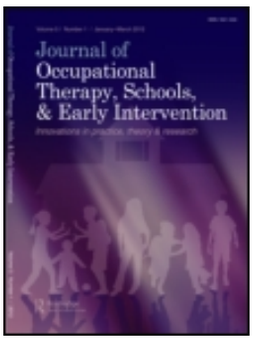

Journal of Occupational Therapy, Schools, & Early Intervention

ISSN: 1941-1243 (Print) 1941-1251 (Online) Journal homepage: http://www.tandfonline.com/loi/wjot20

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**To cite this article:** Emily McMaster BScOT (Hons) & Tara Roberts BAS (OT) (2016) Handwriting in 2015: A main occupation for primary school–aged children in the classroom?, Journal of Occupational Therapy, Schools, & Early Intervention, 9:1, 38-50, DOI: 10.1080/19411243.2016.1141084

**To link to this article:** http://dx.doi.org/10.1080/19411243.2016.1141084

JOURNAL OF OCCUPATIONAL THERAPY, SCHOOLS, & EARLY INTERVENTION
2016, VOL. 9, NO. 1, 38–50
http://dx.doi.org/10.1080/19411243.2016.1141084

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# Handwriting in 2015: A main occupation for primary school–aged children in the classroom?

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**ABSTRACT**

Historically, handwriting is a skill acquired by children in the classroom. The relevance of this skill today is currently debated due to advances in technology. A nonexperimental time-series design investigated how much time Australian primary school children spend on handwriting in the classroom. A second aim investigated how much time was spent on technology activities in the classroom. Three schools participated and nine classrooms were observed. Findings indicated that the use of technology is still emerging in a primary school classroom and, although time spent on fine motor activities has reduced, handwriting remains a main occupation for children in the classroom in the early 21st century.

**ARTICLE HISTORY**
Received 10 November 2015
Accepted 8 January 2016

**KEYWORDS**
Classroom; handwriting; occupational therapy; technology



It has been widely accepted in the past 2 decades that handwriting is a major occupation for children in the classroom environment, with past studies finding that 30% to 60% of a child's day while at school was spent on fine motor activities, with 85% of these fine motor activities being paper-and-pencil tasks (McHale & Cermak, 1992; Rodger & Ziviani, 2006). Fine motor tasks are embedded in a child's routine as young as age 5–7 years in educational settings, with a cohort study of 20 American kindergarten classrooms finding that 36% to 66% of time is spent on fine motor activities, 42% of which involved paper-and-pencil activities (Marr, Cermak, Cohn, & Henderson, 2003). A recent systematic review reported that as children's handwriting skills continue to develop over time as the children age, handwriting is used with increased frequency in the classroom (Dinehart, 2015). Recently in the United Kingdom, a large annual survey of 32,000 children aged 8–18 years found that in 2014 only 27.2% of children and young people write something outside of the classroom that isn't school related every day, while one child in every five reported rarely or never writing something outside of the classroom that wasn't school related (National Literacy Trust, 2015). This confirms the belief that handwriting is typically a main occupation for children in a classroom environment.

As handwriting in the past has been an occupation that consumes a substantial amount of time for children, occupational therapists commonly work with children to develop and improve their handwriting skills. For pediatric occupational therapists, referrals for handwriting make up a large bulk of their client base (Case-Smith, 2002; Feder, Majnemer, & Synnes, 2000). In the United States, a cross-sectional study of 314 elementary teachers indicated that 23% of children in a mainstream classroom presented with handwriting

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difficulties and that 94.7% of referrals to occupational therapy for handwriting intervention were due to the student's handwriting skills not improving with classroom assistance alone (Hammerschmidt & Sudsawad, 2004). Occupational therapists are skilled in providing interventions that assist in improving children's handwriting abilities (Case-Smith, 2002; Case-Smith, Weaver, & Holland, 2014; Howe, Roston, Sheu, & Hinojosa, 2013; Weintraub, Yinon, Hirsch, & Parush, 2009; Zwicker & Hadwin, 2009). Historically, occupational therapists would target underlying performance components such as fine motor skills, visual-motor integration skills, or pencil grasp to improve handwriting abilities (Kaiser, Albaret, & Doudin, 2009). However, new American evidence suggests that intensive, handwriting-specific groups and task-focused interventions are more effective in improving a child's handwriting legibility and fluency (Case-Smith et al., 2014; Howe et al., 2013; Schwellnus, Cameron, & Carnahan, 2012; Taras, Brennan, Gilbert, & Reed, 2011). This evidence indicates that for children to proficiently learn and develop their handwriting skills, practice and repetition of specific handwriting tasks is required.

As a learning activity largely participated in by children, many researchers have focused on the effects of handwriting on brain development. A recent cohort study in America with fifteen 4- to 5-year-old children used magnetic resonance imaging (MRI) to discover that self-generated handwriting activated parts of the brain that are also involved in reading systems (James & Engelhardt, 2012). The study also investigated other forms of text generation, including typing and tracing, and found that these methods did not activate the same brain regions that were involved with reading. In addition to this study, the significant positive correlations between handwriting and reading have been well documented internationally (Clark & Luze, 2014; McCarney, Peters, Jackson, Thomas, & Kirby, 2013; Medwell, Strand, & Wray, 2009; Roux et al., 2014). As well as this relationship with reading development, further cohort studies have found that handwriting activates motor, visual, and linguistic areas of the brain and has a direct relationship with improving math, spelling, and science outcomes in later years (Grissmer, Grimm, Aiyer, Murrah, & Steele, 2010; Press, Hinojosa, & Roston, 2009; Shah et al., 2013).

While proficient handwriting is known to have positive correlations with other academic skills, poor handwriting skills and a lack of automaticity with handwriting increases the cognitive load of a child and consequently reduces his or her ability to draw on other cognitive capacities to improve the content of writing (Connelly, Dockrell, & Barnett, 2005; Grissmer et al., 2010; McCarney et al., 2013; Medwell et al., 2009; Peverly, 2006). A large UK correlational study of 284 mainstream primary school children produced evidence that children with poor handwriting had restricted cognitive ability and working memory toward the content of their educational task as they were required to use more cognitive energy on the task of writing itself (McCarney et al., 2013). This impact continues throughout the academic years, with another correlational study involving 22 undergraduate university students with slow handwriting finding that the slow pace of their writing negatively impacted the quality of the content of their work owing to an increased cognitive focus on the act of handwriting (Connelly et al., 2005). In addition to this, poor handwriting has caused students to lose marks on assessed pieces of work as a direct result of illegible writing (Wallen, Duff, Goyen, & Froude, 2013).

Although handwriting has typically been used as a main method of showing understanding of classroom concepts, the recent and rapid advances in technology have introduced new tools for learning and expressing knowledge. As technology has become

more readily available, the accessibility of technological supports in learning environments has increased from early child care centers to secondary and tertiary education (Lynch & Warner, 2004; McDermott & Gormley, 2016). More than 40 states in the United States have adopted the Common Core Standards into their curriculum (National Governors Association, 2010), which integrates technology into both its reading and writing standards (McDermott & Gormley, 2015). In Australia there has been recent encouragement by government education departments of schools to incorporate the use of digital technologies as a learning support (Victorian Department of Education and Training, 2015).

Despite this international shift in classroom mediums, there has been little investigation surrounding the use of technology in the classroom with respect to how it is used and the frequency of this use. The studies that have been conducted on this topic present contrasting results. While some studies report teachers using minimal technology tools to support their writing practices, others report that technology is used frequently for the purpose of displaying multimedia content, generating interactive learning activities, focusing student attention, and displaying texts for shared reading (Bielefeldt, 2012; Cutler & Graham, 2008; Lynch & Warner, 2004; McDermott & Gormley, 2015).

As technology has become more advanced and accessible in society, a debate has sparked among professionals and in the media about whether technology should replace existing methods of text generation (Cahalan, 2014; Casey, 2013; Chemin, 2014). This discussion has led to research that provides preliminary insights into the benefits of using technology within an educational setting. Multiple studies with large samples found that access to and the use of technology in the early years of education can positively influence a child's academic achievement, enrich a creative and playful learning environment and improve a student's confidence with technology use (Cauley, Aiken, & Whitney, 2010; Espinosa, Laffey, Whittaker, & Sheng, 2006; Randolph, Kangas, Ruokamo, & Hyvonen, 2013).

In contrast, when looking at using digital text generation as a compensatory tool instead of handwriting, there is inconclusive evidence to support the benefits of using computers for text generation over typical handwriting methods. Comparisons between the transcription modes of using either a pen or a keyboard to generate text in an accelerated cohort study of 241 children found that children, both with and without learning disabilities, produced longer essays with a faster word processing rate with a pen than a keyboard (Berninger, Abbott, Augsburger, & Garcia, 2009). Although some technology can have a positive influence of children's performance and behaviors, there is inconclusive evidence that technology enhances written productivity (Batorowicz, Missiuna, & Pollock, 2012). Nevertheless, digital forms of text generation provide an alternative to forming text for those with severe handwriting difficulties. However, a recent cross-sectional study of 93 pediatric occupational therapists in Canada reported that occupational therapists currently lack confidence in the area of technology, with particular regard to knowing what age is appropriate to begin using technology as a compensatory technique for children with handwriting challenges (Cramm & Egan, 2015).

Given that the most recent study on the time use of primary school–aged children with respect to fine motor and handwriting activities was conducted over 2 decades ago (McHale & Cermak, 1992), and considering the technological advances over this time period, there is currently no recent and contextually relevant literature that outlines how much time children are spending on handwriting in the classroom. Further, there is no evidence that outlines

whether this time is consistent across grade levels or whether the demands of handwriting increase as children reach higher grade levels. The current evidence surrounding the prevalence and exact use of technology within a classroom environment is contrasting and inconclusive. Despite global encouragement by governments to incorporate technology into classrooms as a learning support, there is currently no Australian study that provides evidence about whether technology is being used and, if so, the frequency of this use. Further, there is no study that indicates whether technology use is in conjunction with the learning and practicing of handwriting in the classroom or whether one is being compromised owing to attention to the other. As such, this study aims to investigate (1) what percentage of classroom participation involves handwriting for primary school–aged children in today's context, (2) how much time is spent on handwriting throughout a school day for different grade levels, and (3) what percentage of classroom participation involves technology-based activities in the classroom.



## Method

### Participants

The participants for this project were primary school classes. The project focused on the activities performed collectively within a primary school classroom environment, making the classes the participants for the project. A convenience-sampling method was used to locate potential primary schools within regional Victoria, Australia. Inclusion criteria for classrooms included that the class be in a mainstream school funded by the Victorian Department of Education and Training and be a typical class for that grade level of standard size—that is, not a class specifically for advanced students or students requiring extra support. A total of nine classes were recruited for the project from three separate primary schools. The classes consisted of three groups each of the grade levels prep (first year of school), Grade 3, and Grade 5. One class for each grade level was recruited from the participating primary schools. These grade levels were chosen in order to gain a representative sample of "primary school classes" and to observe any differences in time use between grade and therefore age levels. To compare the results of this study to the 1992 study by McHale and Cermak, the sample was matched as closely as possible to the number and range of classrooms.

Of these nine classes, four (44%) had an open-plan design that incorporated team-teaching strategies with either two or three classroom teachers, and five (56%) had a traditional, closed classroom design with one classroom teacher. One Grade 5 class (11%) had an iPad program incorporated into the curriculum, and three classes (33%), one from each year level, were part of a school that had a high focus on incorporating the use of technology into their teaching methods. Four of the nine classes (44%) observed were split grades—that is, had two consecutive grade levels in one class. Of these four split grades, two were split grades 3 and 4 classes and two were split grades 5 and 6 classes. Split grades were not excluded from the project as they were seen to reflect typical classroom designs for these grade levels.

### Instrumentation

No existing tool was found that gathered the specific information required for this study, therefore the authors developed a data collection tool. In order to make accurate comparisons to McHale and Cermak (1992), the authors developed a data collection tool in a

similar format to that used in the previous study, which allocates activities into broad categories and specific subcategories. The tool uses 5-minute time intervals to document what activity is being participated in within the classroom. The tool gives a description of the activity, the environment, and task category for the activity for every 5-minute time period.

Four categories and seven subcategories were developed, with a particular focus on coding fine motor skills and technology use. The subcategories were developed so the authors could gather information about the overall time spent on a category of activities as well as detail about the time spent on explicit activities. These categories and their subcategories, with examples of each, are displayed in Table 1. The first category developed was "fine motor," with subcategories of "handwriting," "tool use," and "other fine motor" tasks. The handwriting subcategory reflected activities that involved direct handwriting methods on any mediums, while the tool use and other fine motor subcategories reflected tasks that involved the use of an instrument and tasks that primarily involved the use of in-hand manipulation, respectively. Similar to this, a "technology" category included the subcategories "technology fine motor" and "technology other." The technology–fine motor subcategory reflected activities that had a fine motor component while directly using a form of technology, such as a keyboard; while the technology other subcategory involved all other activities that involved the direct use of technology. A "general" category was formed in order to code all other activities that may occur in a typical classroom. These were coded under the subcategories "academic," for activities that directly related to the school curriculum without involving a major fine motor or technology component or "nonacademic," for transitional activities. A final category was developed called "inquiry learning." This category aimed to account for times when the class was participating in self-directed learning tasks and there were no set activities for the classroom. This category enabled the authors to code for times when the entire class was participating in a variety of individual activities that may or may not involve the components mentioned above.

The data collection tool was pretested by the authors with one of the participating classes. The researchers independently observed and completed the data collection tool for a period of 1 hour and compared their results following the completion of this hour. The pretest met the assumptions of Cohen's kappa, which was used to produce an interrater reliability score of 0.66. Two observations were coded differently during the trial between the two authors; however both researchers produced identical percentage times for each subcategory. This pretest indicated a high level of agreement between the two authors, and the tool was deemed suitable for use for the project.

**Table 1.** Categories and sub-categories with examples for developed data collection tool.

| Category | Subcategory | Example activity |
|---|---|---|
| Fine motor | Handwriting | Writing in workbook |
| | Tool use | Cutting with scissors |
| | Other fine motor | Molding clay |
| Technology | Technology-fine motor | Typing on a keyboard |
| | Technology-other | Reading from an iPad |
| General | Academic | Discussing ideas |
| | Nonacademic | Packing away items |
| Inquiry learning | | Self-directed learning task |

## Procedure

The project was granted ethical approval by the Deakin University and the Victorian Department of Education and Training (DET). An observational time series study design was used in order to measure what activities were being participated in at different points in time throughout the school day. The nine participating classrooms, consisting of prep, Grade 3 and Grade 5 classes, were observed by the first author for a whole "typical" academic day—that is, a day during which the class completed its usual activities for that day without scheduled special events or interruptions. In order to account for variations between classrooms, days of the week, and times of the day, the schedule of observations across the nine classrooms was randomized using a Latin square. Using this design each grade level was observed for a total of five school days, one each for every day of the school week (i.e., Monday to Friday). As there were three different year levels, 15 school days were observed in total. The arrangement for observational days is outlined in Table 2.

Each classroom was observed for the whole duration of the school day in order to obtain data on the percentage of the day spent on handwriting and technology tasks. The schools' bell times were used to determine when this day commenced and finished. Recess and lunch breaks were not included in the observation time. In accordance with the schools' bell times, each classroom was observed for a total of 300 minutes. Each classroom was observed using 5-minute time intervals to code the activities that were being participated in. This time interval was chosen due to the structured nature of a classroom environment. This resulted in 60 observations in total per classroom per day. For each -minute time period, the main activity that the students participated in for the majority of the 5-minute block was coded. When two different activities were being participated in at the same time in the classroom (e.g., 20 students reading a hard-copy book and five students reading from an iPad), the activity that had the majority of students participating in it was counted for that time period. This was to obtain the most generalized results about what typically was occurring in the classroom. At times when the class was split into equal groups of students participating in multiple different activities, handwriting activities were preferentially selected to be coded for that time period in order for the data to reflect the maximum amount of time that could possibly be spent on handwriting activities for that day for that class. This approach was taken only when the class was split into groups of students that were equal in size and there was no clear majority.

## Data analysis

Data were analyzed using the IBM Statistical Package for Social Sciences (SPSS), Version 22, program. Descriptive statistics were used to analyze data for frequency and percentage of time spent on activities.

**Table 2.** Latin square design used for observation of prep, Grade 3, and Grade 5 levels.

| School | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| School A | Prep | Prep | Grade 3 | Grade 3 | Grade 5 |
| School B | Grade 5 | Grade 5 | Prep | Prep | Grade 3 |
| School C | Grade 3 | Grade 3 | Grade 5 | Grade 5 | Prep |

## Results

### Across all grade levels

The average times recorded for each category across all year levels observed are presented in Table 3. Overall, the average time spent on fine motor activities during a school day was 96 minutes (*SD* = 42), or 33% (*SD* = 14). Handwriting made up 85% of these fine motor activities, with an average of 81 minutes (*SD* = 44), or 27% (*SD* = 15.1) spent on handwriting tasks. Throughout the day, the majority of classroom participation was spent on activities that fell under the general category (mean = 53.1%, *SD* = 10), consisting of academic activities (38.5%, *SD* = 10.6) and nonacademic activities (14.6%, *SD* = 5.5). After general activities, fine motor activities were the second-most-participated-in activities. The amount of time spent on technology activities varied across the nine classrooms. The average time spent on technology-based activities was 30 minutes (*SD* = 23.1), or 10% (*SD* = 7.7) of a school day.

### Individual grade levels and time spent on handwriting

The average time spent on handwriting during the day was 62 minutes for the prep grades, 94 minutes for the Grade 3 classrooms and 86 minutes for the Grade 5 classrooms. The prep classrooms spent the least amount of time on handwriting activities, averaging 24–32 minutes less a day than the higher grade 3 and 5 classrooms. The Grade 3 classrooms had the highest average time.

## Discussion

The results of this project indicate that the use of technology within a Victorian classroom environment remains limited. As technology has become more advanced and prevalent in society, a natural assumption could be made that this prevalence also extends to a classroom environment. This assumption may be particularly fuelled by the current discussion in society about whether technology is a more appropriate method for text generation

**Table 3.** Time spent on categorized classroom activities during one academic day across prep, Grade 3, and Grade 5.

| | Mean | Mean | *SD* | *SD* | Mode | Mode |
|---|---|---|---|---|---|---|
| | Minutes | % | Minutes | % | Minutes | % |
| Fine motor total | 96.3 | 32.6 | 42.0 | 14.4 | 65.0 | 21.7 |
| Handwriting | 80.7 | 27.4 | 43.7 | 15.1 | 65.0 | 21.7 |
| Tool use | 5.0 | 1.7 | 8.5 | 2.8 | 0.0 | 0.0 |
| Other fine motor | 10.7 | 3.5 | 14.1 | 4.7 | 0.0 | 0 |
| Technology total | 30.0 | 10.0 | 23.1 | 7.7 | 10.0 | 3.3 |
| Technology fine motor | 5.7 | 1.9 | 10.8 | 3.6 | 0.0 | 0.0 |
| Technology other | 24.3 | 8.2 | 23.6 | 7.8 | 10.0 | 3.3 |
| General total | 157.3 | 53.1 | 30.7 | 10.2 | 155.0 | 51.7 |
| Academic | 114.0 | 38.5 | 31.9 | 10.6 | 80.0 | 26.7 |
| Nonacademic | 43.3 | 14.6 | 16.3 | 5.5 | 25.0 | 8.3 |
| Inquiry learning | 12.3 | 4.1 | 25.3 | 8.4 | 0.0 | 0.0 |

*Note: SD* = standard deviation.

than handwriting for children in an educational environment (Cahalan, 2014; Casey, 2013; Chemin, 2014). While there is some American literature that supports the increased use of technology in classroom environments (McDermott & Gormley, 2015), this study found that Victorian primary school children spend only 10% of their school day using technology in the classroom. The first author observed that all schools in the project had access to common forms of technology such as iPads, laptops, and projector screens or interactive whiteboards, which is consistent with the reported increase in the prevalence and accessibility of technology in the classroom (Lynch & Warner, 2004; McDermott & Gormley, 2015). However, this study found that the actual use and application of these technologies remained one of the least-participated-in types of activities within a classroom environment. At this point in time, it appears that technology may either still be emerging in the classroom environment or more traditional forms of learning and showing understanding, such as handwriting, are preferred.

In 1992, McHale and Cermak determined that primary school children spend between 30%–60% of their classroom time on fine motor activities, 85% of which involved handwriting. More than 2 decades later, the results of this project provide updated evidence that in the early 21st century primary school children are spending between 18% and 47% of their classroom time on fine motor activities. Similar to the previous study, handwriting makes up 84% of this time. It is interesting to note that while time spent participating in fine motor tasks has decreased in the past 20 years, the percentage of time spent on handwriting within the category fine motor is the same.

The results of this study produced large standard deviations for the average time spent on fine motor activities; however, this is not dissimilar to the results found by McHale and Cermak (1992), which originally found that the average time spent on fine motor activities was 43% of the total day with a standard deviation of 12%, resulting in the rounded 30%–60% statistic that the study reports. This study found that the average time spent during a day on fine motor activities was 33% with a standard deviation of 14%, resulting in a confidence range of 18% to 47%. Due to the similar nature of the analysis, the results of the two studies are comparable and indicate that children are now spending less time today on fine motor activities and handwriting in the classroom than in previous decades.

Being fluent in handwriting increases the reading, linguistic, and motor skills of a child and supports children's creativity and ability to communicate effectively (Clark & Luze, 2014; James & Engelhardt, 2012; Shah et al., 2013). In contrast, poor handwriting hinders the ability of a child to put quality information into the content of work and can cause the child to be marked more harshly by assessors based on the illegibility of written work (Connelly et al., 2005; Wallen et al., 2013). Reduced fine-motor and handwriting skills have the potential to restrict a child's academic performance (Grissmer et al., 2010; McCarney et al., 2013; Medwell et al., 2009; Wallen et al., 2013), which may prevent them from meeting curriculum standards. Failing to meet requirements at school can lead to secondary issues such as reduced self-esteem, lack of confidence, and social exclusion. This study found that children are spending less time on fine motor activities within a classroom environment. This poses the question, what functional implications does this reduced time have on the participation of children in their occupations inside and outside of the classroom?

This study identified that on average students in the first year of school spend 24–32 minutes less a day on handwriting than students in the higher grade 3 and 5 levels.

Despite this difference not being statistically significant, recent studies indicate that effective handwriting intervention for children is dose dependent and relies on sufficient repetition and practice (Hoy, Egan, & Feder, 2011; Wallen et al., 2013). Therefore the 24- to 32-minute difference in time could be viewed as clinically significant when considering a skill acquisition perspective. Fitts and Posner (as cited in Zwicker & Hadwin, 2009) describe motor learning in three stages: cognitive, during which the individual may have a basic idea of what is required; associative, the intermediate stage, during which the individual can execute the movement with some errors; and autonomous, the final stage, during which the skill has been learned and the individual requires little cognitive effort to do the movement. In order to reach automaticity with a motor pattern, practice is vital (Zwicker & Hadwin, 2009).

The Victorian curriculum standards for primary school children vary greatly from the first year of school (prep) to the last year at primary school (Grade 6) (Victorian Curriculum and Assessment Authority (VCAA), 2015a), indicating a large amount of expected development in this time. The Australian Victorian Essential Learning Standards (AusVELS) states that writing standards for preps involve understanding of letter knowledge, correct formation of upper- and lower-case letters, and experimentation with capital letters and full stops, while the writing standards for Grade 3 students involve expression of experiences, information and ideas, and demonstration of the purpose and context of their writing with consistent, legible letters (VCAA, 2015b, 2015c). These standards indicate that while the prep level focuses on early letter knowledge and development, by Grade 3, students are expected to be fluent with their writing in order to focus more on the content of their written work. Therefore, the 24- to 32-minutes less a day spent on handwriting activities for the prep students identified in this study may, in fact, limit the opportunity for the required development of handwriting abilities. As the evidence demonstrates that poor handwriting decreases a student's ability to focus on the content of what they are writing (Connelly et al., 2005; Wallen et al., 2013), it can be questioned whether this reduced time spent on handwriting in earlier years is providing students with effective preparation for the expectations of writing at a Grade 3 level.

For occupational therapy intervention to be evidence informed and effective, occupational therapy goals and classroom demands need to match in order to produce positive functional outcomes for children. Therefore a current understanding of what, how, and when occupations are being participated in within the classroom environment is essential. The results of this study provide evidence that although the overall time spent on fine motor activities has decreased in recent years, handwriting remains a main occupation for children in the classroom. It therefore validates, if not encourages further, the role of occupational therapy within an educational, classroom setting in order to provide support and improve handwriting competency for children.

The findings of this study indicate that occupational therapists should consider targeting their handwriting interventions toward early–primary school years in order to adequately prepare students for the greater writing expectations that are placed upon them from Grade 3 upwards. Increasing the automaticity of handwriting and having the ability to fluently and correctly handwrite letters allows children to reduce their cognitive load and focus more on the content of their writing, instead of the act of writing itself (Connelly et al., 2005; Grissmer et al., 2010; McCarney et al., 2013;

Medwell et al., 2009; Peverly, 2006). Targeting early primary years to increase this handwriting automaticity for children may then increase their performance and enable participation in contextually relevant occupations while at school and, therefore, facilitate their occupational role as a student. Occupational therapists can also take an active role in the transfer of knowledge and subsequent discussions with classroom educators as to whether enough time is provided in the curriculum to ensure the acquisition of handwriting as an automatic skill.

There is currently confusion between occupational therapists in knowing when it is appropriate to implement compensatory intervention strategies for handwriting (Cramm & Egan, 2015). As children are spending more time on handwriting activities from Grade 3 and upwards, and the AusVELS standard requires students to demonstrate expression and understanding through writing, this could be a time when occupational therapists provide compensatory techniques to handwriting for children with handwriting difficulties. The increased availability in society of digital forms of text generation allow occupational therapists to consider this as an alternative to written text for children with handwriting difficulties. The results of this study show that more time is spent on handwriting from Grade 3 and upwards in primary school, and with school curriculum focusing on demonstrating expression and thought through writing, this may be a time for occupational therapists to consider compensatory intervention strategies, such as through the use of technology, for children whose poor and nonautonomous handwriting is a barrier to their written expression. Although there is conflicting evidence in the literature to suggest that using technology as a compensatory tool for handwriting increases written productivity for children without handwriting difficulties (Batorowicz et al., 2012), the increased availability of technology in the classroom suggests that it could be an appropriate means of compensatory intervention for occupational therapists to consider for older primary school children with significant handwriting difficulties.

In order to collect reliable data that gave a valid snapshot of the time use of primary school children in the classroom across during a typical school day, several steps were taken including interrater reliability for the time use observation and randomization of observation times across schools and classrooms. This study set out to make direct comparisons with the findings of McHale and Cermak (1992), as a renowned study that continues to be cited internationally, and aimed to include a sample of similar size in order to make accurate comparisons. The sample in this study included observation of an extra school, three more classrooms, and a greater spread of ages within a primary school setting, with the intention of increasing the generalizability of the results.

Despite steps taken to strengthen the project, some limitations remained. The sample size was relatively small for a quantitative study and was obtained from one region of Victoria, which may limit the generalizability of the results, particularly on a national or international scale.

This study produced new, current evidence on the time use of primary school children in the classroom. Further research is needed to investigate whether children in the early years of primary school are receiving adequate preparation of handwriting skills for the higher expectations of middle-later years. Further investigation into the effect, if any, of the reduced time spent on fine motor skills on children's participation in contextually relevant occupations while at school is needed. Research to gather time use data on all primary grade levels would be beneficial to gain more

accurate data and make further comparisons. Trends in the literature suggest that technology use in the classroom environment is increasing, and this should be monitored in order for occupational therapists to have a current understanding of what occupations children are participating in within the classroom to ensure that relevant client-centered goals can be made. Research in this area will also provide occupational therapists with stronger evidence as to when to introduce technology into their intervention techniques as a compensation strategy. Further research in this area will support the collaboration of occupational therapists, childhood educators, and schools to maximize children's participation in classroom relevant occupations.

## Conclusion

This study demonstrates that despite the advances of technology and the current debate concerning handwriting as a relevant skill in today's context, handwriting does remain a main occupation for primary school children in the classroom. The project found that compared to McHale and Cermak's findings over 20 years ago, children in the Victorian classroom today are spending less time participating in fine motor activities, with these activities making up only 18%–47% of classroom time. Similar to the findings of McHale and Cermak (1992), in the current study, handwriting continued to make up 84% of time on fine motor activities. This study provides updated evidence on the time use of primary school children in the classroom, providing occupational therapists with a current understanding of what occupations are relevant for children in a classroom environment. The study validates the role of occupational therapists working with children in a classroom setting in order to provide support for children and assist in developing handwriting skills, with the aim of consequently facilitating their participation in other highly relevant classroom occupations.

## Acknowledgment

The authors would like to acknowledge the Victorian Department of Education and Training and express great appreciation for their support in the undertaking of this research project.

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