggests a need for researchers to provide participants' chronological age in accordance to international standards. By doing so, it will facilitate a valid comparison in data collected from Korea and other countries.

The key findings from the scoping review also reinforce the need for neglected topics in Korean handwriting research. This research will involve study with typically developing children or different types of intervention approaches other than sensory integration based approaches (e.g. named handwriting intervention programs). On top of that, it is identified that no studies primarily investigated environmental aspects in South Korea, which is similar to the result of the previous scoping review by Cusick and Elvery (2017) that environmental aspects were identified as neglected. As handwriting is understood as activity which children participate in within the natural context, studies focusing on contexts where handwriting performance occurs would benefit practice development in occupational therapy.

Also, despite the fact that there has been a great attention to children with medical conditions and sensory integration approaches for handwriting practice in Korean occupational therapy, the current trend of Korean occupational therapy for children's handwriting is still unrevealed due to the absence of qualitative research and a small number of handwriting studies of which almost half are out-of-date. This means that another descriptive research will be needed to explore the current trend of Korean occupational therapy handwriting practice regarding caseload, standardized/non-standardized assessments, intervention approaches and targeting performance components or factors including environmental aspects (Cusick & Elvery, 2017). Therefore, as part of the follow up work associated with the scoping review, the thesis author was involved in developing a protocol for a survey. Due to time limitations for the thesis unit (which required assessment before semester one commencement in 2019), the survey could not be implemented. The development of the protocol is, however, part of the work undertaken for this thesis (see Appendix E: A protocol for a survey of occupational therapy handwriting practice in South Korea).

Recently, one of WFOT executive members, Ritchard Ledgerd visited a head office of the KAOT, and he discussed with Korean occupational therapists and identified global connections as a priority to enhance research project and development in occupational therapy profession, which reflects on diversity derived from different countries (KAOT, 2018b). The scoping review is a very recent collaboration between a native Korean-speaking student researcher originally from a non-English speaking country, South Korea and a native English-speaking researcher in Australia. The methodology of the current scoping review which was described in great detail could be utilised for future bilingual approaches to review of non-English literature in occupational therapy.

Apart from the issue of bilingual methods, effective communication within collaborations can be also achieved when team members share a common language where key terms have the same meaning (Mitzkat, Berger, Reeves, & Mahler, 2016). The ICF was used in this study to define aspects of the hand and hand function. The ICF taxonomy may be useful for international collaboration, as it was developed through international consensus, and its codes can be used by any health professionals from different cultural and linguistic backgrounds. For instance, if researchers or clinicians address children's "attention", which is categorised under "Mental functions", and present codes between b1400 and b1409 in their document, any other professionals from different nationalities or disciplines or countries may be able to check what the term indicates in their own language (currently available in English, Chinese, French, Russian, and Spanish; and multiple languages may be in translation process). If a child's hand function is reported with b7300 "Power of isolated muscles and muscle groups" (e.g. small muscles of hands), b152 "Emotional functions" (e.g. hate and anxiety) and d145 "Learning to write", impairments in these areas may trigger a referral to be made in relation to relevant health professions such as physiotherapists, psychologists and occupational therapists. Therefore, understanding the ICF location and categorization of the hand will help ensure consistent use of terms and stimulate boundless communication in health research and practice worldwide.

3.4 Study Limitations

Specific limitations are associated with this scoping review have been presented in the relevant section, Chapter 2. In this section, other limitations are identified. This includes the limited time available to conduct the study because it was located within the coursework of a Master's degree program. Another limitation was reliance on the author (SL) to complete all translations due to financial reasons. The studies could not be professionally translated and it

is possible that the author's translation could be inaccurate. It should be noted, however, that the thesis author is a qualified occupational therapist with a bachelor degree in Korea and has practiced for two years as an occupational therapist. Therefore, this enhances the likelihood of appropriate translation of Korean occupational therapy research literature.

3.5 Chapter Synopsis

The current chapter presented a summary of key findings from the scoping review. The implications and recommendations for future research and practice were considered. A survey protocol for future research was introduced and appended, and general study limitations were described.

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TABLES

Table 2.1: Inclusion and exclusion criteria

	For screening the title and abstract	For reviewing the full text
Inclusion	Papers were: a) About Korean occupational therapy practice AND b) Written either in English or in Korean AND c) Targeting children as study population AND d) Containing search strategy terms	Papers were: a) About Korean occupational therapy practice AND b) Written either in English or in Korean AND c) Targeting children as study population AND d) Having a handwriting topic
Exclusion	Papers were: a) Not articles b) Not relating to handwriting c) Studies not conducted in South Korea but other countries	Papers were: a) Not having original data on handwriting b) Not including the data from the population of Korean children

Table 2.2: Study settings

Type of Settings	Name of Settings	Study Identifiers
Education setting	elementary school	[13], [22]
	kindergarten	[5], [19]
	special education school	[11]
	rehabilitation school	[9]
	daycare centre	[15]
Hospitals	university hospital	[6], [7], [18]
	rehabilitation hospital	[4], [8]
Clinics/centres	occupational therapy/sensory integration room	[2], [20]
	developmental clinic/centre	[12], [21]
	rehabilitation centre (inpatient/outpatient),	[14]
Multiple service setting*	elementary school, clinic	[3]
	kindergarten, community rehabilitation centre (outpatient), university hospital (inpatient)	[10]
	local children's centre, church (Sunday school), private educational institute	[1]
Not specified		[16], [17]

**Multiple locations were used to collect data for study.*

Table 2.3: Participant demographics - age

Category		Study Identifiers
Years and/or months with:	mean age and age-range	[5], [7], [8], [9], [12], [13], [15], [16], [17], [18], [19], [22]
	age range	[10]
	no mean age and age-range	[2], [3], [4], [6], [11], [20], [21]
No years and/or months	only age-range	[14]
	only grades (grade 1 ~ grade 6)	[1]

Table 2.4: Participant demographics - existence of medical conditions

Category		Study Identifiers
Children with medical conditions:	Cerebral palsy (CP)	[4], [6], [8]*, [9], [14], [16]
	Attention Deficit Hyperactivity Disorder (ADHD)	[2], [3]
	Intellectual disability (ID)	[11]
	Developmental Coordination Disorder (DCD)	[12]
	Syndrome & ID	[20]
	Mixed group	[7]**, [10]***
Children without medical conditions:	Typically developing children (TCD)	[1], [5], [13], [15], [17], [19], [22]
	TCD (having difficulty in maintaining learning attitudes and relationships with peers)	[21]
Children with and without medical conditions	TCD + CP	[18]

**Adults cohort was excluded.*

***A mixed group consisted of CP, delayed development (DD), language disorder, intellectual disability and brain injury.*

****A mixed group consisted of CP and traumatic brain injury (TBI)*

Table 2.5: Assessment administrators

Administrators mentioned:	Identified administrators OR professions if unidentified	Study Identifiers
Yes clear	Occupational therapist(s)/OT researcher(s)	[3], [6], [7]
	Occupational therapists, OT researchers and OT students	[5]
	Occupational therapist and physiotherapist	[9]
	Special education teacher(s)/researcher(s)	[11], [12]
Yes but not clear	OT ("therapists" or "observers" or "evaluator" or "investigator")	[2], [8], [15], [17]
	OT and physiotherapy ("therapist")	[19]
	OT and physical medicine and rehabilitation ("evaluators")	[22]
No	OT	[1], [4], [13], [16], [20], [21]
	Special education	[14]
	OT and physiotherapy	[18]
	OT and rehabilitation medicine	[10]

Table 2.6: Intervention type, programme and approaches

Category	Intervention type	Intervention name/tool	Intervention approach	Study Identifiers
Handwriting as a primary focus	Task-oriented handwriting program (*targeting* legibility + speed)	• Task-oriented intervention; copy contents of textbooks	Task-oriented approach	[2]
		• Sensory integration treatment	Sensory integration (SI)	[3]
		• Collaborative teamwork intervention for application of the low-tech assistive technology	Collaborative teamwork approach	[11]
	Task-oriented and performance component targeted handwriting program	• Customised vest *targeting* legibility + postural stability	Sensory integration (SI)	[12]
		• Visual perception training program *targeting* legibility + visual perception	Nothing mentioned	[18]
		• Sensory integrative intervention *targeting* legibility + fine motor function	Sensory integration (SI)	[21]
	Performance component targeted handwriting program	• Intentional Snoezelen program *targeting* eye-hand coordination	Multi-sensory environment	[4]
		• Visual perception training program *targeting* eye-hand coordination	Nothing mentioned	[6]
Handwriting as a part of measure not a program's focus	Task-oriented occupational therapy program	• Occupational therapy functional training* *targeting* performance of activities of daily living	Occupation/activity focused approach	[14]
	Performance component targeted program	• Sensory integration therapy *targeting* tactile sensitivity, postural response, bilateral coordination, fine motor skills and motor planning	Sensory integration (SI)	[20]

**Comparison study between occupational therapy functional training with and without therapeutic exercises focusing on gross motor and/or fine motor.*

Table 2.7: Frequency and duration of interventions

Day/s a week	Study Identifiers	Minutes for a day	Study Identifiers
1	[12], [18]*	10≤	-
2	[4], [21]	20≤	[2], [11], [18]*
3	[3], [6], [14]	30≤	[6], [14]
4	[11]	40≤	[3], [12], [21]
Not reported	[2], [20]	Not reported	[4], [20]

**Intervention was conducted two times a day. The duration of each session was between 10 and 15 minutes so the total duration for a day was estimated at approximately 25 minutes.*

Table 2.8: Intervention administrators

Administrators mentioned:	Identified administrators / professions if unidentified	Study Identifiers
Yes clear	Occupational therapists	[12], [18]
	OT researcher	[6]
	Collaborative team (consisting of occupational therapists and special education teachers)	[11]
Yes but not clear	OT ("therapist")	[2], [3]
No	OT	[4], [20], [21]
	Special education	[14]

Table 2.9: Participant screening criteria (based on groups of children with or without medical conditions)

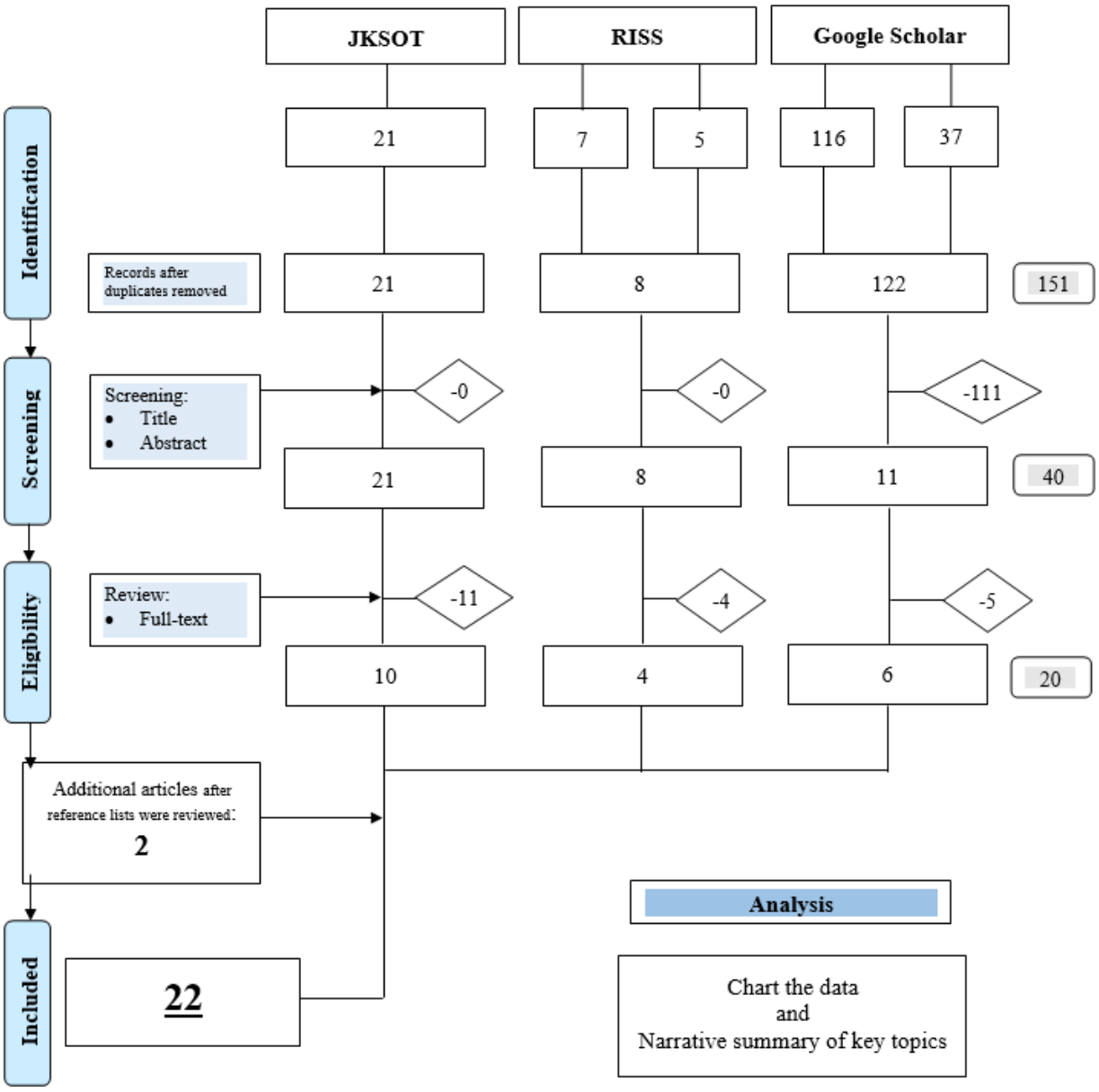
Eligibility Criteria	Study Identifiers for studies with Children who had medical conditions	Study Identifiers for studies with Children who have no medical conditions
No history of any disease or physical impairments / disabilities (e.g. visual, hearing, arm, hand functions)	[11], [12], [16]	[13], [17], [19], [22]
Comprehensive developmental/functional status score	[6] tested with LAP, [14] tested with Activities of Daily Living, [8] tested with FIM (dressing and eating items)	[5] K-DDST-2, [15] K-DDST-2, [19] DDST-2
Can follow verbal instructions (no difficulty to understand)	[2] tested with K-WISC-3 for intelligence score, [9], [11]	[19], [22]
No experience of receiving interventions	[2] no previous handwriting intervention, [3] no previous SI therapy program, [11] no previous handwriting therapy AND no previous experience on low-tech assistive device	[5] no previous special education or therapy
No visual perception problem	[2] tested with DTVP-2	-

Table 2.10: Targeting measurements of observational cohort studies (except for instrumentation study)

Aim of study	Handwriting quality	Performance component	Study Identifiers
Correlation	legibility and speed	visual perception, praxis	[19], [22]
	legibility	visual perception, fine motor skills, proprioception, bilateral coordination & ULs speed, hand strength, sitting balance	[5], [15], [16], [17]
	speed	finger coordination	[13]
	writing as measure not a program focused	cognition	[7]
Comparison (between groups)	speed as measure not a program focused	-	[10]
Observation	-	in hand manipulation, grasp pattern	[8], [9]

FIGURES

Figure 2.1: Study identification and selection flow chart



Flow Chart Format Adapted From: Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., The PRISMA Group. (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. *PLoS Med* 6(7): e1000097. doi:10.1371/journal.pmed1000097

Figure 2.2: Published articles in Korean occupational therapy for children's handwriting

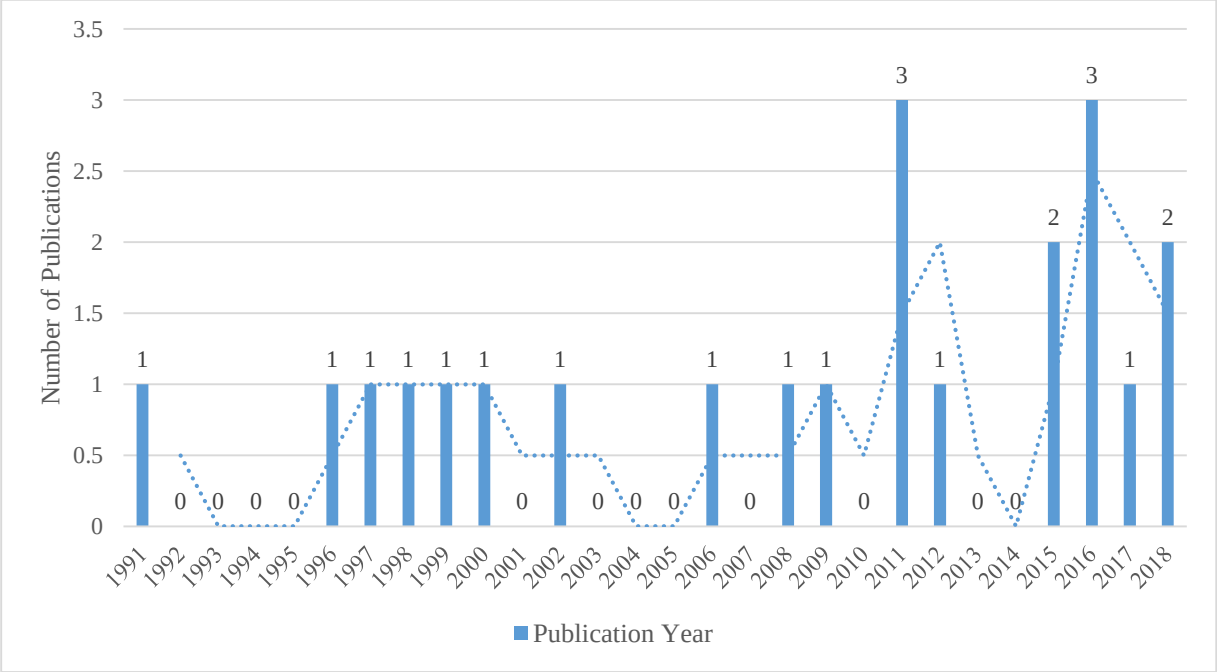


Figure 2.3: Sample sizes

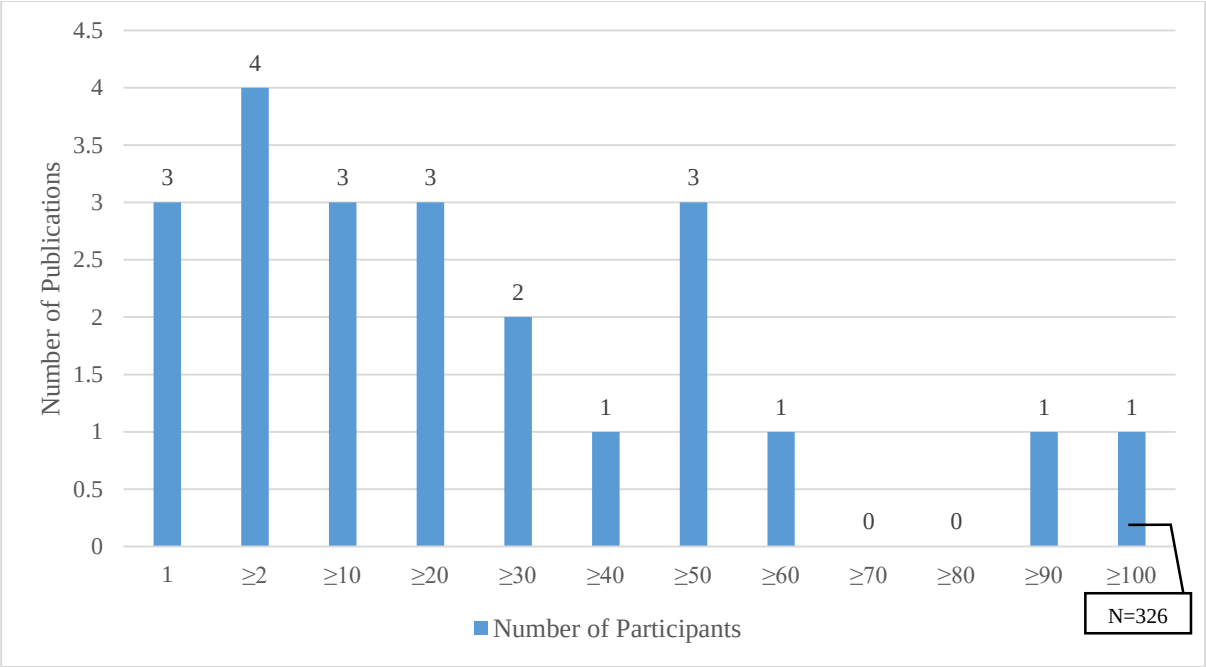
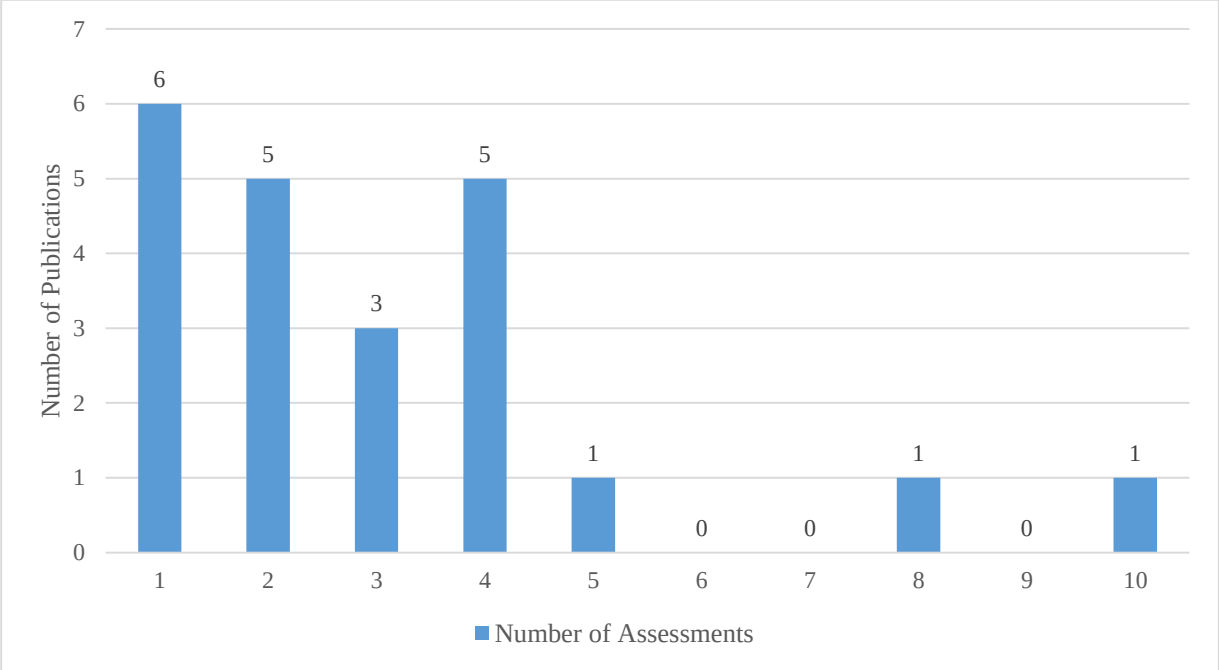


Figure 2.4: Total number of assessments used in each study



APPENDICES

Appendix A: Search strategy (Please see Word document as an email attachment; in journal article, this would be online supplementary)

Appendix B: Study identifiers for the included studies (n=22) (Please see Word document as an email attachment; in journal article, this would be online supplementary)

Appendix C: Chart for data extraction (Please see Excel attachment; in journal article, this would be online supplementary)

Appendix D: Lists of standardised, non-standardised and non-determined assessment reported with targeting elements (n=41) (Please see Word document as an email attachment; in journal article, this would be online supplementary)

Appendix E: A protocol for a survey of occupational therapy handwriting practice in South Korea

Design. A quantitative and qualitative cross-sectional study design is selected. An online survey will be used to collect the information about demographic characteristics of Korean paediatric occupational therapists, their employment characteristics and types of handwriting assessments and interventions used by them for children with handwriting difficulty. To test the feasibility of administration, a full protocol was developed as follows:

- Develop instrument (e.g. items based on scoping review).
- Identify convenience sample of occupational therapists working in South Korea to pilot the survey and receive feedback on the items.
- Develop recruitment strategy.
- Develop an administration protocol to test the feasibility of administration.
- Apply for pilot ethics.
- Create a survey on the online platform.
- Administer pilot survey.
- Collect data which include users' feedback and their suggestions for improvements.
- Analyse data including users' feedback.
- Revise instrument and protocol for use in lager study.

Instruments. The survey will be developed based on the results of the 2018 scoping review and divided into the five sections: a) demographic characteristics of occupational therapists such as gender, age and occupational therapy practice experiences, b) their employment characteristics such as location and type of setting, c) intervention, d) assessment, and e) comments. Except for the last section which has an open type of questions, other individual questions will be designed as a close response. For example, Yes/No questions or multiple choice questions will be applied to promote the response rate for a future study. All questions will be created in English by the research team and then the research investigator whose first language is Korean will translate the questions into Korean. To make all questions clear, the Korean version will be inspected by a native speaking Korean occupational therapist not previously involved in the survey or associated document development. If any issues of intelligibility, interpret-ability or local relevance are identified, these will be addressed by further translation and the use of professional back-translation from Korean to English.

Sample and recruitment. Participants of survey will be Korean occupational therapists who self-identified themselves as having experience with paediatric handwriting practice. A convenience and snowball sampling will be used in order to try reaching a large pool of potential participants who live outside Australia. To recruit survey participants, the Korean Association of Occupational Therapist (KAOT) will be contacted. If the association agrees to help the recruitment process, their database system will be used by the association staff to send email invitations to occupational therapists who agreed with using their details for the research purpose. The email invitation will include Participant Information Statement and a link for online survey.

Ethics. No personal details of potential participants will be sought for privacy protection. Potential participants will also be given an acknowledgement of their right to agree or refuse to participate in the survey.

Data collection and analysis. The anonymous responses will be collected via a database of a secure website for online survey. Any users' feedback and suggests for improvements will be recorded electronically. The data collected from the online survey will be then summarised by using a descriptive statistical method. The qualitative data such as feedback on question order or categorisation will be also analysed to improve the survey instrument and protocol.

Appendix F: Survey instrument (English version)

OCCUPATIONAL THERAPY PRACTICE FOR CHILDREN WITH HANDWRITING DIFFICULTIES IN SOUTH KOREA: A NATIONAL SURVEY

Online survey structure/ layout	Questions
Information on survey	*The whole Participant Information Statement (PIS) will be embedded in this section.*
Online consent	Please select your choice below. Clicking on the "Agree" button indicates that you voluntarily agree to participate. ☐ Agree ☐ Disagree
Section 1. Demographic Characteristics	1. What is your gender? ☐ Male ☐ Female 2. What age group are you in? ☐ Under 25 years old ☐ 25 - 29 ☐ 30 - 39 ☐ 40 - 49 ☐ 50 - 59 ☐ Over 60 years old 3. What type of Occupational Therapy (OT) qualification do you have? ☐ College degree ☐ University degree ☐ Postgraduate degree ☐ Doctoral degree 4. How long have you been working as an occupational therapist? (Years of practice) ☐ Below 2 years ☐ 3 - 5 years ☐ 6 - 9 years ☐ 10 - 14 years ☐ Over 15 years 5. How long have you worked with children? (Years of paediatric practice) ☐ Below 2 years ☐ 3 - 5 years ☐ 6 - 9 years ☐ 10 - 14 years ☐ Over 15 years 6. Are you currently working with children? ☐ Yes ☐ No, but used to work before
Section 2. Employment Characteristics **<u>(Multiple choice included)</u>**	7. Which option best describes where you work(ed) when working with children? ☐ Seoul ☐ Sejong ☐ Incheon/ Gyeonggi ☐ Daejeon/ Chungcheong ☐ Daegu/ Gyeongbuk/ North Gyeongsang ☐ Busan/ Ulsan/ South Gyeongsang ☐ Gwangju/ Jeolla ☐ Kangwon ☐ Jeju

8. Which category best describes your primary work setting when working with children?
   - ☐ University hospital
   - ☐ General hospital
   - ☐ Children's hospital
   - ☐ Hospital
   - ☐ Rehabilitation
   - ☐ Private clinic
   - ☐ School/ supporting centre for special education
   - ☐ Specialized child-care centre
   - ☐ Community welfare centre

9. Please indicate your caseload in the selected primary work setting.
   - ☐ Inpatient
   - ☐ Outpatient
   - ☐ Community-based
   - ☐ School-based
   - ☐ Other:

10. Do/did you have children with handwriting difficulty in your caseload?
    - ☐ Yes
    - ☐ No

    * If No, please go to question 12.

11. Please indicate your client groups in handwriting difficulty.
    - Age
    - ☐ Infants (0-6 months)
    - ☐ Toddlers (6 months-2 years)
    - ☐ Pre-schoolers (3-7 years)
    - ☐ Primary school-age students (8-13 years)
    - ☐ Middle school-age students (14-16 years)
    - ☐ High school-age students (17-19 years)

    - Diagnostic characteristics
    - ☐ Cerebral palsy (CP)
    - ☐ Developmental Coordination Disorder (DCD)
    - ☐ Attention Deficit Hyperactivity Disorder (ADHD)
    - ☐ Autism
    - ☐ Brain injury
    - ☐ Intellectual disability
    - ☐ Visual impairment
    - ☐ Hearing impairment
    - ☐ Developmental delay
    - ☐ Dyslexia
    - ☐ Others:
    - ☐ No diagnosis/ typically developing children

12. In your experience, are handwriting difficulties a primary reason for referral to occupational therapy?
    - ☐ Yes
    - ☐ No

    10-1. If Yes, who refers to occupational therapy for handwriting intervention?
    - ☐ Parents
    - ☐ Teachers
    - ☐ Schools
    - ☐ Doctors

	☐ Others: 10-2. If No, what are the other primary reasons for occupational therapy referral?
Section 3. Interventions **<u>(Multiple choice included)</u>**	13. How often do/did you provide handwriting programs to children with handwriting difficulties? ☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always 12-1. If Never, what are/were the reasons? Due to: ☐ Other needs of children ☐ Other goals of parents ☐ Other goals of teachers ☐ Uncertainty about the effectiveness/ lack of evidence ☐ Other: 14. What type of interventions do/did you provide? ☐ Performance component intervention ☐ Sensory motor intervention ☐ Task-specific/oriented intervention ☐ Assistive devices/ equipment ☐ Other: 13-1. Which component of handwriting performance do/did you target in treatment? ☐ Sensory – sensory processing ☐ Sensory – perceptual processing ☐ Neuromusculoskeletal ☐ Motor – Gross motor skills ☐ Motor – Find motor skills ☐ Motor – visual motor integration ☐ Cognitive ☐ Psychosocial/ psychological 15. How do/did you plan handwriting programs? ☐ Korean textbooks ☐ Korean journals ☐ English textbooks ☐ English journals ☐ English textbooks or journals translated in Korean ☐ Other:
Section 4. Assessments **<u>(Multiple choice included)</u>**	16. Please select all assessments that you use(d) in your setting for children's handwriting performance. ☐ Korean (Hangul) Alphabet Writing Evaluation ☐ Curriculum-Based Measurement (CBM) ☐ Copy Korean Sentences ☐ Jebsen-Taylor Hand Function Test (JHFT) ☐ The School Version of the Assessment of Motor and Process Skills (School AMPS) ☐ Developmental Test of Visual Perception (DTVP)/ DTVP-2 ☐ Beery Buktenica Developmental Test of Visual-Motor Integration (Beery VMI) ☐ Digitizing Tablet/ Computerized Handwriting Evaluation System (ComPET) ☐ Evaluation Tool of Children's Handwriting (ETCH) ☐ Bruininks Oseretsky Test of Motor Proficiency (BOT-MP) ☐ Minnesota Handwriting Assessment (MHA) ☐ Southern California Sensory Integration Tests/ Sensory Integration and Praxis Test ☐ Concise Evaluation Scale for Children's Handwriting (BHK)

	☐ Movement Assessment Battery for Children (Movement ABC)/ Movement ABC-2 ☐ Hebrew Handwriting Evaluation Scale ☐ Wechsler Intelligence Scale for Children (WISC) ☐ Learning Accomplishment Profile (LAP) 15-1. Are/were there other standardised assessments that you use(d) but not on the list? 15-2. Are/were there other non-standardised assessments that you use(d)? 15-3. Do/did you use any Korean version of English assessments? 17. Which option best describes your frequency of the use of standardised assessments? ☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always 18. When do/did you use standardised assessments? For the stage of: ☐ Screening ☐ Baseline ☐ Progress ☐ Outcome 19. How do/did you use assessment results? ☐ Treatment plan for yourself ☐ Treatment plan with the team ☐ Report to parents/carers ☐ Report to school ☐ Other: 20. Why did you choose the standardised assessments used for handwriting? ☐ Evidence from the literature. ☐ They are already in use at the practice. ☐ Other:
Section 5. Any feedback/ opinions	If you would like to share any of your thoughts on handwriting practice, please leave comments below. (e.g. barriers, available resources or research areas you wish to explore)
Online consent	Please click a button 'Return of a Survey'
End page (e.g. "Thank You!")	

Appendix G: Survey instrument (Korean version)

글씨 쓰기 어려움이 있는 아동을 위한 작업치료행위: 국내 설문지 조사

Online survey structure/ layout	Questions
Information on survey	*The whole Participant Information Statement (PIS) will be embedded in this section.*
Online consent	아래에 귀하의 결정을 선택해주십시오. "동의" 버튼을 클릭하는 것은 귀하께서 자발적으로 연구 참여에 동의함을 의미합니다. ☐ 동의 ☐ 비동의
Section 1. Demographic Characteristics	1. 귀하의 성별은 어떻게 되십니까? ☐ 남성 ☐ 여성 2. 귀하는 어떤 연령대 그룹에 속합니까? ☐ 25 세 이하 ☐ 25 - 29 ☐ 30 - 39 ☐ 40 - 49 ☐ 50 - 59 ☐ 60 세 이상 3. 귀하의 작업치료학 관련 최종 학력은 무엇입니까? ☐ 대학 전문학사 ☐ 대학교 학사 ☐ 대학원 석사 ☐ 대학원 박사 4. 귀하의 작업치료사 경력은 얼마나 되십니까? ☐ 2 년 미만 ☐ 3 년 – 5 년 ☐ 6 년 – 9 년 ☐ 10 년 – 14 년 ☐ 15 년 이상 5. 귀하는 아동작업치료에 얼마 동안 종사했습니까? ☐ 2 년 미만 ☐ 3 년 – 5 년 ☐ 6 년 – 9 년 ☐ 10 년 – 14 년 ☐ 15 년 이상 6. 현재 아동작업치료에 종사하고 있습니까? ☐ 예 ☐ 아니오. 그러나 이전에 종사한 경험이 있습니다.

Section 2. Employment Characteristics **(Multiple choice included)**	7. 귀하의 근무지는 어느 지역입니까/였습니까? ☐ 서울 ☐ 세종 ☐ 인천/ 경기도 ☐ 대전/ 충청도 ☐ 대구/ 경북/ 경상북도 ☐ 부산/ 울산/ 경상남도 ☐ 광주/ 전라도 ☐ 강원도 ☐ 제주도 8. 귀하의 근무 기관은 무엇입니까/이었습니까? ☐ 대학병원 ☐ 종합병원 ☐ 어린이병원 ☐ 병원 ☐ 재활병원 ☐ 사설기관 ☐ 학교/ 특수교육지원센터 ☐ 특수장애아동센터 ☐ 복지관 9. 근무 기관에서 귀하의 클라이언트 형태는 무엇인지/이었는지 선택해 주십시오. ☐ 입원환자 ☐ 외래환자 ☐ 지역사회 기반 ☐ 학교 기반 ☐ 외: 10. 귀하의 클라이언트 중에 글씨 쓰기 어려움이 있는 아동이 포함되어 있나요/있었나요? ☐ 예 ☐ 아니오 * 만약 아니오를 선택했다면, 12 번 질문으로 가십시오. 11. 귀하가 봐온 글씨 쓰기 어려움이 있는 아동 그룹을 선택해 주십시오. • 연령대 ☐ 영유아 (0-6 개월) ☐ 유아 (6 개월-2 세) ☐ 학령전기 아동 (3-7 세) ☐ 초등학생 (8-13 세)

	☐ 중학생 (14-16 세) ☐ 고등학생 (17-19 세) • 진단적 특징 ☐ 뇌성마비(Cerebral palsy, CP) ☐ 발달성 협응장애(Developmental Coordination Disorder, DCD) ☐ 과잉행동장애(Attention Deficit Hyperactivity Disorder, ADHD) ☐ 자폐스펙트럼장애(Autism Spectrum Disorder, ASD) ☐ 뇌손상(Brain injury) ☐ 지적장애(Intellectual disability) ☐ 시각적 장애(Visual impairment) ☐ 청각적 장애(Hearing impairment) ☐ 발달지연(Developmental delay) ☐ 난독증(Dyslexia) ☐ 외: ☐ 진단 없음/ 정상발달아동 12. 귀하께서 임상에서 있는 동안, 글씨 쓰기 어려움이 제일 주요한 이유로 작업치료에 의뢰되고 있습니까? ☐ 예 ☐ 아니오 10-3. 만약 예를 선택했다면, 누가 작업치료에 글씨 쓰기 중재를 위해 의뢰합니까? ☐ 부모 ☐ 선생님 ☐ 학교 ☐ 의사 ☐ 외: 10-4. 만약 아니오를 선택했다면, 작업치료를 의뢰하는 다른 주요한 이유들은 무엇입니까?
Section 3. Interventions **<u>(Multiple choice included)</u>**	13. 얼마나 자주 글씨 쓰기 어려움이 있는 아동에게 글씨 쓰기 중재를 제공합니까/했었습니까? ☐ 전혀 ☐ 드물게 ☐ 가끔 ☐ 자주 ☐ 항상 12-1. 만약 전혀를 선택했다면, 그 이유는 무엇입니까? 다음의 이유 때문에: ☐ 장애아동의 다른 특수 욕구(Other needs of children) ☐ 부모의 다른 목적들(Other goals of parents) ☐ 선생님들의 다른 목적들(Other goals of teachers)

	☐ 중재 효과에 대한 불확실성/ 근거 부족 ☐ 외: 14. 어떤 종류의 중재를 제공합니까/했었습니까? ☐ 수행 요소 중재(Performance component intervention) ☐ 감각운동 중재(Sensory motor intervention) ☐ 과제중심/지향적 중재(Task-specific/oriented intervention) ☐ 보조도구/ 장비(Assistive devices/ equipment) ☐ 외: 13-1. 어떤 글씨 쓰기 수행 요소가 치료 목적이었습니까? ☐ 감각-감각처리(Sensory – sensory processing) ☐ 감각-지각처리(Sensory – perceptual processing) ☐ 신경근육뼈대(Neuromusculoskeletal) ☐ 운동-대운동 기술(Motor – Gross motor skills) ☐ 운동-소운동 기술(Motor – Find motor skills) ☐ 운동-시각 대 동작성 통합(Motor – visual motor integration) ☐ 인지적(Cognitive) ☐ 심리사회적/ 심리적(Psychosocial/ psychological) 15. 글씨 쓰기 프로그램은 어떻게 계획합니까/했었습니까? ☐ 한글 원서(Korean textbooks) ☐ 한글 저널(Korean journals) ☐ 영어 원서(English textbooks) ☐ 영어 저널(English journals) ☐ 한글로 번역된 영어 원서 또는 저널 ☐ 외:
Section 4. Assessments **<u>(Multiple choice included)</u>**	16. 귀하가 아동의 글씨 쓰기 수행과 관련하여 사용하는/했던 모든 평가도구를 선택해 주십시오. ☐ 한글 자음 쓰기 평가; Korean (Hangul) Alphabet Writing Evaluation ☐ 교육과정 중심 측정; Curriculum-Based Measurement (CBM) ☐ 한글 문장 따라 쓰기; Copy Korean Sentences ☐ 젭슨-테일러 손기능 테스트; Jebsen-Taylor Hand Function Test (JHFT) ☐ The School Version of the Assessment of Motor and Process Skills (School AMPS) ☐ 시지각 발달검사; Developmental Test of Visual Perception (DTVP)/ DTVP-2 ☐ Beery Buktenica Developmental Test of Visual-Motor Integration (Beery VMI) ☐ Digitizing Tablet/ Computerized Handwriting Evaluation System (ComPET) ☐ Evaluation Tool of Children's Handwriting (ETCH) ☐ 운동 적합성 검사; Bruininks Oseretsky Test of Motor Proficiency (BOT-MP) ☐ Minnesota Handwriting Assessment (MHA) ☐ Southern California Sensory Integration Tests/ Sensory Integration and Praxis Test ☐ Concise Evaluation Scale for Children's Handwriting (BHK) ☐ Movement Assessment Battery for Children (Movement ABC)/ Movement ABC-2 ☐ Hebrew Handwriting Evaluation Scale

	☐ Wechsler Intelligence Scale for Children (WISC) ☐ Learning Accomplishment Profile (LAP) 15-4. 위에 명시되어 있지 않지만 글씨 쓰기 관련 귀하가 사용하는 표준화된 평가도구가 있습니까/있었습니까? 15-5. 글씨 쓰기 관련 귀하가 사용하는 비 표준화된 다른 평가도구가 있습니까/있었습니까? 15-6. 귀하는 한글로 번역된 본래 영문이었던 평가도구를 사용하십니까/했었습니까? 17. 표준화된 평가도구를 얼마나 자주 사용하십니까/했었습니까? ☐ 전혀 ☐ 드물게 ☐ 가끔 ☐ 자주 ☐ 항상 18. 표준화된 평가도구를 언제 사용하십니까/했었습니까? 다음 단계에서: ☐ 스크리닝; Screening ☐ 기초선; Baseline ☐ 진전; Progress ☐ 치료결과; Outcome 19. 평가도구 결과를 어떻게 사용하십니까/했었습니까? ☐ 치료 계획; Treatment plan for yourself ☐ 팀 치료 계획; Treatment plan with the team ☐ 부모 또는 보호자에게 보고; Report to parents/carers ☐ 학교에 보고; Report to school ☐ 외: 20. 귀하는 왜 글씨 쓰기와 관련하여 특정 표준화된 평가도구를 사용하기로 결정하십니까/했었습니까? ☐ 문헌적 근거; Evidence from the literature. ☐ 이미 근무 영역에 도입되어 있어서; They are already in use at the practice. ☐ 외:
Section 5. Any feedback/ opinions	글씨 쓰기 치료 영역과 관련하여 공유하고 싶은 의견 있으시면, 아래에 의견 남겨주십시오. (예를 들어, 제약들, 이용 가능한 자원들 또는 귀하께서 알아보고 싶은 연구 영역)
Online consent	'설문지 제출' 버튼을 클릭해 주십시오.
End page (e.g. "Thank You!")	

Appendix H: Participant Information Statement (English version)

THE UNIVERSITY OF SYDNEY

Professor Anne Cusick
Faculty of Health Sciences

Masters of Occupational Therapy Program
Faculty of Health Sciences

Room J126
Cumberland Campus, The University of Sydney
NSW 2006 AUSTRALIA
Telephone: +61 2 9351 9386
Email: anne.cusick@sydney.edu.au

OCCUPATIONAL THERAPY PRACTICE FOR CHILDREN WITH HANDWRITING DIFFICTULTIES IN SOUTH KOREA: A NATIONAL SURVEY

PARTICIPANT INFORMATION STATEMENT

You have been invited to participate in this study because you are a member of the Korean Occupational Therapy Association. This *Participant Information Statement* tells you about the research study. Knowing what is involved will help you decide if you want to take part in the research. Please read this sheet carefully and ask questions about anything that you do not understand or want to know more about.

(1) **What is this study about?** This study aims to describe occupational therapy (OT) handwriting practice in Korea. There is little information internationally about OT handwriting practice. To date, few studies have been published in Korean or in English about Korean OT handwriting programs. We think the findings of this study will fill an important gap in practice knowledge and contribute to future guidance on OT handwriting services.

Participation in this research study is voluntary. By returning the survey which is anonymous, you will be consenting to take part in this study and this means you:

- ✓ Understand what you have read.
- ✓ Agree to take part in the research study as outlined below.
- ✓ Agree to the use of your survey responses as described.

(2) **Who is running the study?** The study is being carried out by the following researchers:

- Professor, Anne Cusick (Chief Investigator and supervisor)
  University of Sydney
- Associate Professor, Lynette Mackenzie (Co- Investigator and co-supervisor)
  University of Sydney
- Student, Siwon Lee (Co-Investigator)
  Postgraduate Student Faculty of Health Sciences
  University of Sydney

Siwon Lee is conducting this study as part of her Masters of Occupational Therapy Program in the Faculty of Health Sciences, The University of Sydney.

(3) **What will the study involve for me?** If you choose to participate in this study, you will be required to complete an anonymous, self-administered online survey. The survey questions investigate your experiences about what assessments and intervention approaches you have been using for clients with handwriting difficulties.

(4) **How much of my time will the study take?** It is estimated that most therapists will complete the survey within 7 minutes.

(5) **Who can take part in the study?** Korean occupational therapist volunteers having worked in handwriting programs for children with handwriting difficulties.

(6) **Do I have to be in the study? Can I withdraw from the study once I've started?** Being in this study is completely voluntary and you do not have to take part. Your decision whether to participate will not affect your current or future relationship with the researchers or anyone else at the University of Sydney or in the Korean Association of Occupational Therapists (KAOT).

Submitting your completed questionnaire is an indication of your consent to participate in the study. You can withdraw your responses any time before you have submitted the questionnaire. Once you have submitted it, your responses cannot be withdrawn because they are anonymous and therefore we will not be able to tell which one is yours.

(7) **Are there any risks or costs associated with being in the study?** Aside from giving up your time, we do not expect that there will be any risks or costs associated with taking part in this study.

(8) **Are there any benefits associated with being in the study?** We cannot guarantee that you will receive any direct benefits from participating in this study. You will however have the opportunity to contribute vital information that may inform future occupational therapy practice in handwriting programme and allow researchers to conduct future studies relevant to your real-world setting and practice.

(9) **What will happen to information about me that is collected during the study?** Your anonymous responses will be entered into a database of a secure website "REDcap" for the online survey. Reports of responses will be stored and transferred into an electronic file securely. Only investigators involved in this research will have access to the results of your responses. The data will be analysed to see what types of handwriting assessments and interventions are commonly used in your setting and to see how factors such as demographics are related to the use of the assessments and interventions. Study findings may be published, but you will not be individually identifiable in these publications.

(10) **Can I tell other people about the study?** Yes, you are more than welcome to tell other people about the study. You can also distribute our invitation email to other people if you think they are eligible.

(11) **What if I would like further information about the study?** When you have read this information, Siwon Lee will be available to discuss it with you further and answer any questions you may have. If you would like to know more at any stage during the study, please feel free to contact the student researcher, Siwon Lee, in Korean or English through email: slee6404@uni.sydney.edu.au, or the chief, supervising researcher, Anne Cusick, in English through email: anne.cusick@uni.sydney.edu.au.

(12) **Will I be told the results of the study?** You have a right to receive feedback about the overall results of this study. This feedback will be in the form of an article submitted to in the Korean Occupational Therapy Association webpage/newsletter.

(13) **What if I have a complaint or any concerns about the study?** Research involving humans in Australia is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this study have been approved by the HREC of the University of Sydney (2018/XX). As part of this process, we have agreed to carry out the study according to the *National Statement on Ethical Conduct in Human Research (2007).* This statement has been developed to protect people who agree to take part in research studies.

If you are concerned about the way this study is being conducted or you wish to make a complaint to someone independent from the study, please contact the university using the details outlined below. Please quote the study title and protocol number. The Manager, Ethics Administration, University of Sydney:

- **Telephone:** +61 2 8627 8176
- **Email:** human.ethics@sydney.edu.au
- **Fax:** +61 2 8627 8177 (Facsimile)

This information sheet is for you to keep.

Appendix I: Participant Information Statement (Korean version)

THE UNIVERSITY OF SYDNEY

Masters of Occupational Therapy Program
Faculty of Health Sciences

Professor Anne Cusick
Faculty of Health Sciences

Room J126
Cumberland Campus, The University of Sydney
NSW 2006 AUSTRALIA
전화번호: +61 2 9351 9386
이메일: anne.cusick@sydney.edu.au

글씨 쓰기 어려움이 있는 아동을 위한 작업치료행위: 국내 설문지 조사
연구대상자용 설명서

귀하께서는 대한작업치료사협회(Korean Association of Occupational Therapists) 회원이므로 본 연구 대상자로 초대되셨습니다. 이 *연구대상자용 설명서*는 귀하께 연구에 관한 충분한 설명을 제공하고자 작성되었습니다. 이 연구가 왜 수행되며, 무엇을 수행하는지에 대한 정보 제공함으로써, 귀하께서 본 연구에 참여할 것인지 여부를 결정하는데 도움이 될 것 입니다. 이 설명서를 신중하게 읽어보시고 이해가 안 되는 부분이나 더 알고 싶은 정보와 관련하여 질문이 있으시면 담당 연구자가 자세하게 설명해 줄 것입니다.

(1) **연구 배경과 목적이 무엇인가요?** 본 연구의 목적은 한국에서 글씨 쓰기와 관련된 작업치료행위를 살펴보기 위함입니다. 국제적으로 글씨 쓰기 중재를 위한 작업치료행위에 관한 정보는 극히 적습니다. 최근까지 글씨 쓰기 중재 프로그램을 위한 한국 작업치료에 대한 선행연구들도 국문이나 영문으로 미미하게 출간되어 왔습니다. 저희는 본 연구의 결과가 임상 지식 관련한 연구 부족을 보완하고 글씨 쓰기 관련 작업치료 서비스 영역을 위한 미래 안내에 이바지할거라고 생각합니다.

이 연구는 자발적으로 참여 의사를 밝히신 분에 한하여 수행될 것 입니다. 익명으로 온라인 설문지를 제출함으로써, 귀하께서 본 연구에 참가하는 것에 동의할 수 있습니다. 이것의 의미는 귀하께서:

- ✓ 본 연구에 대한 설명서를 이해했고,
- ✓ 이하 서술된 본 연구 참여에 동의하며,
- ✓ 귀하의 설문지 응답이 본 연구에 사용되는 것에 동의함을 의미합니다.

(2) **연구는 누구에 의해 주관되나요?** 본 연구는 다음 연구자에 의해 진행되고 있습니다:

- 교수 Anne Cusick (연구책임자)
  University of Sydney
- 학생 이시원 (공동연구자)
  Postgraduate Student Faculty of Health Sciences
  University of Sydney

이시원 학생은 본 연구를 시드니 대학교, 작업치료 석사 프로그램의 한 부분으로 진행하고 있습니다. 이것은 Anne Cusick 교수님의 지도 하에 이루어질 것입니다.

(3) **연구참가자로서 무엇을 하게 되나요?** 만일 귀하께서 본 연구에 참여의사가 있으시면, 귀하는 익명성의 자기기입식 온라인 설문지에 참여하도록 요청 받을 것입니다. 설문지는 손 글씨 어려움이 있는 아동을 위해 귀하께서 사용해 온 평가도구와 중재 접근에 관한 경험을 묻는 질문들로 구성되어 있습니다.

(4) **소요시간은 얼마나 걸리나요?** 설문조사를 완료하는데 대략적으로 총 7분 정도 소요 될 것으로 예상됩니다.

(5) **연구 참여 대상자는 누구인가요?** 한국 작업치료사 선생님들 중 a) 아동작업치료에 종사하고 있는 분들이나, b) 아동 치료와 관련된 임상경험이 있는 분들 중, 자발적으로 참여 의사가 있으신 분들이 대상자 입니다.

(6) **연구에 꼭 참여해야 하나요? 만일 시작한 후에 연구에 참여하는 것을 중단 할 수 있나요?** 연구 참가는 온전히 자발적인 것이므로, 귀하는 본 연구에 참여하지 않을 자유가 있습니다. 연구 참여 여부와 관련하여 어떤 결정을 내리시더라도 귀하께 어떤 불이익도 없으며, 담당 연구자 또는 시드니대학교의 다른 사람들 또는 대한작업치료사협회와 귀하의 현재 또는 미래 관계에 어떠한 영향도 없을 것입니다.

다만 완료된 질문지를 제출하는 것은 본 연구에 참여한다는 동의를 의미하게 됩니다. 제출하기 전에 귀하는 설문지에 응답하는 것을 언제든지 그만둘 수 있습니다. 만일 이미 설문지를 제출했다면, 귀하의 설문지 응답은 돌려드릴 수 없습니다. 익명성으로 인해 어떤 응답지가 귀하의 것인지 확인할 수 없기 때문입니다.

(7) **연구 참여에 따른 어떤 위험이나 불편함이 있나요?** 귀하의 시간을 소요하는 것을 제외하고는 어떠한 위험이나 불편함도 발생하지 않을 것으로 사료됩니다.

(8) **연구 참여에 따른 보상이 있나요?** 귀하가 이 연구에 참여하는데 있어서 직접적인 이득에 대한 보장은 없습니다. 그러나 귀하께서는 글씨 쓰기 중재 프로그램과 관련된 미래 임상작업치료 영역을 확대하고 연구자들이 귀하의 임상 영역과 관련된 연구들을 수행할 중요한 정보를 형성하는 데 이바지하게 될 것입니다.

(9) **연구 기간 동안 수집된 연구참가자에 대한 정보는 어떻게 다뤄 지나요?** 귀하의 익명성 응답은 온라인 설문지를 위한 보안 웹사이트인 "레드캡(REDcap)"의 데이터베이스로 수집될 것입니다. 수집된 정보는 전자 파일에 안전하게 보관되고 저장될 것입니다. 오직 연구수행자만이 귀하의 응답 내용에 접근 가능합니다. 이 데이터는 어떤 손 글씨 평가도구와 중재 방법이 흔히 귀하가 제공하는 서비스 영역에서 사용되고 있는 지와 귀하의 직무특성과 같은 요인들이 평가와 중재 사용과 관련하여 어떤 상관관계가 있는지 알아보기 위해 분석 될 것입니다. 이 연구 결과는 아마도 출간될 수 도 있으나, 출판물에서 귀하의 신상이 파악될 일은 없습니다.

(10) **다른 사람들에게 연구에 대해 말해도 되나요?** 예. 귀하께는 언제든지 이 연구에 대해 다른 사람들에게 말할 수 있습니다. 만약 귀하가 생각하시기에 이 분들이 연구 참여 대상자로 적합하다면, 귀하께서 받으신 초대 이메일을 이 분들에게 보내셔도 됩니다.

(11) **연구에 대해 문의가 있다면 어떻게 해야하나요?** 귀하께서 이 설명서를 읽으시고 이와 관련하여 상의하고 싶은 부분이나 질문이 있다면, 이시원 학생이 더욱 자세하게 설명해드릴 수 있을 것입니다. 만일 추가적으로 더 알고 싶은 정보가 있다면 어느때라도 이시원 학생연구원에게 이메일: slee6404@uni.sydney.edu.au이나 또는 책임 및 지도 연구원인 Anne Cusick 교수에게 이메일: anne.cusick@uni.sydney.edu.au을 통해 연락 주십시오.

(12) **연구 결과에 듣게 될까요?** 귀하는 본 연구의 전반적인 결과에 대한 피드백을 받을 권리가 있습니다. 이 피드백은 기사 형식으로 대한작업치료사협회의 웹 페이지나 뉴스레터에 제출될 예정입니다.

(13) **만약 이 연구와 관련하여 불만족스러운 부분이나 걱정되는 부분이 있다면 어떻게 하나요?** 호주에서는 인간 대상자가 포함된 연구는 독립된 그룹인 인간연구윤리위원회(Human Research Ethics Committee)에 의해 검토됩니다. 본 연구의 윤리적인 측면은 시드니대학교의 인간연구윤리위원회에 의해 승인되었습니다 (2018/XX). 이 승인 과정의 부분으로서, 저희는 *인간 연구의 윤리 규범에 대한 국립 성명서(National Statement on Ethical Conduct in Human Research) (2007)*에 따라 연구를 진행하는 데 동의했습니다. 이 성명서는 조사 연구에 참여하는 데 동의한 사람들을 보호하고자 개발되었습니다. 만약 귀하께서 이 연구가 진행되는 형식에 염려되는 부분이 있거나 이 연구와 관계없는 사람에게 항의하고 싶은 부분이 있으시다면, 아래 상세하게 나열된 연락처를 이용하여 시드니대학교에 연락 주십시오. 연구 제목과 프로토콜 번호를 인용해 주시기 바랍니다. 매니저, 윤리 행정과, 시드니대학교:

- **전화번호:** +61 2 8627 8176
- **이메일:** human.ethics@sydney.edu.au
- **팩스:** +61 2 8627 8177 (Facsimile)

이 안내 문서는 귀하께서 보관할 수 있습니다.

Appendix J: Email invitation (English version)

Dear fellow **Occupational Therapists**,

We are currently looking for volunteers to participate in our research project looking to understand **occupational therapy (OT) handwriting program practice in South Korea.**

Volunteers need to be:

- ✓ ***Occupational therapists*** *having worked with*
  - ***handwriting programs***
  - ***children with handwriting difficulties***

You can help by completing the anonymous, self-administered online survey which should take you 10 minutes at most. The survey questions investigate your views about what assessments and intervention approaches you have been using for clients with handwriting difficulties.

Please complete the survey by clicking on the following link:
XX

A participant information statement is provided in the first page of the survey link.

If you would like more information before or after completing the survey, please see the attached *Participation Information Sheet* or email your questions to Siwon Lee (slee6404@uni.sydney.edu.au).

We appreciate your feedback,

Siwon Lee
Occupational Therapist (Korean Qualified)
Masters of Occupational Therapy | Student
The University of Sydney

Appendix K: Email invitation (Korean version)

친애하는 **작업치료사** 선생님들께,

현재 저희는 **한국에서 손 글씨 쓰기 중재와 관련된 작업치료행위**를 조사하기 위한 연구에 자발적인 참여를 원하는 분들을 모집 중입니다.

자발적 연구 참가자는:

- ✓ ***작업치료사****로*
  - *글씨 쓰기 중재 프로그램 또는*
  - *글씨 쓰기에 어려움이 있는 아동과 관련된 임상경험이 있는 분이 대상입니다.*

최대 10 분 정도 소요되는 익명성의, 자기기입식 온라인 설문지를 작성함으로써 본 연구에 참여할 수 있습니다. 설문지는 글씨 쓰기 어려움이 있는 아동을 위해 작업치료사 선생님께서 사용해 온 평가도구와 중재 접근에 관한 경험을 묻는 질문들로 구성되어 있습니다.

다음 링크를 클릭하여 설문지를 작성해주세요:

XX

만약 새로운 창이 뜨지 않는다면, 링크를 복사한 후 인터넷 브라우저에 붙여넣기 하는 과정을 통해 주십시오.

설문지를 작성하기 전 또는 후에 추가적인 정보를 원하시면, 첨부된 *연구대상자용 설명서*를 참고하시거나 질문사항을 이시원 연구담당자 (slee6404@uni.sydney.edu.au)에게 문의 메일 보내주십시오.

여러분의 의견에 감사드립니다.

이시원 올림
작업치료사 (한국 면허)
작업치료학 석사 / 학생
시드니 대학교

Appendix L: Ethics application

THE UNIVERSITY OF SYDNEY

HUMAN RESEARCH ETHICS COMMITTEE FORM

Please Note:

This form was created via the University's online system (IRMA) and the information provided is recorded in the University's research office database.

This information is used to assess the ethics submission under the National Health and Medical Research Council's (NHMRCs) National Statement on Ethical Conduct in Human Research (2007) by the University Ethics Committee and its expert advisers, including the RPAH Clinical Trials Subcommittee.

Sign off by researchers is provided online in IRMA and will not be displayed in this document.

ADMINISTRATIVE DETAILS

Title: Occupational therapy practice for children with handwriting difficulties in South Korea: A national survey

Chief Investigator: Prof. Anne Cusick

Primary Faculty/Department: Ageing Work and Health Unit; Faculty of Health Sciences

Other Internal Investigators: Dr. Mackenzie Lynette (Co-investigator), Lee Siwon (Masters Student)

Grants linked:

External Authorities:

Additional Information:

Occupational therapists were identified in a recent review as the health professionals most commonly involved in researching, designing and providing programs for children with handwriting difficulties. Surprisingly limited information is available in the published literature about assessments and treatments used by occupational therapists in these programs. Surveys of practice have been conducted in Australia, North America and the United Kingdom but not elsewhere. This study will survey occupational therapists in South Korea to reveal practice approaches, assessments and treatment used for this client group, as well as service characteristics such as caseload conditions, treatment settings, service frequency and funding sources.

This study will be conducted in South Korea with the assistance of a colleague who has agreed to disseminate information about the study. He is the President of the peak occupational therapy professional association - the Korean Association of Occupational Therapists (KAOT). Since this association joined the World Federation of Occupational Therapists (WFOT), it has been the official body that represents Korean occupational therapist community.

QUESTIONNAIRE

1 - Welcome to the University of Sydneyâ€™s Human Ethics Application Questionnaire. Please be aware that there is a limit of fifteen minutes to complete each individual question. If you exceed this time then your answer may not be saved by the system. We recommend

that you prepare long answers outside of IRMA before pasting it back into the report questionnaire and/or save your answers regularly. If you choose to edit a previous question, your responses to subsequent questions will be deleted. The restore button can be used to refill your subsequent answers if this happens. For further information on the application procedure, please consult our website or email the Human Ethics team at ro.humanethics@sydney.edu.aulf you experience any technical difficulties, please do not hesitate to contact Research Support using the details below:T +61 2 8627 8183E research.support@sydney.edu.au

Continue

2- SECTION A

Section A is designed to distinguish between staff and student projects. In addition, this Section also seeks to identify projects that have been approved by other ethics committees.

3 - Is this project a University of Sydney student project ONLY (i.e. ethics application restricted to the activities of the student research project)?

Yes

4 - Select appropriate student classification:

Masters

3 - Indicate whether this project has been or will be submitted to any other ethics committees

No

5 - SECTION B

Section B is designed to determine whether your study falls within the National Statementâ€™s definition of low or negligible risk. Throughout this section, you may be asked specific additional questions where you indicate that your study involves particular participant and/ or project types. Please note that the option â€œPossible Recruitmentâ€ with reference to specific participant populations indicates that these people MAY be recruited into your study, but are not the specific population of interest. If this population is the focus of your study, you should select â€œYesâ€.

Please answer the following questions.

12 - Does your research involve women who are pregnant and the human foetus?

No

13 - Does your study involve children and/or young people (i.e. younger than 18 years)?

No

15 - Does your study involve people in existing dependent or unequal relationships with the researcher(s)?

No

29 - Does your research involve people with a cognitive impairment, an intellectual disability or a mental illness?

No

33 - Does your research involve people highly dependent on medical care who may be unable to give consent?

No

38 - Does your study have the potential to discover illegal activity by participants or others? This includes research intending to expose illegal activity, as well as research not specifically designed to, but likely to discover, illegal activity.

No

41 - Does your research involve Aboriginal and/or Torres Strait Islander peoples?

No

47 - Does your research involve CALD (Culturally and Linguistically Diverse) people?

Yes

63 - Does your research involve travel overseas?

No

64 - Is your study likely to cause or elicit distress in participants due to its subject matter, the procedures involved, information that might be revealed about the participant or related persons, or in some other way?

No

78 - Does your study involve research that could jeopardise a participant's employment?

No

79 - Is your proposed research a clinical trial? A clinical trial is a form of research designed to find out the effects of an intervention, including a treatment or diagnostic procedure. A clinical trial can involve testing a drug, a surgical procedure, other therapeutic procedures and devices, a preventive procedure, or a diagnostic device or procedure.

No

84 - Does your study involve the use of human tissue?

No

138 - Does your study involve human genetics or human stem cells?

No

185 - Does your study involve limited disclosure involving active concealment and/or planned deception?

No

186 - Does your study involve research that poses a risk to the physical or emotional safety or welfare of a University of Sydney student researcher (e.g. honours student or postgraduate student)? If you are a student and your research takes place off-campus a completion of a safety protocol may be necessary.

No

192 - Does your research involve any of the following: â€¢ Collection of biological samples (e.g. blood, saliva, bodily fluids).â€¢ Physical screening (e.g. blood pressure, cholesterol, physical fitness, MRI scans).â€¢ Physical exertion? (i.e. physical activity, exercise).

No

196 - SECTION C

The questions in Section C are designed to determine whether there are any conflicts of interests which may compromise the research process.

208 - Are any "conflict of interest" issues likely to arise in relation to this research?

No

209 - Do the researchers have any affiliation with, or financial involvement in, any organisation or entity with direct or indirect interests in the subject matter or materials of this research? (Note that such benefits must be declared in the Participant Information Statement)

No

211 - Do the researchers expect to obtain any direct or indirect financial or other benefits from conducting this research? (Note that such benefits must be declared in the Participant Information Statement)

No

213 - Have conditions already been imposed OR are likely to be imposed in the future, upon the use (e.g. publication), or ownership of the results (e.g. scientific presentations) or materials (e.g. audio-recordings), by any party other than the listed researchers?

No

215 - SECTION D

The questions in Section D are specifically directed at the consent process. Describe how you will identify and select potential participants for recruitment into the study.

You should include information about how you will obtain contact details for potential participants.

Occupational therapists in South Korea are the target population for this study.

In 2018, the number of Korean occupational therapists is estimated at nearly 16,700 (Korean Association of Occupational Therapist [KAOT], 2018). According to the collaborator of the Korean Association of Occupational Therapist (KAOT), nearly 70% of occupational therapists are the association members. A database system of the association will be used by their staff to identify occupational therapists who agreed with using their details for research purposes and to send email invitations.

217 - Describe how and where initial contact will be made with potential participants and how you will avoid real or perceived coercion. Copies of all relevant correspondence (e.g. email, letter of introduction, covering letter, circular/flyer etc.) need to be uploaded with your application. If you are using email addresses please outline how their use will not be in breach of privacy or spam legislation.

The consultation has been in the process with the president of the Korean Association of Occupational Therapist (KAOT), particularly regarding the survey recruitment. Although it is not officially required, permission has been gained from the president of the association for the recruitment process.

- Permission Letter in English and Korean (attached).

The therapists will receive an email invitation which includes study aim and methods and a link to an online survey. Participant Information Statement (PIS) will be also attached to the invitation; they will be given an acknowledgement of their right to agree or refuse to participate in the survey.

- Study Recruitment Email Invitation to occupational therapists (attached). This invitation can be used by any volunteer occupational therapist who wishes to refer the study to colleagues they know (snowball recruitment).

- Participant Information Statement (PIS) (attached).

All participants will submit data anonymously, so there is no need for us to have email addresses for them.

218 - If a participant, or person on behalf of a participant, chooses to withdraw from the research, what specific consequences should they be made aware of, prior to giving consent? These details should be included in the Participant Information Statement.

There are no consequences. Submission of the online survey form is voluntary and anonymous. This is outlined in the Participant Information Statement (PIS).

219 - Will participants receive any reimbursement of out-of-pocket expenses, or financial or other "rewards" as a result of participation?

No

220 - How will consent be obtained (more than one may apply)

Return of a Survey

Other

222 - Please clarify your response to the question above and justify with reference to the National Statement (e.g. sections 2.2.5, 3.1.16, 5.2.16). For instance, if you indicated that consent will be written and oral, does this refer to all participants undergoing written and oral

consent or does it refer to different consent processes for different participant groups? You should also justify why you have chosen these forms of consent. If you are using oral consent, explain how it will be recorded (e.g. in field notes, using tape recording).

Participants will be volunteers. Their responses will be anonymous. If they decide to participate, they indicate their consent by inserting a tick mark in a question item and returning the online survey.

223 - Will there be participants who are not fluent in English or who have difficulty understanding English?

Yes

225 - In what language(s) will the research be conducted?

Korean.

The research team is multilingual with native English and Korean speakers. The Participant Information Statement (PIS), email invitation and survey will be developed in English then professionally translated into Korean. The Korean version will be inspected by a native speaking Korean occupational therapist not previously involved in the survey or associated document development. If any issues of intelligibility, interpret-ability or local relevance are identified, these will be addressed by further translation and the use of professional back-translation from Korean to English.

226 - Will an interpreter be present during discussions with the participants about the research project?

No

227 - Why will an interpreter not be present during discussions with participants about the research project?

The study is conducted entirely in written form online with participants who have university level education. Also, participants will not be identifiable using an online survey.

228 - Will participants be provided with certified translated documents (Participant Information Statement and Participant Consent Forms, questionnaires etc) in the language in which they speak?

Yes

230 - Is there an intention to recruit participants who have a physical impairment or disability that may affect the consent process (e.g. blind/vision impaired/deaf/hearing impaired/speech impaired)?

No

232 - SECTION E

The questions in Section E relate to how you will protect participantsâ€™ privacy and the confidentiality of their information in your research project.

Will any part of the project involve recordings (e.g. audio, video, online surveys)?

No

234 - Will you be collecting information/data about a participant from a third party (i.e. another individual)? Please note that this DOES NOT include agencies or organisations.

No

237 - The following questions will establish whether the HREC needs to apply federal or state/territory privacy legislation when reviewing your ethics application. Will you use, collect or disclose information about human participants from an agency, authority or organisation? This includes Commonwealth agencies, private sector organisations, state/territory agencies and international organisations. For instance, you may be using information from a medical practice, a hospital, a university, a state or federal government department. You should say â€˜yesâ€™ even if it is your own organisation (e.g. your medical practice).

No

241 - Is the research project likely to produce information or results that are of personal significance to individual participants? For instance, a project may reveal that participants are at risk of developing a particular disease, provide insight into their intellectual/other abilities, or indicate that they have physical or mental health problems.

No

335 - Is the research project likely to reveal a significant risk to the health or wellbeing of persons other than the participant (e.g. family members, colleagues, community members)?

No

319 - Does this project involve the use of information that you or your organisation had collected previously for another purpose?

No

344 - Describe how the overall results of this research project will be disseminated (e.g. journal publications and book chapters, conference presentations, student theses, creative works).

The study will be written up as a research report in the form of a journal article for the Master of Occupational Therapy coursework program and submitted by Siwon Lee for assessment. The study will also be a presentation to other students and staff for this course.

The study will be written up as a conference paper, and for submission to an occupational therapy related conference.

The study will be written up as a paper for submission to a peer reviewed occupational therapy journal.

347 - Will the confidentiality of participants and privacy of their data be protected in the dissemination of overall research results? Please note that if you propose to identify individuals in publications, you should select â€˜noâ€™ here and obtain their consent for this. Please also note that if you have obtained personal information without individual consent under a waiver of consent, you can only publish this information in de-identified form.

Yes

349 - Explain how confidentiality of participants and privacy of their data will be protected in the dissemination of research results.

All responses are anonymous in the online survey.

350 - Will the information generated in this research project be used for any purpose(s) other than those outlined in this application? For example, will data be retained and used in future research projects, used to establish a database/research register, provided to a third party or to a public data sharing resource? Please note that this question does not refer to the use of the data for the purposes of this project (e.g. publication of results).

No

351 - Outline how feedback concerning the overall results of the project will be made available to participants (e.g. via a lay summary or newsletter). If participants are not to receive feedback, please justify why not.

The summary of study results will be submitted as an item for dissemination in the Korean Association of Occupational Therapists webpage/newsletter. This summary will be in Korean.

The study will be written up for submission to a peer reviewed conference in Korea - if accepted, this will provide an opportunity for dissemination in Korean.

353 - Describe where study materials will be stored DURING the project (including electronic and hard copy files, consent forms, audio recordings, questionnaires, interview transcripts, video recordings, photographs etc). Please include building and room numbers for hard copy materials.

Surveys returned by volunteers will be stored during the project on the on-line platform Redcap.

354 - Describe where study materials will be stored upon COMPLETION of the project (including electronic and hardcopy files, consent forms, audio recordings, questionnaires, interview transcripts, video recordings, photographs etc). Please include building and room numbers for hardcopy materials. Note that on conclusion of the project a copy of all materials must be kept in an accessible and secure location on University premises.

All records will be electronic and will be stored on CloudStor and according to a research data management plan in the University of Sydney Research Archive.

355 - Outline the security measures that will be used to protect study materials from misuse, loss or unauthorised access during and after the project (e.g. removal of identifiers, secure storage, restriction of access to appropriate personnel etc).

There will be no identifying material on the data - it is submitted voluntarily. All contact details for the Korean Occupational Therapy Association are publicly available on internet. All documents are stored on CloudStor or in the University of Sydney research archive according to Research Data Management Plan.

356 - Specify how long study materials will be retained for after project completion. Please note that the options provided below are intended to facilitate compliance with relevant legislation from the State Records Authority of NSW. Data from research involving children; and from clinical trials, scanning and radioactivity studies, clinical studies, genetic manipulation, human tissue studies, and psychological research that has potential long term effects must be retained for a minimum of 20 years or until participants are 25 years of age (whichever is longer). Data from other types of studies must be retained for a minimum of 5 years. For some types of research (e.g. oral history, gene therapy) or where it is intended to reuse data in the future, it is appropriate to retain data in perpetuity (i.e. indefinitely).

5 years

357 - Explain why this storage period has been chosen.

This is a straightforward survey design and following publication the standard storage period is 5 years.

358 - At the end of the project, will study materials/information be stored in individually identifiable or re-identifiable form? Please note that this does not refer to the consent forms. Individually identifiable information is that from which the identity of a specific individual can reasonably be ascertained. Re-identifiable information has had identifiers removed and replaced by a code, so it is possible to identify individuals by using the code. Non-identifiable information has had all identifiers irreversibly removed or was never identifiable (see Chapter 3.2 of the National Statement for more information).

No

359 - If they are not to be kept in perpetuity, how will project materials ultimately be disposed of?

The electronic files will be deleted.

361 - SECTION F

The questions in Section F concern risks to both participants and others connected with the study.

Participation in research can involve potential harm to participants including physical, psychological, reputational, financial, spiritual, emotional and social distress. Please outline any potential harm and justify it with regard to the potential benefits of the project. What steps will the researchers take to minimise potential harm endured as a consequence of participation? (e.g. by providing access/information to counselling)

There is no perceived risk of harm in this study. All participants are health professional occupational therapists and all are volunteers. Questions are related to practice approaches, assessments treatments and de-identified service characteristics.

362 - Are there any other risks involved in this research? For example, to the research team, the organisation, others? What are these risks? Explain how these risks will be negated/ minimised/ managed.

Nil risk - anonymous survey completion

363 - SECTION G

The questions in Section G concern details of the research study. Please answer the following questions.

The nature of this project is most appropriately described as research involving (more than one may apply):

Questionnaire/survey

364 - Are you doing research in a context which requires you to get permission from an appropriate authority e.g. a school, corporation, NGO, or similar?

No

365 - Outline in lay language the theoretical, empirical and/or conceptual basis, background evidence for the research proposal with reference to the relevant literature (include at least four research citations). Note, that your study should be "based on a thorough study of the current literature, as well as previous studies" (NS 1.1 c).

Handwriting difficulty has been demonstrated to be a problem for many children regardless of handwriting form (characters, letters) - the problem is evident worldwide. Over the decades, it has been discussed in the international research literature that children with and without medical conditions are experiencing handwriting difficulty. According to an international scoping review of handwriting practice conducted by Cusick and Elvery in 2017, handwriting interventions and assessments were mostly conducted by occupational therapists; and the most common group to receive handwriting therapy assistance in research was typically developing children. There is no gold standard best evidence assessment or intervention established through the research literature. Consequently local practice can vary and relies on therapists own judgements on what is best. Over 100 standardized handwriting assessments are available for use (Cusick & Elvery, 2017); performance-based observational assessments are the most commonplace. Although children across the world are known to experience handwriting problems, very little evidence is available regarding the assessment and intervention practices used by occupational therapists in non-English speaking countries. A recent review of Korean literature (Lee & Cusick, 2018, research proposal) identified that no survey of paediatric handwriting practice by occupational therapists or any other health professional had ever been conducted. The only evidence relating to handwriting practice in Korean occupational therapy were a few studies were conducted in Korean adult patients with stroke or Alzheimers disease (Yoon, Suh, & Kim, 2010; Yoon et al., 2011).

This study aims to fill the gap in knowledge by surveying occupational therapists in Korea. The next section describes the occupational therapy profession in Korea as this relates to the recruitment strategy to be employed in the study.

In South Korea, the official association for Korean occupational therapists was established in 1993. Since then more than 16,000 occupational therapists have obtained a national Occupational Therapist Licence (KAOT, 2018). According to a survey conducted by Lee and colleagues (2010), most Korean occupational therapists worked in hospitals. This may be relevant to occupational therapy handwriting practice because the Cusick and Elvery (2017) study found that most occupational therapy handwriting interventions occurred in community or school settings, not hospitals. The study recruitment method therefore relies on occupational therapists self-identifying as eligible and self-reporting their place of work and other practice information.

The ee et al (2010) study found that occupational therapists rated the following as priorities: professional standards and responsibilities, evaluation, treatment plan and interventions respectively, and the interventions were considered as the most important, followed by professional standards and responsibilities, treatment plan and evaluation. We are therefore hopeful that occupational therapists in Korea will be interested in participating because the evidence generated will help inform consideration of a number of these priorities in paediatric practice.

Given information provided by the professional society, we anticipate approximately 3,500 occupational therapists are working with children. Paediatric occupational therapists are known as usually working not only in hospitals but also in rehabilitation centres and private clinics; it is rare for the therapists in Korea to work in a school-based setting. Some therapists do work in this setting as indicated in a study by Oh and Kim (2010) that showed that the satisfaction of Korean occupational therapists in the school setting is higher than in other settings. These therapists worked 40 hours a week with students mainly who have intellectual difficulties. It was also identified that other common diagnoses of children who received occupational therapy in the school-based setting were cerebral palsy and autism spectrum disorder (Lee et al, 2015).

Even outside the school-based setting, similar diagnoses of children are identified as the top common topic area of paediatric occupational therapy in an official publication of Korean occupational therapy which was established in 1993. In a review conducted to underpin the present study, Lee and Cusick (2018) found 112 articles in the official Korean journal of Occupational therapy were related to paediatric research. The interventions and assessments were predominantly conducted using a theoretical model that is called Sensory Integration (SI). This model is the subject of intense debate in English speaking coutnries regarding the rigor of evidence available to support it. The most frequent type of paediatric research design was a lower level of evidence - descriptive research (e.g. case study and survey) (Yoo, Lee, Lee, Park, & Yoo, 2011). A few systematic reviews and no randomized controlled trials (RCT) were found. Thus very little evidence on assessments and intervention studies for children with handwriting difficulties in the Korean literature.

It is clear that many gaps in research exist between Korean and English literature when it comes to handwriting practice for children. This gap should be addressed, as there is a potentially increasing demand for handwriting programme among Korean children with handwriting difficulties. A Korean newspaper, Kook-Je Newspaper stated that Korean students struggle with pencil-and-paper tasks since they spend an increasing amount of time using electronic devices such as smartphones and computers (Min, 2015).

Given that the maximum value of the estimated prevalence of handwriting difficulties in school-age children in other developed countries is nearly 30% (Overvelde & Hulstijn, 2011; Volman, van Schendel, & Jongmans, 2006), more than 800,000 Korean children could be estimated to be in need of handwriting intervention programmes; the number of elementary school students was estimated at 2,674,227 in 2017 (Korean Educational Development Institute, 2017). As children with a medical condition have been also reported to experience handwriting difficulties (Wallen, Duff, Goyen, & Froude, 2013), it can be seen that there are more Korean children screened yet with handwriting difficulties outside the school system.

Thus, survey research is needed to investigate what assessments Korean occupational therapists use for children with handwriting difficulties and what types of interventions for handwriting programme the therapists provide, specifically to which clients' group. This work will assist in defining the gap between evidence and clinical practice for Korean occupational therapists who work with children experiencing handwriting problems. The survey study will further encourage the evidence-based practice, providing recommendations for future research topics and practice areas in relation to caseload, assessments and intervention approaches.

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367 - Outline in lay language the methodology for the research proposal. Note, that you study should be "designed or developed using methods appropriate for achieving the aims of the proposal" (NS 1.1 b). Your response should include:

â€¢ Aims and hypotheses/research questions

â€¢ Research plan including duration of the study and/or timeline

â€¢ Participant characteristics including sex, age range and inclusion/exclusion criteria (if relevant)

â€¢ The intended sample size with a justification, and/or the particiant sampling/selection strategy (as relevant to your study)

â€¢ Details of where the study will be undertaken (location/site/URL)

â€¢ Details of how data will be collected and analysed

â€¢ Potential significance of the study

Aim: To describe occupational therapy handwriting practice in South Korea

Plan: Survey online launch October 2018. Survey Close November 2018. Survey data analysis November 2018. Report writing December 2018.

Participants: Qualified occupational therapists in Korea who self identify as having worked in handwriting programs. All will be adults. Any gender. No exclusion criteria as participants self identify. Participants are doing so in their capacity as private citizens who self identify as occupational therapists - there is therefore no need to have institutional approvals from any institution in Korea.

Sample size: Volunteer responses - no prospective sample size. Since our estimate based on professional society information is that 3500 therapists work in paediatrics, we would hope for a 10% response rate thus, 350 participants.

Location: The study participation is online. Participants are being recruited from Korea, self identify as being in Korea and the survey is in Korean. The survey is thus on an online survey platform, REDcap. The study URL will be supplied following HREC approval.

Data collection: submission by participants of the online survey.

Significance: There is a dearth of information internationally about OT handwriting practice, and few studies were published in Korean or English about Korean OT handwriting programs. This study will fill an important gap in practice knowledge.

LIST OF ATTACHED DOCUMENTS

Date Uploaded	Type	Document Name

Appendix M: A journal submission guideline and template (*International Occupational Therapy*)

Downloaded from https://www.hindawi.com/journals/oti/guidelines/

Author Guidelines

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In order to ensure sufficient diversity within the authorship of the journal, authors will be limited to having two manuscripts under review at any point in time. If an author already has two manuscripts under review in the journal, they will need to wait until the review process of at least one of these manuscripts is complete before submitting another manuscript for consideration. This policy does not apply to Editorials or other non-peer reviewed manuscript types.

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Article Types

The journal will consider the following article types:

Research Articles

Research articles should present the results of an original research study. These manuscripts should describe how the research project was conducted and provide a thorough analysis of the results of the project. Systematic reviews may be submitted as research articles.

Clinical Studies

A clinical study presents the methodology and results of a study that was performed within a clinical setting. These studies include both clinical trials and retrospective analyses of a body of existing cases. In all cases, clinical studies should include a description of the patient group that was involved, along with a thorough explanation of the methodology used in the study and the results that were obtained.

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of the abstract. Trials initiated after July 1, 2005, must be registered prospectively before patient recruitment has begun. For trials initiated before July 1, 2005, the trial must be registered before submission.

Reviews

A review article provides an overview of the published literature in a particular subject area.

Formatting

An optional research article manuscript template can be downloaded here. We recommend that all manuscripts follow the structure below:

Title and Authorship Information

The following information should be included:

- Manuscript title
- Full author names
- Full institutional mailing addresses
- Email addresses

Abstract

The manuscript should contain an abstract. The abstract should be self-contained, citation-free, and should not exceed 300 words.

Introduction

This section should be succinct, with no subheadings.

Materials and Methods

The methods section should provide enough detail for others to be able to replicate the study. If you have more than one method, use subsections with relevant headings, e.g. different models, in vitro and in vivo studies, statistics, materials and reagents, etc.

Hindawi journals have no space restriction on methods. Detailed descriptions of the methods (including protocols or project descriptions) and algorithms may also be uploaded as supplementary information or a previous publication that gives more details may be cited. If the method from a previous article is used then this article must be cited and discussed. If wording is reused from a published article then this must be noted, e.g. This study uses the method of Smith et al. and the methods description partly reproduces their wording [1].

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Protocols in the Clinical Sciences. We encourage authors of clinical trials and other clinical studies to upload the detailed plan of their study that was approved by the ethics committee as supplementary materials. If there is a published version of the protocol, this should also be cited in the methods section.

Results and Discussion

This section may be divided into subsections or may be combined.

Main Text (Review only)

This section may be divided into subsections or may be combined.

Conclusions

This should clearly explain the main conclusions of the article, highlighting its importance and relevance.

Data Availability (excluding Review articles)

This statement should describe how readers can access the data supporting the conclusions of the study and clearly outline the reasons why unavailable data cannot be released. For guidance on composing a Data Availability statement, including template examples, please see here.

Conflicts of Interest

Authors must declare all relevant interests that could be perceived as conflicting. Authors should explain why each interest may represent a conflict. If no conflicts exist, the authors should state this. Submitting authors are responsible for coauthors declaring their interests.

Funding Statement

Authors must state how the research and publication of their article was funded, by naming financially supporting body(s) (written out in full) followed by associated grant number(s) in square brackets (if applicable), for example: “This work was supported by the Engineering and Physical Sciences Research Council [grant numbers

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Acknowledgments

All acknowledgments (if any) should be included at the very end of the manuscript before the references. Anyone who made a contribution to the research or manuscript, but who is not a listed author, should be acknowledged (with their permission).

References

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Hindawi recommends writing dates out fully to avoid confusion with different all-numeral date styles. For example, 11/10/2018 could be 10 November 2018 or 11 October 2018 depending on the reader, therefore, the date should be written out in full. For example, the date September 1, 2018 can be used rather than 01/09/2018 or 09/01/2018.

Units of Measurement

Units of measurement should be presented simply and concisely using the International System of Units (SI).

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Upon submission of an article, authors should include all figures and tables in the PDF file of the manuscript. Figures and tables should not be submitted in separate files. If the article is accepted, authors will be asked to provide the source files of the figures. Each figure should be supplied in a separate electronic file. All figures should be cited in the manuscript in a consecutive order. Figures should be supplied in either vector art formats (Illustrator, EPS, WMF, FreeHand, CorelDraw, PowerPoint, Excel, etc.) or bitmap formats (Photoshop, TIFF, GIF, JPEG, etc.). Bitmap images should be of 300 dpi resolution at least unless the resolution is intentionally set to a lower level for scientific reasons. If a bitmap image has labels, the image and labels should be embedded in separate layers.

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In any studies on human or animal subjects, the following ethical guidelines must be observed. For any experiments on humans, all work must be conducted in accordance with the Declaration of Helsinki (1964). Manuscripts describing experimental work which carries a risk of harm to human subjects must include a statement that the experiment was conducted with the human subjects’ understanding and consent, as well as a statement that the responsible Ethical Committee has approved the experiments. In the case of any animal experiments, the authors must provide a full description of any anesthetic or surgical procedure used, as well as evidence that all possible steps were taken to avoid animal suffering at each stage of the experiment.

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Correspondence should be addressed to Firstname B. Lastname; lastname@institution.edu

Abstract

The abstract should be a single, self-contained paragraph which summarises the manuscript. Ideally it will provide a brief context for the study, before describing the scientific approach and some key results in a qualitative manner. It should finish with a sentence to describe the implications for the field. The abstract must not include references, figures or tables.

Introduction

The introduction should be succinct, with no subheadings. Limited figures may be included only if they are truly introductory, and contain no new results.

Materials and Methods

The materials and methods section should contain sufficient detail so that all procedures can be repeated. It may be divided into headed subsections if several methods are described.

Results and Discussion

Subheadings

The results and discussion may be presented separately, or in one combined section, and may optionally be divided into headed subsections.

Advice on Equations

Equations should be provided in a text format, rather than as an image. Microsoft Word's equation tool is acceptable. Equations should be numbered consecutively, in round brackets, on the right-hand side of the page. They should be referred to as Equation 1, etc. in the main text.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{1}$$

Advice on Figures

At the point of submission, authors may provide all figures embedded within the manuscript at a convenient break near to where they are first referenced or, alternatively, they may be provided as separate files. All figures should be cited in the paper in a consecutive order. Where possible, figures should be displayed on a white background. When preparing figures, consider that they can occupy either a single column (half page width) or two columns (full page width), and should be sized accordingly. All figures must have an accompanying caption which includes a title and, preferably, a brief description (see Figure 1).

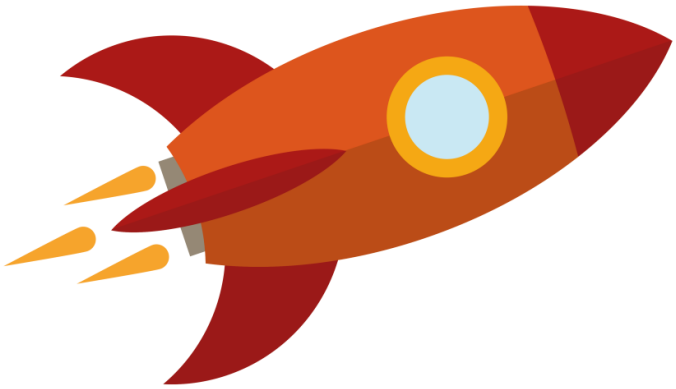

Figure 1: Basic rocket ship design. The rocket ship is propelled with three thrusters and features a single viewing window. The nose cone is detachable upon impact.

The caption can also be used to explain any acronyms used in the figure, as well as providing information on scale bar sizes or other information that cannot be included in the figure itself. Plots that show error bars should include in the caption a description of how the error was calculated and the sample size (see Figure 2).

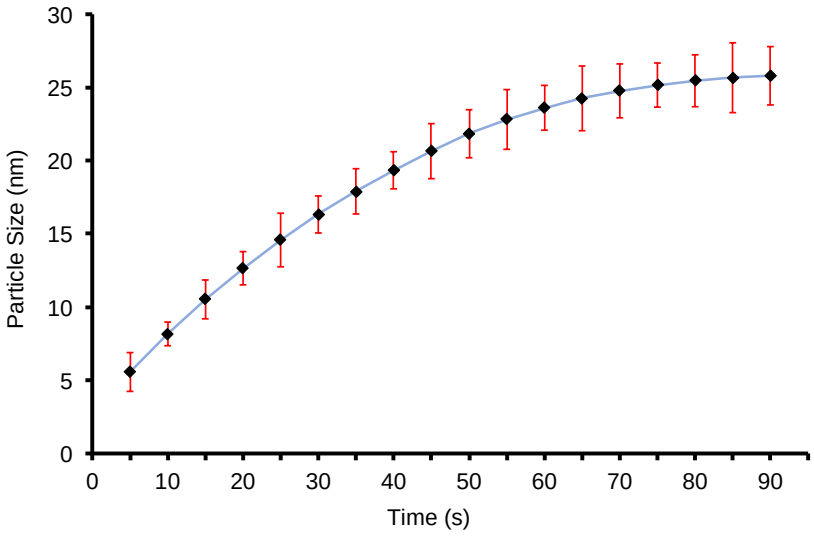

Figure 2: Plot of nanoparticle size with respect to time, recorded over a 90 s period. The error bars represent the standard deviation of measurements for 20 particles in five separate sample runs (n = 100).

If a figure consists of multiple panels, they should be ordered logically and labelled with lower case roman letters (i.e., a, b, c, etc.). If it is necessary to mark individual features within a panel (e.g., in Figure 3a), this may be done with lowercase Roman numerals, i, ii, iii, iv, etc.

All labels should be explained in the caption. Panels should not be contained within boxes unless strictly necessary.

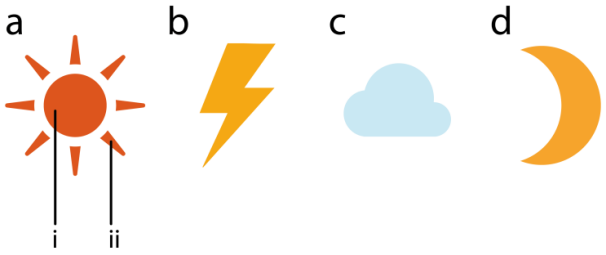

Figure 3: Representations of some common weather symbols. (a) The sun with (i) core, and (ii) rays. (b) Thunder bolt. (c) Cloud. (d) Moon.

Upon acceptance, authors will be asked to provide the figures as separate electronic files. At that stage, figures should be supplied in either vector art formats (Illustrator, EPS, WMF, FreeHand, CorelDraw, PowerPoint, Excel, etc.) or bitmap formats (Photoshop, TIFF, GIF, JPEG, etc.). Bitmap images should be of at least 300 dpi resolution, unless due to the limited resolution of a scientific instrument. If a bitmap image has labels, the image and labels should be embedded in separate layers.

Advice on Tables

Every table must have a descriptive title and, if numerical measurements are given, the units should be included in the column heading. Vertical rules should not be used (see Table 1). Tables should be cited consecutively in the text.

Table 1: Temperature and wildlife count in the three areas covered by the study.

Location	T [° C]	Turtles	Sharks	Octopuses	Starfish
Blue Lagoon	21.2	5	3	4	543
Regent's Canal	5.2	8	0	24	312
Shark Bay	12.8	4	7	9	122

Conclusions

The Conclusions section should clearly explain the main findings and implications of the work, highlighting its importance and relevance.

Data Availability

A data availability statement is compulsory for research articles and clinical trials. Here, authors must describe how readers can access the data underlying the findings of the study, giving links to online repositories and providing deposition codes where applicable. For more information on how to compose a data availability statement, including template examples, please visit: https://www.hindawi.com/research.data/#statement.

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Acknowledgments

An Acknowledgements section is optional and may recognise those individuals who provided help during the research and preparation of the manuscript.

Supplementary Materials

If Supplementary Materials are provided (e.g., audio files, video clips or datasets) they should be described here. Note that authors are responsible for providing the final Supplementary Materials files that will be published along with the article, which are not modified by our production team. You should remember to reference the Supplementary Materials' contents at appropriate points within the manuscript. We recommend citing specific items, rather than referring to the Supplementary Materials in general, for example: "See Figures S1-S10 in the Supplementary Material for comprehensive image analysis."

References

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[x] Author initials and surname, "Title in sentence style," Journal title, vol. (volume number), no. (issue number), pp. (page numbers separated by an en-dash), Year.

For example:

[1] J. D. Watson and F. H. C. Crick, "A structure for deoxyribose nucleic acid," *Nature*, vol. 171, no. 4356, pp. 737–738, 1953.

For articles with six or more authors, the first three authors are listed followed by 'et al.'. When journals use only article numbers, no page numbers are necessary. For example:

[2] B. P. Abbott, R. Abbott, T. D. Abbott et al., "Observation of Gravitational Waves from a Binary Black Hole Merger," *Physical Review Letters*, vol. 116, no. 6, Article ID 061102, 2016.

This page is the end of the thesis document.