

Shaping young children’s handwriting and keyboarding performance: Individual and contextual-level factors

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There is a strong body of research showing associations between handwriting automaticity and children’s writing performance. However, less is known about keyboarding automaticity and young students’ writing performance. We investigated the relationship between handwriting and keyboarding automaticity and writing performance in both modalities in a sample of 49 students, as well as children’s attitudes toward writing in each modality. We also examined the frequency and the nature of the teaching strategies implemented to support children’s writing development at school, and the writing practices and support that children reported experiencing at home. Our findings showed statistically significant associations between letter writing automaticity in both modalities and the quality and the length of Year 2 children’s handwritten and keyboarded texts. Results further suggested statistically significant moderate to strong associations between all handwriting and keyboarding variables assessed. While our findings concur with research stressing the importance of preparing students to become “hybrid” writers by mastering both handwritten and keyboarding modalities, they also stress the need to examine contextual factors, such as teaching and home writing practices, to gain a more comprehensive view of factors impacting children’s writing acquisition and development.

Introduction

Writing is a powerful mean of communication, historically enabling the recording of human beings’ actions, emotions, and achievements throughout times (Merga et al., 2021). Learning how to write is, however, a highly demanding process that involves the development of foundational writing skills, like producing letters and conventional spellings, and process skills, like planning and revising skills to create coherent written texts for different purposes and audiences (Kellogg, 2008). As a social activity, writing is shaped by specific teaching and learning contexts, including formal instruction through schooling and informal teaching in home-based environments (Graham, 2018; Hall et al., 2015). In today’s digital world, the first writing experiences children often have is using different keyboards, resulting in the marginalisation of paper-based writing in some countries (Woolscheid et al., 2016). In Australia, for example, handwritten national assessments have been replaced by online national assessments, with students’ literacy

skills being assessed via keyboarding as early as in Year 3 (ACARA, 2021) (Australian Curriculum, Assessment and Reporting Authority). Hence, it becomes fundamental to investigate the contributions of these writing modalities on children's writing performance and the formal and informal teaching and learning experiences that shape the development of handwriting and keyboarding skills.

Automaticity of transcription skills

Transcription skills play a fundamental role in effective writing development. In a meta-analysis synthesising 25 years of research in the field, Kent and Wanzek (2016) examined the relationship between component skills (e.g., handwriting automaticity and spelling) and writing performance across year levels (K-12). Findings showed that transcription skills explained roughly 25% of the variance in writing quality, pointing out that failing to achieve transcription automaticity in the early years of schooling may impact students' writing development. Automaticity can be defined as "effortless and lack of conscious awareness in component skills needed to allow cognitive resources to be available for higher order processes and to access and retrieve relevant information efficiently to support the goal of meaning processing and production" (Kim, 2020, p. 19). Indeed, research shows that handwriting automaticity uniquely predicts the writing performance of young writers (Berninger et al., 2009). As per McCutchen's capacity theory of writing (McCutchen, 1996), limited handwriting automaticity is said to constrain the writer's ability to focus on other composition aspects of writing, including ideation and word selection (Medwell & Wray, 2014). In a longitudinal study examining the writing performance of beginning writers, Malpique et al. (2020) found that handwriting automaticity predicted the quality of children's texts concurrently and longitudinally, with findings indicating that handwriting automaticity predicted the quality of the texts that children wrote in their kindergarten year and one year later in Year 1. This accumulating evidence clearly showcases the contributions of handwriting automaticity in predicting children's writing performance.

Contrasting with the considerable amount of research showing predictive relationships between handwriting automaticity and children's writing performance, less is known about the contributions of keyboarding automaticity to young students' writing. Theoretically, whether via handwriting (HW) or keyboarding (KB), higher levels of automaticity in these transcription skills are expected to allow writers to focus on idea generation to maximise writing fluency and quality (Berninger & Swanson, 1994; Malpique et al., 2023d; Weigelt-Marom & Weintraub, 2018). HW and KB are highly complex skills that require the development of cognitive, linguistic, and sensory-motor skills (Cerni & Job, 2023; Preminger et al., 2004). Both HW and KB require the writer to access and retrieve alphabet letters, but they differ in several sensory-motor aspects of performance (Mayer et al., 2020). While HW requires the writer to match appropriate motor functions to a specific formation of a letter, including the speed with which to write each letter and its size, during KB the writer must visually recognise and select alphabet letters on a keyboard, learn and use specific movement patterns and keystrokes, relying primarily on kinesthetic feedback that supports accurate typing (Preminger et al., 2004; Spilling et al.,

2022). Considering the different physical requirements of both transcription modes, it becomes relevant to examine the contributions of each modality to children's writing performance.

Attitudes towards writing

Motivational factors influence writing performance throughout schooling (Pajares, 2003). Recent systematic reviews of studies examining motivational factors in writing (Camacho et al., 2021; Ekholm et al., 2018) report students' writing attitudes is a strong motivational predictor of writing in elementary (Years 1-5) schools. For example, Ekholm and colleagues (2018) systematically reviewed research published between 1990 and 2017 focused on investigating writing attitudes. The authors highlighted that few studies examined relationships between writing attitudes and writing achievement, with only four studies (Graham et al., 2007; Graham et al., 2012a; Knudson, 1992; Olinghouse & Graham, 2009) focusing on early primary students (Years 1-3). From the four studies included, two studies reported that writing attitudes influenced students' writing achievement, including writing quality and text length (Graham et al., 2007; Graham et al., 2012a). Olinghouse and Graham's study (2009), using multiple regression analyses, however, found that Year 2 students' writing attitudes did not predict their writing performance. Writing attitudes are viewed as a multidimensional construct, potentially dependent upon specific contextual factors, including writing modes (Graham et al., 2017). As such, students may differ in their attitudes towards composing handwritten and keyboarded texts. Indeed, research shows that students generally have favourable attitudes toward using word processing for writing (e.g., Bangert-Drowns, 1993; Morphy & Graham, 2007). However, at the time of writing this paper, we were not able to find any study investigating beginning writers' attitudes toward composing keyboarded texts and its relationship to students' writing performance.

Contextual-level factors: Home and classroom writing practices

A fundamental tenet of sociocultural theories of writing is that children develop different writing practices, skills, and motivation for writing by interacting with more skilled adults and peers, who via scaffolding and modelling help children accomplish writing related tasks that they could not undertake independently (Graham, 2018). Parents are often children's first educators and the first to provide them with instruments and opportunities to translate their ideas into written language. Parental involvement in children's writing is still under-studied (Alston-Abel & Berninger, 2018; DeFauw, 2017), but research suggests benefits to children's writing performance. For example, Camacho and Alves (2017) designed and tested an intervention program to promote parental involvement in Year 2 children's writing. The authors found that Grade 2 children's writing performance (i.e., handwriting fluency, dictated spelling, writing quality and text length) was better when parents provided their children with specific suggestions to write more, improve text ideas, and check their spelling and handwriting. Their findings further suggested that parents' encouragement and praise on children's handwriting, spelling correctness, and quality of their texts played an important role, potentially impacting children's writing

outcomes. Overall, research in this field highlights that writers are part of writing communities where teachers and families often act as writing mentors, supporting children's capacity to use writing for different communicative purposes (Graham, 2018; Hall et al., 2015).

Developing text composing skills is a challenging process that typically begins with formal schooling (Malpique & Veiga Simão, 2019). Research examining instructional practices for writing in different educational contexts has recurrently reported concerns about the frequency and nature of the teaching practices developed to support writing in primary education (Graham, 2019; Merga et al., 2021; Malpique et al., 2023c). Several national surveys have consistently reported that primary teachers allocate minimal time for writing instruction in their classrooms, focusing on teaching spelling over other foundational and process writing skills (Graham, 2019). For example, in a national survey investigating writing instruction in Australian primary classrooms, Malpique et al. (2023c) found that teachers typically allocated on average only three hours per week for writing practice, over-emphasising the teaching of spelling over the teaching of composition skills, like text planning and revising. Findings were also indicative that the teaching of handwriting and keyboarding was done sparingly, with results further showing that teaching strategies to extend writing to the home environment were the least frequently reported strategies from the 20 instructional practices assessed. Researchers have currently little data on what writing instruction looks like in typical primary classrooms in Australia, and research examining parental involvement in writing is scarce (Alston-Abel & Berninger, 2018; Malpique et al., 2023). Hence, the present study aimed to address this gap by taking a more comprehensive approach to gain insights into the writing performance of beginning writers.

The current study

This exploratory study is part of a larger project designed to examine individual and contextual level factors explaining writing development across the primary years of schooling (Malpique et al., 2023a, b, c, d, e). For the current study, we examined relationships between Grade 2 students' handwriting and keyboarding automaticity and their writing performance across writing modalities. We also investigated relationships between students' attitudes towards producing handwritten and keyboarded texts and their writing performance in both modalities. Considering the role that teachers and home variables play in promoting effective writing development, we also sought to gain insights into formal and informal teaching practices being implemented to support children's writing development at school and at home. To our knowledge, this is the first study examining individual and contextual-level factors potentially impacting the writing performance of beginning writers across writing modalities. We addressed the research questions below:

1. What are the associations between handwriting automaticity and keyboarding automaticity and Grade 2 students' writing performance in both writing modalities (i.e., writing quality, text length, and spelling)?

2. What are the associations between Grade 2 students' attitudes towards writing and their writing performance in both modalities?
3. What instructional practices for writing are put in place to promote Grade 2 students' writing development?
4. Which writing practices and support do Grade 2 students report experiencing at home?

Method

Participants and setting

Two schools (one independent school and one independent public school) within the Perth Metropolitan Region of Western Australia were invited to participate in this study. Participant schools were positioned above the median value of the Index of Community Socio-Educational Advantage (ICSEA), which is an Australian composite measure of the relative socio-economic advantage of the population of students served by a school (ACARA, 2012). The median value is 1000, with 1300 indicating extreme advantage and 500 demonstrating extreme disadvantage. The participant schools had an ICSEA value of 1173 (government school) and 1079 (non-government school), and the percentage of students with language backgrounds other than English was 23% and 26%, respectively. Within the schools, three teachers (all female) agreed to participate in this study. They all held bachelor degrees and varied in terms of their professional experience, ranging from 13 to 35 years. A sample of 49 children without identified special educational needs ($M_{age} = 7.19$, $SD = 0.39$; 25 female) enrolled in three Grade 2 classrooms participated in this study. Written informed consent was obtained from each student and their primary guardian before participation in the study.

Child-level measures

Children's data were gathered during the final school term in Grade 2 (October to December 2020). Assessments were administered in a quiet location outside the classroom during the school day. Length, times, and venues for the assessment sessions were negotiated with the teachers, ensuring children's comfort and appropriate levels of monitoring as judged by each setting.

Transcription skills

The alphabet writing task (Berninger & Rutberg, 1992) was used to assess children's handwriting and keyboarding automaticity. Children were asked to write as fast and as accurately as they could each letter of the alphabet in alphabetical order and in lowercase format using a pencil on lined paper (handwriting mode) and using a laptop running a Microsoft *Windows* operating system (keyboarding mode). Following previous research protocols (Berninger et al., 2009), children's HW and KB work received a score of 1.0 for each correctly formed letter (handwriting mode) and sequenced letter (handwriting and keyboarding mode) produced at 15 seconds. Inter-rater reliability (random 20% of data)

between the two researchers who administered the tasks was high (ICC = 1.00 for the handwriting task and ICC = .99 for the keyboarding task).

Children's spelling skills were assessed using the spelling subtest from the *Wechsler Individual Achievement Test WIAT- III Australian and New Zealand Standardised* (Wechsler, 2016). The spelling subtest measures the written spelling of letter sounds and single words. Research assessing the validity of the WIAT-III, namely content, construct, and criterion-related evidence, shows that the instrument composites and subtests satisfactory measure each construct, with results showing moderate to high correlations with similar assessment tests (Pelling & Burton, 2017).

Writing performance across modalities

Children were requested to write a short story following a specific writing prompt by hand ("On my way home from school, I found a robot") and by keyboard ("On my way home from school, I found a spaceship"). Topics were similar across transcription modes to control for children's knowledge and motivation. Children completed the handwritten task on a sheet of A4 lined paper using a pencil and the keyboard-based task using a laptop running a Microsoft *Windows* operating system with spelling and grammar checks turned off. Students were given 10 minutes to complete each task and the order of tasks was counterbalanced to control for order effects (see Berninger et al., 2009, for similar procedures).

Children's writing performance in both modalities was assessed in two ways. We used an analytical scoring method to assess the writing quality of paper-based and keyboard-based texts. Texts were scored on 10 criteria namely:

1. Audience (e.g., capacity to orient, engage, and affect the reader);
2. Ideas (e.g., development of main idea);
3. Text structure (e.g., beginning, middle, and end);
4. Character and setting (e.g., capacity to portray and develop characters and/or time and atmosphere);
5. Vocabulary (e.g., interesting and specific words to convey meaning);
6. Cohesion (e.g., use of grammatical elements to link parts of the text);
7. Paragraphing (e.g., segmenting of text into paragraphs);
8. Sentence structure (e.g., sentence-level grammar and flow);
9. Punctuation and capitalisation; and
10. Spelling (e.g., spelling of grade-level words).

Scores ranged from 1 (*low quality*) to 5 (*high quality*). The final writing quality mark reflects the average of the 10 marking criteria (range 0-50). These marking criteria were adapted from the Australian National Assessment Program, Literacy and Numeracy (NAPLAN) narrative writing marking (ACARA, 2016) and from the *6 + 1 Trait Writing rubric for Primary Grades* (NREL, 2011) as these assessment measures are aligned with the judging standards for writing and creating texts for Year 2 in the Western Australia curriculum (School Curriculum and Standards Authority [SCSA], 2018). Children's writings were also assessed for the total number of words (TNW) to measure text length. Used recurrently in

previous research, findings show that TNW predicts writing quality in the primary years (e.g., Graham et al., 2016). All words that represented a spoken word were counted, independent of spelling mistakes. Inter-rater reliability (random 20% of data) for writing tasks were between .89 and .99 (i.e., .89 for paper-based; .92 for keyboard-based; .99 for TNW in both modalities).

Attitudes toward writing and home practices

Semi-structured interviews were conducted to investigate Year 2 students' attitudes toward writing handwritten and keyboarded texts. Children were prompted to complete a survey assessing their attitude toward writing by hand and by keyboard. Items from the *Writing Attitude Survey* (WAS) (Kear et al., 2000) were adapted to assess children's attitudes toward writing. The survey included four questions, and children were asked to circle a variety of options in the form of emotions using a face emoji scale ranging from *angry* (1) to *fantastic* (5) (i.e., *How much do you like writing using paper and pencil? Using a keyboard?; How do you feel when you are asked to write a story using paper and pencil?/ using a keyboard?*) A supplementary question asked students to try to explain the reason for their choice (i.e., *Why so?*). In addition, questions from Gardner's child-friendly questionnaire (Gardner, 2013) were adapted to assess the types of writing activities children do at home (e.g., *What kinds of writing do you do at home? Do you write* (6 options: stories; lists; diary; letters or cards; notes; any other writing activities) and their perceptions of their parent's involvement in their writing (e.g., *Does anyone help you write at home?*). This survey, which was developed and worded specifically for lower-primary-school-aged students, was found to have good ecological validity when previously tested (Gardner, 2013). To cater for the developmental needs of this cohort, questions were read aloud by the researchers, and open-ended responses were audio-recorded.

Classroom-level measures

After collecting all children's data, we asked teachers to complete a Likert-type survey providing information about themselves and the writing practices that they had developed with their students during the school year. The questionnaire was completed at a time convenient for the teacher, with an expected time for completion between 15-20 minutes. The survey was adapted from a national survey examining the teaching of writing in Australian primary classrooms (Malpique et al., 2023c). The survey included 27 items arranged into four main sections:

- Section 1. 4 items. teachers were asked to provide information about themselves including demographic information, gender, highest educational level, and years spent teaching, and to rate the quality of their pre-service preparation to teach writing.
- Section 2. 2 items. Teachers were prompted to indicate number of minutes they allocated for writing practice in their classrooms on a weekly basis, as well as the number of minutes spent on teaching foundational skills, namely spelling, grammar usage, handwriting and typing, and teaching process writing skills, namely planning and revision strategies on a weekly basis.

- Section 3. 1 item. Teachers were asked to select specific writing activities completed during the school year (e.g., writing stories, personal narratives, poems).
- Section 4. 20 items. Teachers were asked to select specific instructional practices they typically used to support writing development using an eight-point Likert-type scale ranging from 1 (*Never*) to 8 (*Several times a day*). The fourth section included four scales to assess the frequency with which teachers used evidence-based practices to support skillful writing; teaching strategies to foster the development of foundational writing skills; teaching strategies to foster the development of process writing skills; and teaching practices to promote writing at home with family support.

Results

Relationships between HW and KB automaticity and writing performance

Descriptive statistics for all child-level variables are presented in Table 1. Results showed that students composed longer ($M = 71.15$, $SD = 24.99$) and higher quality ($M = 28.56$, $SD = 5.00$) texts via handwriting compared to keyboarding ($M = 38.92$, $SD = 17.27$; $M = 21.52$, $SD = 5.52$, respectively). These differences were statistically significant, $t(47) = 9.66$, $p < .001$, $d = 2.36$ and $t(47) = 9.28$, $p < .001$, $d = 1.36$, respectively. However, students' letter writing automaticity scores were higher ($M = 8.59$, $SD = 3.69$) via keyboarding compared to handwriting ($M = 6.31$, $SD = 2.17$). This difference was also statistically significant, $t(47) = 4.62$, $p < .001$, $d = 0.75$. Female students ($M = 30.24$, $SD = 4.77$) outperformed male students ($M = 26.74$, $SD = 4.67$) in writing quality via handwriting, $t(46) = 2.56$, $p < .05$, $d = 0.74$, with female students writing higher quality passages via handwriting than male students.

Table 1: Writing performance and attitudes towards handwritten and keyboarded compositions (means and standard deviations)

Measure	<i>M</i>	<i>SD</i>
HW automaticity	6.31	2.17
HW text length	71.15	24.99
HW quality	28.56	5.00
KB automaticity	8.59	3.69
KB text length	38.92	17.27
KB quality	21.52	5.52
Spelling	101.94	10.24
HW attitudes	3.73	0.92
KB attitudes	3.82	1.14

Note. HW = Handwriting; KB = Keyboarding.

To evaluate the size and direction of the linear relationship between handwriting automaticity and keyboarding automaticity and Grade 2 students' writing performance (text length, writing quality and spelling), we calculated bivariate Pearson's product-moment correlation coefficients (Table 2). Findings indicated moderate to strong positive

associations between all HW variables and between all KB variables. Results suggested moderate associations between children's HW automaticity and the quality and length of the stories they produced using paper and pencil; and strong associations between children's KB automaticity and the quality and length of the stories they produced using a keyboard. Findings further suggested moderate associations between spelling performance and the quality of handwritten texts and moderate to strong associations between all KB outcomes and spelling performance.

Attitudes towards handwritten and keyboarded compositions

Descriptive results suggested some differences between children's attitudes towards writing via keyboard and writing using paper and pen(cil) favouring keyboarding, but this difference was not statistically significant. To examine whether children's attitudes towards writing via keyboard and writing using paper and pen(cil) related to their writing performance, we computed bivariate Pearson's product-moment correlation coefficient (r). Results indicated moderate positive associations between children's attitude towards writing via keyboard and all writing outcomes, namely keyboarding automaticity, text length and writing quality (Table 2).

Table 2: Associations between handwriting, keyboarding, spelling and attitudes (bivariate Pearson's product-moment correlation coefficient, r)

	HW auto	HW text length	HW quality	KB auto	KB text length	KB quality	Spelling	HW attitude
HW auto								
HW text length	.32*							
HW quality	.34*	.53**						
KB auto	.47**	.28	.45**					
KB text length	.31*	.45**	.48**	.62**				
KB quality	.23	.42**	.50**	.60**	.78**			
Spelling	.20	.19	.58**	.45**	.47**	.69**		
HW attitude	.06	.17	.14	-.05	.12	.15	.03	
KB attitude	.43**	.28	.24	.40**	.44**	.42**	.24	.09

Note. HW = Handwriting; KB = Keyboarding; Auto = Automaticity. * $p < .05$; ** $p < .001$

Instructional practices for writing

The three participating teachers reported that, on average, they allocated over one hour a week for writing practice in their classroom ($M = 73.33$ min, $SD = 23.09$; range = 60-100 min). Teachers reported spending two hours a week teaching spelling ($M = 120.00$ min, $SD = 34.64$; range = 100-160 min); one hour a week for teaching handwriting ($M = 60.00$ min, $SD = 60.00$; range = 0-120 min); less than half-hour a week for teaching typing ($M = 15.00$ min, $SD = 25.98$; range = 0-45 min); and over one hour a week for teaching grammar ($M = 63.33$ min, $SD = 47.26$; range = 10-100 min). On a weekly basis, teachers allocated more time teaching spelling than teaching handwriting ($t(2) = 3.00$, $p < .05$, $d = 1.22$) and teaching typing ($t(2) = 21.00$, $p < .001$, $d = 3.43$). Results further showed that, on average, teachers allocated nearly two hours a week for teaching revising ($M = 110.00$ min,

Home writing practices

The majority (94%) of children reported engaging in at least one writing activity at home in general, namely on writing stories (41%); writing lists (31%); writing in a diary (43%); writing letters/cards (65%); writing notes (26%); other writing activities (29%). Most children (74%) reported engaging in paper-based writing tasks at home, with only 12% reporting using a computer to write. Most children (76%) reported having someone at home who helped them with their writings. Children were most likely to report their mother (59%) as a person who helped them, with 43% of students reporting that their father also supported them on writing activities at home. Siblings were the next most commonly reported person to provide writing assistance at home, namely sisters (18%) and brothers (18%). Children also reported that their grandparents helped them with their writings (10%). Lastly, 6% of the participating children reported that someone else helped them at home with their writings, including babysitters and occupational therapists.

Discussion

Relations between transcriptions skills and children's writing performance

The contribution of handwriting automaticity in predicting primary school students' writing performance is well established. Results from the current study confirm previous national and international research establishing associations between handwriting automaticity and children's writing outcomes (Kent & Wanzek, 2016; Kim et al., 2013; Malpique et al., 2017, 2020). Current results also expand knowledge in the field by examining relationships between keyboarding automaticity and keyboard-based text composing. Our findings indicated that the quality and length of children's handwritten and keyboarded texts were associated with children's ability to automatically and accurately write and type alphabetical letters. Namely, HW automaticity accounted for 11% of the variance in writing quality and 10% of the variance in text length in handwritten texts. In turn, KB automaticity accounted for 36% of the variance in writing quality and 38% of the variance in text length of computer-generated texts. These stronger associations between KB automaticity and KB writing outcomes suggest that automaticity could potentially play a more significant role in computer-based writing than that observed in paper-based writing. Future research with a larger sample of students should test this hypothesis given potential implications for teaching and learning. Overall, current results confirm and enhance theoretical and empirical research arguing for the critical role that transcription skills, like handwriting and keyboarding, play in fostering effective writing development in primary education (e.g., Berninger & Swanson, 1994; Kim, 2020).

Current findings also indicated that children wrote longer and higher-quality texts using paper and pencil than using a keyboard. Regarding text length, results are well-aligned with international research showing that elementary school students (Grades 1-7), independent of age, write longer handwritten essays (Berninger, 2009). Regarding writing quality, previous research examining differences related to composing texts by hand and via keyboard has reported conflicting findings (Malpique et al., 2023b). On the one hand, studies between 1992-2002 suggested dissimilar contributions of handwriting and

keyboarding on writing quality, with findings indicating that students produce higher quality texts via keyboard across primary and secondary grades (Goldberg et al., 2003). On the other hand, research has suggested similar contributions of both modes to students' writing quality across grades (Feng et al., 2019) and advantages of handwriting over keyboarding on Grade 2 students' writing quality (Alves et al., 2016). Results from this study confirm Alves and colleagues (2016) findings with a Grade 2 cohort of students, with statistically significant differences indicating that children produced higher quality texts by pencil and paper than by keyboard. It is worth noting that research indicates that keyboarding experience impacts writing outcomes (Feng et al., 2019; Tate et al., 2019). For example, Tate and colleagues (2019) findings showed that prior computer use predicted high-school students' writing outcomes, including number of keypresses, written word production, and writing quality. Moreover, teachers traditionally prioritise teaching handwriting in primary education (Santangelo & Graham, 2016), and early primary students are still developing the sensory-motor skills that will enable them to rely on kinesthetic feedback that supports effective keyboarding (Preminger et al., 2004). Further research is warranted to examine the unique contributions of handwriting and keyboarding automaticity on students' writing performance while controlling for students' handwriting and keyboarding experiences.

Children's attitudes toward handwritten and keyboarded compositions

Research shows that students, especially young writers, prefer using the computer for text composing (e.g., Harrington et al., 2000; Malpique et al., 2023a). Several studies show the benefits of using computers to promote children's motivation for writing (e.g., Pifarré & Fisher, 2011) and to support interaction and feedback while writing, impacting writing performance (e.g., Wood, 2000). However, children's attitude toward writing keyboarded texts has been understudied. Findings from this study showed positive associations between children's attitudes towards composing keyboarded texts and all keyboarded writing outcomes, namely automaticity, text length and writing quality. Hence, children who felt more positive about composing texts using a keyboard were more likely to write longer and higher quality keyboarded texts. Participating teachers reported, however, placing less than 30 minutes a week teaching typing, potentially impacting children's attitudes towards writing and their keyboard-based writing performance. While we were not able to test this hypothesis in our study, our findings reinforce the need for teachers to allocate more attention to teaching keyboard-based text composing in the early years of schooling. Current results did not show any associations between attitudes towards composing handwritten texts and writing performance. While our results are well aligned with Olinghouse and Graham's study (2009) examining the writing attitudes of Grade 2 students in the US, the absence of such relationships may be attributable to sample size. Research replicating current findings with a larger sample and using more robust statistical analyses to examine potential cause and effect relations is warranted.

Home and classroom writing practices

The digital revolution in schools today "places greater responsibility on schools and families to help children become more efficient at accessing, transmitting, and using

information” (Parette et al., 2000, p. 243). Our findings replicate reports from national (e.g., Malpique et al., 2023c; Wyatt-Smith et al., 2018) and international research (Graham, 2019) showing that primary school teachers typically allocate less than the recommended six hours per week for writing instruction and practice in their classrooms (Graham et al., 2012b), placing a stronger focus on teaching spelling skills than other transcription skills, such as handwriting and keyboarding, and process writing skills, including planning and revision strategies. Our findings also suggest that despite teachers rarely capitalising on the home context to encourage writing, homes can be rich and meaningful environments where writing for purpose happens. Children in this study reported engaging in a wide range of writing tasks, including writing stories, lists, cards and journaling. Moreover, children’s responses suggest that support for writing is a family affair, with parents, siblings, grandparents and other meaningful others scaffolding their writing efforts.

Our findings are consistent with Gardner’s (2013) interviews with primary-aged children (n=106) identified by their teachers as “reluctant writers”. His findings indicated that children engaged at home in a variety of writing genres had consistent adult support and “ready-made audiences” (Gardner, 2013, p. 71). With evidence indicating the richness of the home context and the positive impact of print-rich environments on children’s emergent literacy (Neumann et al., 2012), it seems that formal educational settings have in families a largely untapped resource. From a research perspective, much is yet to be known about how different family environments and family members support children’s writing development. While the findings from the current study reinforce the need to learn more about the nature of writing activities children do at home with family support (Alston-Abel & Berninger, 2018) and the nature of the teaching activities that children experience in schools, it also reinforces the importance of developing larger scale studies examining the role that specific teaching activities and home activities play in promoting students’ writing outcomes.

Limitations and future research

The present study has several limitations that must be acknowledged to inform future research. First, caution must be applied in interpreting findings from the current study due to small sample sizes for students and teachers, and increased probability of type II errors (false-negative results). Secondly, classroom-level writing practices were collected via self-reporting. While findings from our study replicate previous studies examining writing instruction in Australian primary classrooms (Malpique et al., 2023c; Wyatt-Smith et al., 2018), our data must be viewed cautiously as we did not directly observe teaching practices in action. Future studies should aim at replicating and confirming our findings, including large scale and observational studies. Such future research should also test the contributions of specific classroom-level factors and home writing practices potentially explaining students’ handwritten and keyboarding performances. Most of the existing studies exploring the relationship between parental involvement and children’s writing have focused on the parental perspective and have not provided children with the opportunity to express their perspective of their own home writing environment; something which may be problematic as it can reflect a disconnect between the school and home writing environments (Gardner, 2013). Therefore, whilst evidence suggests

home and classroom writing practices positively affect children's writing performance, more research is needed to understand specific writing support happening at home and in the classroom (Kim et al., 2013).

Conclusion

In the current study, we investigated relations between Grade 2 students' handwriting and keyboarding automaticity and children's writing performance in both modalities. We were also able to examine Grade 2 children's attitudes toward writing handwritten and keyboarded texts and relationships with their paper-based and keyboard-based writing. This exploratory study confirms previous research showing that automaticity in handwriting is of key importance in explaining students' handwritten compositions. In addition, our findings showed statistically significant positive associations between keyboarding automaticity, attitudes toward writing keyboarded texts, and children's keyboarding outcomes, namely writing quality and text length. Hence, current findings concur with research stressing the importance of preparing students to become "hybrid" writers and able to master both handwritten and keyboarding modalities (e.g., Beers et al., 2017) while, simultaneously, stressing the need to examine contextual factors, such as teaching and home writing practices, that may enable the effective development of both paper-based and keyboard-based text composing in the digital world.

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