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Exploring the relationship between habitual-voluminous book reading and writing performance among third-grade students: a correlation analysis

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Abstract

This study examines the impact of habitual-voluminous book reading activities on students' writing skills in a distinct context lacking prior research. Employing technology to monitor students' reading, the research focuses on first language habitual-voluminous book reading activities, a domain unexplored in Taiwan's education system. Tracking book reading over three years, the study unveils the gradual fulfillment of reading goals and explores the connection between habitual-voluminous book reading and writing performance. The investigation also found that graded reading and Bridge Books' roles in enhancing students' reading and writing outcomes. Employing rigorous data analysis, the study offers a comprehensive understanding of the intricate relationship between habitual-voluminous book reading and writing performances. Findings reveal Picture Books and Basic Books as popular reading categories, influencing writing quality and word count during the revision process. However, there are potential trade-offs between quantity and quality of the writing performances, specifically observed in Bridge Books' impact on initial draft and revision quality. The complex interplay between different grades of the book and writing performance emerges, suggesting implications for educational interventions and further research in enhancing writing performances through habitual-voluminous book reading.

Keywords: Habitual-voluminous reading, Writing performance, Reading habits, Technology supported learning, Reading evaluation

Introduction

Taiwanese students had an unsatisfactory reading performance at PISA 2006 which was the first PISA Taiwan participated in with a score of 496 points. Fortunately, with a slight



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increase seen in PISA 2018, Taiwan achieved scores of 503, 531, and 516 for reading, mathematics, and science, correspondingly (Lin et al., 2021). The average reading scores were consistently much lower compared to their math and science scores. As we know, reading is important for learning, no matter what the subject that the student is studying.

In Taiwanese culture, the prevalent belief that mathematics and science hold greater importance than language literature is particularly endorsed by parents and teachers. Furthermore, Taiwan educational norms prioritize consistent practice and a strong foundational knowledge as the bedrock of accomplishment (Tan, 2015a, b, 2017; Stevenson et al., 1993), with academic achievement seen as the principal avenue to future success (Wei & Eisenhart, 2011). Consequently, parents, particularly mothers, become actively engaged in their children's learning, fostering expectations for dedicated effort and favorable academic outcomes (Fejgin, 1995).

Additionally, a prevailing sentiment shared by most of Taiwanese society, including educators, is that mathematics and science pose greater challenges than language literature. This cultural perspective leads Taiwanese students to devote more time to homework and receive more exam preparation support, attributing to heightened pressure for success in the national examination (Chen & Stevenson, 1989; Lin et al., 2021).

Furthermore, until 2014, the national assessment predominantly comprised multiple-choice questions, resulting in limited exposure to constructed-response items that constitute a significant portion of the PISA reading assessment. This scarcity of experience has left Taiwanese students with limited familiarity, potentially contributing to their comparatively modest performance in the PISA reading and writing evaluation (Lin et al., 2021; OECD, 2019, 2021).

In order to solve this problem, the Ministry of Education in Taiwan started promoting the importance of reading and writing in the education system. Over 15 years, the Taiwanese government made persistent efforts to introduce a reading program in elementary schools aimed at encouraging extensive reading among students. However, these endeavors yielded limited success. Moreover, in the Greater China region, programs that aim to use extensive reading as a method to encourage language growth are unable to be completely followed through by teachers (Renandya et al., 2015; Shih et al., 2018). Therefore, Chan et al. (2018) research team designed and promoted the Interest Driven Creator (IDC) Theory based extensive reading activity called Modeled Sustained Silent Reading (MSSR) with technology supported system "Reading for Tomorrow" (Chan et al., 2018, 2019). This research started from an experimental elementary school called Interest Driven Creator (IDC) School located in Taoyuan since 2015. Afterwards, this program was gradually being promoted and succeeded in thousands of schools all over Taiwan (Chan & Education Technology, 2016; Looi et al., 2023).

Moreover, writing is widely recognized as a foundational skill due to its role in fostering creativity, communication, and critical thinking abilities. Specifically, the act of writing plays a pivotal role in shaping the thought processes, rendering our thinking and learning tangible and enduring. Moreover, it enhances the capacity to articulate one's ideas coherently, facilitating both self-expression and the refinement of concepts. Additionally, written work serves as a natural avenue for creative expression, applicable within and beyond the academic realm. Creative writing, in particular, has been identified as a catalyst for the cognitive and communicative development of children (Tompkins, 1982). Consequently, educational institutions prioritize the assessment of students' writing proficiency. Nevertheless, early research within educational settings has indicated prevalent challenges faced by students, encompassing issues such as inarticulate sentences, suboptimal word choices, deviations from the topic, misuse of expressions, comprehension gaps, deficient structural organization, and a dearth of compelling ideas in written content (Jhen, 1994; Lai & Chiu, 2013; MoE, 2009; Wang, 2001). Numerous empirical studies have mentioned the important relationship between extensive reading and writing and explore the correlation between the implementation of reading strategies and effective reading outcomes (e.g., Barrot, 2016; Block, 1986, 1992; Hosenfeld, 1976, 1977; Knight et al., 1985; Shih et al., 2018). However, the impact of long-term extensive book reading remains unknown and the limited evidence regarding the influence of it on writing performance has raised this study interest. Moreover, we made a term for this new approach, the term is habitual-voluminous book reading. Therefore, we try to use the correlation calculation method employed just to verify the impact and understand relationships between habitual-voluminous book reading and writing performance rather than a focus. Our focus is more to the implementation of the technology in supporting the habitual-voluminous book reading tracking and evaluating the effectiveness of habitual-voluminous book reading by assessing their writing performance.

Moreover, meaningful integration of habitual-voluminous book reading and writing activities strengthens the relationship between these skills. Students may develop a deeper understanding of how reading informs effective writing and vice versa. This synergy can lead to improved comprehension, critical thinking, and expression of ideas in written form (Park, 2016). Hence, in this study, with the aim of observing a more pronounced relationship between habitual-voluminous book reading activities and writing performance. The focus was directed towards third-grade students who had engaged in three years of consistent and successful habitual-voluminous book reading practice. The research question of this study is what is the relationship between habitual-voluminous book reading and writing performance of third-grade students?

Related research

Habitual-voluminous book reading

Extensive reading acts as a supplementary class library initiative that provides students with the resources, time, and encouragement to engage in pleasurable reading at their own pace and proficiency level (Davis, 1995). The program's design frees students from the pressures of testing and grading, allowing them to compete against their own progress rather than against peers. The teacher plays a central role in motivating and monitoring students to ensure they make the most of their reading time.

For reading strategies, the effectiveness of extensive reading has been acknowledged by researchers in the first language, second language, and foreign language learning fields as a valuable method for fostering language growth and acquisition (Shih et al., 2018). This recognition is evident in studies conducted by various scholars (e.g., Adams, 1990; Cho & Krashen, 1994; Elley, 1991; Hafiz & Tudor, 1989, 1990; Hayashi, 1999; Krashen, 1993, 1994a, 1994b, 2013; Lao & Krashen, 2000; Mason & Krashen, 1997; Robb & Susser, 1989; Smith, 2011; Tsang, 1996; Walker, 1997). Moreover, simplified readers were initially employed for language acquisition in ancient Greece, while extensive reading practices emerged during the Renaissance (Kelly, 1969). Since then, the utilization of simplified readers for extensive reading has gained substantial popularity, particularly in the Asia-Pacific region in recent times. Notably, extensive reading has yielded positive outcomes in language learning across various locations. For instance, the Fijian Book Flood Experiment witnessed considerable enhancements in reading and listening skills among children after an 8-month period (Elley & Mangubhai, 1983).

Furthermore, Elley's (1986) recommendations for a successful extensive reading initiative encompass five key aspects. First, he highlights that exposing children to substantial reading at an early stage can significantly contribute to their language development. Second, the effectiveness of the Shared Book approach is underscored in language learning contexts. Third, the degree to which teachers adhere to project guidelines directly influences the project's outcomes. Fourth, the preference of children for universally beloved tales like Cinderella over books centered on local themes is observed. Lastly, the program's efficacy is attributed to factors such as high motivation, a focus on meaning, and an increase in the volume and quality of language exposure, as highlighted by Elley (1986).

Moreover, extensive reading and vocabulary studies have almost exclusively focused on word meaning in determining vocabulary acquisition (Pigada & Schmitt, 2006). However, it has been acknowledged by a large number of lexically-minded researchers that knowing a word involves much more than just understanding its meaning (Aitchison, 2012; Laufer, 1997; McCarthy, 1990; Nation, 1990, 2001; Richards, 1976; Schmitt, 1998; Schmitt &

Schmitt, 2000). Additionally, Pigada and Schmitt (2006) is the first to relate the number of encounters with a word during extensive reading with multiple types of word knowledge other than meaning research. The result showed that more knowledge and vocabulary acquisition is possible from extensive reading than previous studies have suggested.

Furthermore, in the Greater Asia region there is a challenge for conducting a persistent and successful extensive reading. Lai's (1993) study mentioned that it is not easy to encourage students to read more in a short period of time and without appropriate extensive reading activity that can cultivate their reading interest and habits (Lai, 1991, 1993). Since the modeled sustained silent reading (MSSR), which emerged with the teacher acting as a model (Chien et al., 2011; McCracken & McCracken, 1978) and silent reading by the students (Gardiner, 2005; McCracken, 1971; Pilgreen, 2000) being promoted, this has evolved into a notable classroom reading activity designed to address the challenges mentioned earlier. The initial section emphasizes teacher modeling due to its substantial influence on student learning, as indicated by McCracken and McCracken (1978). Put differently, reading is an expectation for everyone in the classroom, including the teacher, who reads in front of the students. The latter aspect underscores the practice of maintaining quiet and uninterrupted reading within the classroom over an extended duration (McCracken, 1971). During MSSR, it is crucial to steer clear of interruptions to prevent students from losing their grasp of the material or becoming disinterested (Atwell, 2007; Gardiner, 2005). Students have the autonomy to select the books that pique their curiosity and can swap them out when their interest wanes. This approach grants students the chance to delve into subjects they're genuinely fascinated by, fostering an absorbing and pleasant book reading encounter without any involvement of particular class subjects or goals to enhance reading skills, vocabulary, or familiarity with various writing styles. Empowered to make their own choices, they assume responsibility for their non-digital book reading habits, a factor that could potentially ignite their interest and lay the groundwork for a lifelong devotion to reading (Chan & Education Technology, 2016; Chien et al., 2011; Kuo, 2019). Therefore, we use the term 'habitual-voluminous book reading' to precisely describe this MSSR reading activity, which has adopted the Interest-Driven Creator Theory (Chan et al., 2018; Chan et al., 2019; Chen et al., 2020; Looi et al., 2023; Wong et al., 2020). 'Habitual-voluminous book reading' refers to a consistent and regular practice of reading a large quantity of books. It not only emphasizes the frequency with which books are read but also the substantial amount and broad scope of book reading consumed over time. It implies a dedicated and ongoing engagement with books, reflecting a deep interest or commitment to reading.

Writing as a formative assessment for habitual-voluminous reading outcomes

Frequently, school examinations require greater memorization efforts than comprehension. Students tend to make more efforts on memorization to achieve high exam scores, and to forget it shortly afterward. This happens often due to a lack of deep understanding of the material. Regrettably, most of the examination-based education system tends to emphasize memorization over genuine comprehension. Moreover, in schools in Taiwan, in order to improve their reading comprehension, students are instructed to memorize an extensive array of words and phrases, rather than being encouraged to engage with a diverse range of books through reading (Chien et al., 2015).

Learning is a cognitive process through understanding and memorization. A difference between comprehension and memorization involves the type of material that can be memorized versus comprehended (Lovett & Flavell, 1990); although almost any type of material can be memorized (e.g., number series, formulas, stories, knowledge). Moreover, Lovett and Flavell's (1990) study on children's remembering and understanding showed that children being confused with understanding with remembering. As we know, it is important that an understanding of the comprehension-memory discretion can be for successful learning in an academic setting. Children (and even college students) sometimes fail to realize that although some material has been memorized, it has not yet been understood. However, only structured or organized material such as words, sentences, paragraphs and stories can be said to be understood (Markman, 1981). However, there is a difficulty in assessing the outcome of the extensive reading and the assessment of reading outcome formatively with writing performance are scarce (Lai, 1991).

Consequently, writing activity can be considered as one of the better ways of knowing the understanding of a particular piece of knowledge and the memorization through understanding is more unforgettable, because writing involves structuring and organizing knowledge material such as words, sentences, paragraphs and stories. Furthermore, by understanding the knowledge, the student can use knowledge as a way of brainstorming to create ideas and be a creator. For that reason, investigating reading outcomes with writing as a formative assessment is a more comprehensive way to understand how far the students understand a particular knowledge and further generate new ideas. The most important is to prove Krashen (1989) hypothesis on "if language acquisition and the development of writing ability occur in the same way, writing ability is not learned but is acquired via extensive reading in which the focus of the reader is on the message."

Moreover, most of the study is in the implementation of extensive reading and its impact on writing has challenges such as cursory reading, characterized by low-level cognitive engagement for entertainment purposes, potentially leading to weak comprehension skills. While the study acknowledges the risk of shallow learning within the extensive reading framework, it falls short in providing detailed strategies or interventions to address these

concerns. The study touches upon the homogeneity of materials in extensive reading but does not delve into potential drawbacks related to a lack of diversity in genres, topics, or difficulty levels. Therefore, there is a study needed in more nuanced insights and strategies to optimize the integration of extensive reading and writing practices in not just language teaching contexts (Sun et al., 2016) but also learning contexts in general.

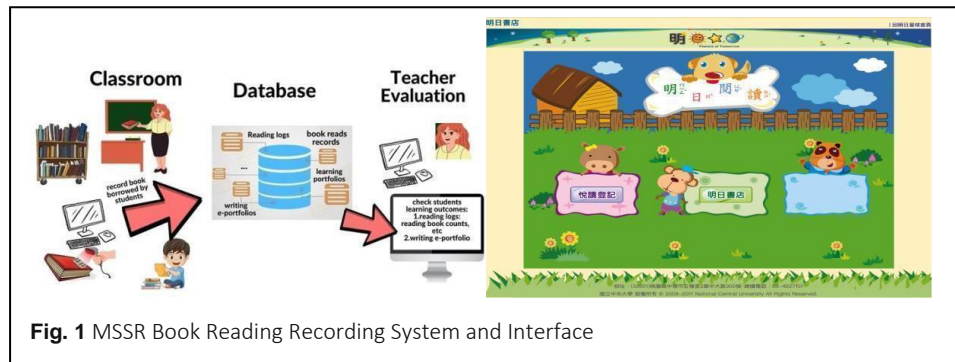
Evaluating habitual-voluminous book reading

The key question to consider when evaluating a habitual-voluminous book reading is: how many non-digital books did the students read? This leads to the idea that the most crucial information to keep track of is the number of books each student reads in a period of time, along with the difficulty level of those books. In the Edinburgh Project On Extensive Reading (EPER) Program implemented by some extensive reading projects (e.g., East Africa 1963-1970 Extensive Reading Program, The English Language Reading Programme (ELRP) 1975-1985 in Malaysia (Crevola & Hill, 1998), The English Language Teaching Support Programme (ELTSP) Phase 1 and Phase 2 1986 in Tanzania (Romaine, 2006), The English Language Improvement Project (ZELIP) in Zanzibar (Brumfit & Hikmany, 1997), The Extensive Reading Scheme in English (HKERS) 1991 in Hong Kong (Green, 2005), Extensive Reading Program 1988 in Maldives) (Jacobs et al., 2000), the books read by students were recorded with book borrowing cards. However, this condition increases the burden of classroom management and habitual-voluminous book reading implementation can be more costly. Therefore, there is a need to have a book read recording online system to track and record the books the students have read to assist the habitual-voluminous reading evaluation.

MSSR Book Reading Recording System

Without careful guidance, there is a risk of cursory reading, where students may engage with the material superficially for entertainment rather than delving into deeper comprehension. Moreover, the potential for shallow learning is a concern if habitual-voluminous book reading is not carefully implemented. Students might prioritize quantity over quality in their reading, potentially compromising the depth of understanding (Park, 2016). Therefore, there is a need for a book recording system to easily track the student's reading to avoid cursory reading and this reading behavior.

Therefore, in the MSSR program the books borrowed by students were recorded by MSSR Book Reading Recording System in the "Reading for Tomorrow" Platform, as shown in Figure 1. There is a computer and barcode scanning device which records the number of books in each classroom and the books borrowed by each student. In this system, the teacher can evaluate and keep track of the students' reading improvement and provide help for the students who need it by checking their reading performance.



Reading materials

The students read books using the MSSR framework and the books are physical or non-digital books. Choosing a paper book offers several benefits over e-books. Readers of print books absorb and remember more of the plot, as shown by studies indicating higher scores in empathy, immersion, and understanding of the narrative due to the tactile sensation of holding a book (Mangen & Kuiken, 2014). Print books also help readers track their progress and easily revisit information without losing their place. For children, print books improve comprehension as e-books can be distracting (Dobler, 2015). Print books are easier on the eyes, avoiding screen fatigue, and aid in better sleep by not emitting blue light that affects melatonin levels (Chi, 2017). Print readers are less likely to get distracted compared to e-book readers who may scan for keywords rather than processing the content. Additionally, the physical experience of reading a print book, including the smell of the pages, can enhance the joy of reading and even inspire positive life changes. The MSSR prioritizes quantity and variety in book selection, focusing on books that are engaging and relevant to students' lives, rather than exclusively on literary merit. While fiction is the predominant genre, the collection also includes non-fiction and magazines. The article suggests that each class should ideally possess a book shelf containing various titles, graded by category and reading level, with about ten more books than the number of students in the class.

There are two categories of grading the reading material in MSSR activity. They are the breadth and depth of the book. The breadth of the book includes science and technology (engineering technology, natural sciences, life sciences, and sustainable development), story fiction (warm and inspiring, adventure and reasoning, myth and fable, science fiction and martial arts), and human society (life, arts, social and literature). The depth of the books is graded into five levels: Picture Book, Bridge Book, Basic Book, Middle Book and Advanced Book. The Basic Book, Middle Book and Advanced Book contain more text than Picture Books; and the Bridge Book is considered as a higher grade or level of book to read.

Picture Books, in the early days, were a type of book primarily focused on illustrations, with text playing a secondary role, and sometimes even consisting entirely of pictures without any text. As the name suggests, they are “books that are drawn.” In simpler terms, Picture Books are books that emphasize visual effects through a large number of illustrations, with beautifully designed and impactful layouts that enhance the presentation of the story’s plot and themes. They are primarily intended for infants and children, with the goal of stimulating their interest in viewing and reading.

Moreover, in 2003, when the new concept of “Bridge Books” emerged in Taiwan, these concise reading materials with word counts, page numbers, proportional illustrations, and chapter divisions were published with profound and meticulous considerations. The most important aspect was the goodwill of accompanying readers, just like the training wheels for children learning to read independently in their early stages. Bridge Books serve as a transition between Picture Books and purely text-based books, with both the amount of text and the number of illustrations falling somewhere in between these two categories. Their purpose is to assist children in progressing from being able to read Picture Books to being able to independently read longer texts such as Harry Potter or novels by Jin Yong.

Method

This study carried out a three-year study by implementing MSSR activity with the Reading for Tomorrow system as the technology supported learning system. This design-based research was conducted in the experimental elementary school in Taiwan. The research question addressed as follows: What is the relationship between habitual-voluminous book reading and writing performance among third-grade students?

Participants

The participants’ reading and writing data was collected from fall 2017 to spring 2021. This group of students are Grade 3 and Grade 4 by the end of spring 2020, but we collected their accumulative reading data until third-grade only. Grade 3 has 26 students with 12 males and 14 females and Grade 4 has 29 students with 11 males and 18 females, 55 students in total. 15 students’ data were eliminated because some students left schools in the middle of the experiments. The average age of these students are 9 years old. In this school, most of the students are middle-class level of socioeconomic status families from the neighborhood areas. The background of their mother tongue is Mandarin Chinese or Taiwanese.

Procedure

The experimental school runs from 08:00 to 17:00, Monday to Friday. In the beginning of the day, all of the students were required to do MSSR activity for 30 minutes before the

class started. The books available for students per class is 6:1, 6 times of the total number of students in the classroom. The students can choose their book according to their reading preferences. Afterwards, there are 10 minutes of MSSR subject related book category reading for each class in every session. For example, the students will read a book related to science if it is a science class.

Data collection

The ultimate goal of MSSR assessment is self-assessment where the student evaluates or assesses their study or thinks about their learning through their reading logs and writing e-portfolio shown in Figure 1. Because the main purpose of extensive reading is for pleasure and to enjoy reading, which is why the assessment or written task should not become overwhelming or designated for students to take as an assessment (Lyutaya, 2011). Therefore, in this research the core data drawn for analysis were the reading logs, which is reading book count according to the grade; and the writing articles were randomly picked from the students' third-grade writing classroom with the same topic. All of the students' writing progress and outcome was saved in the writing e-portfolio platform called "Writing for Tomorrow" system as shown in Figure 1 (Mustika et al., 2023). Furthermore, quantitative data collection and correlation data analysis methods were utilized in the study to systematically develop an understanding of the relationships.

Table 1 presents data on the students' habitual-voluminous book reading and their writing performance over three years until their third-grade enrollment. A total of 10,143 books were collectively read by the students during this period. Among the various book categories, Picture Books emerged as the most read book count, with a total count of 3,473 books. Following closely behind, Basic Books were the second most read category, with a

Table 1 Total book read for each category

	Picture Book	Bridge Book	Basic Book	Middle Book	Advanced book
	3473	2510	3304	649	207
Total book read	10143				

Table 2 Dataset description of book reading and writing performance

Index	Picture Book	Bridge Book	Basic Book	Middle Book	Advanced book	Draft	Revision	Word Number
Count	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Mean	86.82	62.75	82.6	16.22	5.17	3.69	3.87	499.65
Std	53.92	27.09	45.13	12.58	6.52	0.57	0.69	302.05
Min	2.0	10.0	3.0	1.0	0.0	1.4	1.0	118.0
25%	42.0	45.2	51.7	4.75	0.0	1.0	3.6	297.0
50%	75.0	61.5	74.0	13.0	3.5	1.5	3.9	407.0
75%	127.0	79.0	114.0	24.5	7.5	2.0	4.0	675.5
Max	205.0	129.0	209.0	48.0	30.0	4.4	4.75	1270.0

Table 3 The average of the writing performance

Draft	Word Number	Revision
3.69	499.65	3.87

count of 3,304. In the third position, Bridge Books garnered a total of 2,510 readings. In the fourth place, Middle Books accumulated 649 reads, while Advanced Books were the least read category, with a total of 207.

Moving on to Table 3, this table unveils significant findings related to writing performance. The average draft score was calculated to be 3.7, indicating an intermediate level of writing performance among the participants. Furthermore, the average word count per writing sample was approximately 500 words, demonstrating the participants' ability to produce content of substantial length. Additionally, the revision score, gauging the quality of their edited work, exhibited an average of 3.9, suggesting a commendable level of attentiveness to refining their written output. These results offer valuable insights into the participants' writing capabilities, laying the groundwork for further interpretation and discussion.

Writing assessment instruments

For the writing performance, the researchers adopted the analytic writing performance rubric from Mustika et al. (2021), Tiedt (1989), Tsai (2016), and Vacc (1989) with five criteria. This rubric has a five ratings analytic scoring system. This rubric reached the reliability of Cohen's kappa 0.945 for the draft and 0.969 for the revision.

Data analysis

Defining variables

In our study, book-count (reading exposure) and Word Number (writing performance) are crucial variables representing different aspects of student performance. Importantly, 'book-count' serves as the independent variable. This variable reflects the varying levels of reading exposure among students – essentially quantifying how much they have read. Conversely, Word Number is the dependent variable, representing the students' performance in writing, measured by the length of their written compositions.

Correlation analysis

The initial phase of our data analysis involved employing the Pearson correlation analysis to explore the relationship between reading and writing performances. This analysis aimed to quantify the influence of book reading on writing performance, using the Pearson correlation coefficient to measure the strength and direction of this relationship. This

statistical approach provides a foundational understanding of how reading behaviors might correlate with writing performance.

Quantile Binning method

To delve deeper into the impacts of different levels of book reading exposure on writing performance, the study utilized the Quantile Binning method. This method involves categorizing the book reading variable (e.g., Bridge Books) into three levels of exposure – low, medium, and high – based on the 25th, 50th, and 75th percentile quartiles. The next step involved comparing the mean word count across these categories to discern potential correlations between the levels of book category exposure and the quantity of words in written compositions. This approach offers a nuanced view of how varying reading experiences might translate into differing writing capacities.

Analysis of Variance (ANOVA)

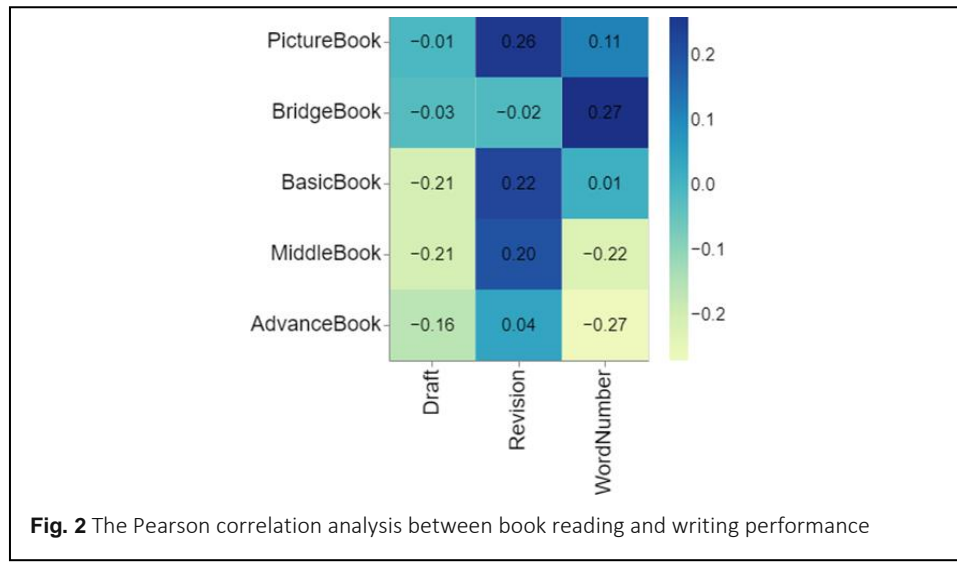
An Analysis of Variance (ANOVA) was conducted to determine if there were statistically significant differences in the mean of the three reading categories. This analysis is crucial for identifying whether the extent of reading exposure has a distinguishable impact on writing performance across different reading intensity categories.

Post-Hoc analysis

Following the ANOVA, a post-hoc analysis was performed using the Tukey Honest Significant Difference (HSD) method. Although ANOVA revealed significant differences, it did not specify which categories differed. The Tukey HSD method is particularly useful for making pairwise comparisons between the mean values of the low, medium, and high reading categories. This test is instrumental in pinpointing specific differences in book count means across these categories, ensuring a rigorous control of the family-wise error rate in multiple comparisons.

Results and findings

Figure 2 depicts the result of the correlation analysis between habitual-voluminous book reading and writing performance. Notably, the analysis revealed significant correlations between Picture Book exposure and various writing performance metrics. Specifically, a positive correlation was observed between Picture Book exposure and Word Number ($r = 0.11$) as well as Revision ($r = 0.26$). Conversely, a negative correlation was found between Picture Book exposure and Draft ($r = -0.01$). These findings elucidate that students who frequently engage in reading Picture Books from an early age demonstrate an inclination towards higher word production and enhanced writing performance during the revision stage. Such observations underscore the potential benefits of early exposure to Picture



Books in fostering writing skills and warrant further investigation into the mechanisms underlying this relationship.

Moving forward, the examination of correlations between Bridge Book exposure and key writing performance indicators yielded noteworthy outcomes. A positive correlation was observed between Bridge Book exposure and Word Number ($r = 0.27$), indicating that students who engaged with Bridge Books demonstrated a tendency to produce a greater volume of written content compared to those who primarily read Picture Books. However, contrasting associations were found concerning the quality of writing. Specifically, Bridge Book exposure exhibited opposite correlations with Draft ($r = -0.02$) and Revision ($r = -0.01$), suggesting that a higher frequency of reading Bridge Books was linked to comparatively lower writing quality when assessed in terms of initial drafts and subsequent revisions. These findings highlight that while students exposed to Bridge Books exhibit greater quantity in their writing, there may be a trade-off with respect to the overall quality of their written compositions. Further exploration into the factors contributing to this dichotomy is warranted to gain deeper insights into the interplay between reading and writing performances.

Similarly, the investigation into the relationship between Basic Book exposure and key writing performance indicators yielded insightful results. A positive correlation was observed between Basic Book exposure and Word Number ($r = 0.01$) as well as Revision ($r = 0.22$), signifying that students who engaged with Basic Books demonstrated an inclination to produce a higher volume of written content and exhibited improved writing quality during the revision process. However, a contrasting association emerged in relation to the quality of initial drafts. Specifically, Basic Book exposure displayed an opposite correlation with Draft ($r = -0.21$), indicating that a higher frequency of reading Basic Books was associated with comparatively lower writing quality in the early draft stages. These

findings explain that while increased exposure to Basic Books may lead to enhanced word production and improved writing quality during the revision phase, it may concurrently be linked to a potential decline in the quality of initial draft compositions. Further exploration into the underlying factors contributing to these associations is warranted to gain a comprehensive understanding of the intricate interplay between habitual-voluminous book reading and writing performances.

Likewise, the examination of the association between Middle Book exposure and key writing performance indicators yielded notable findings. A positive correlation was observed between Middle Book exposure and Revision ($r = 0.20$), suggesting that students who engaged with Middle Books demonstrated an inclination towards improved writing quality during the revision process. In contrast, contrasting associations were evident concerning the quantity and quality of initial drafts. Middle Book exposure exhibited opposite correlations with Word Number ($r = -0.22$) and Draft ($r = -0.21$), indicating that a higher frequency of reading Middle Books was associated with a decrease in the word count of written content and lower writing quality during the early draft stages.

These findings explain that while increased exposure to Middle Books may lead to enhanced writing quality during the revision phase, it may concurrently be linked to a reduction in the quantity of words produced and a decline in writing quality during the initial draft process. These observations highlight the complexity of the relationship between Middle Book reading and writing performances, necessitating further exploration to comprehend the underlying mechanisms driving these divergent outcomes.

The correlation analysis between Middle Book and Word Number revealed a coefficient of $r = -0.22$, indicative of a weak negative correlation. This finding suggests that as the frequency of Middle Book exposure increases, there is a slight tendency for the Word Number value to decrease. This statistical observation underscores the existence of a subtle inverse relationship between Middle Book engagement and the quantity of words produced in written compositions. Further investigation into the factors contributing to this correlation would be valuable to gain a deeper understanding of the potential influence of Middle Book reading on students' written output.

Furthermore, the analysis of the relationship between Advanced Book exposure and key writing performance indicators yielded significant results. A positive correlation was observed between Advanced Book exposure and Revision ($r = 0.04$), suggesting that students who engaged with Advanced Books exhibited an inclination towards improved writing quality during the revision process. However, contrasting associations were evident concerning the quantity and quality of initial drafts. Advanced Book exposure displayed opposite correlations with Word Number ($r = -0.16$) and Draft ($r = -0.27$), indicating that a higher frequency of reading Advanced Books was associated with a decrease in the word count of written content and lower writing quality during the early draft stages.

These findings illuminate that while increased exposure to Advanced Books may lead to enhanced writing quality during the revision phase, it may concurrently be linked to a reduction in the quantity of words produced and a decline in writing quality during the initial draft process. This nuanced pattern suggests that students who read more Advanced Books may prioritize refining their written work during the revision phase, leading to more concise compositions with improved quality. However, it appears that this focus on revision may come at the cost of producing longer initial drafts with potentially diminished writing quality. Further research is warranted to delve into the underlying factors contributing to these correlations and to gain a comprehensive understanding of the intricate interplay between habitual-voluminous Advanced Book reading and writing performances.

Several variables, notably Advanced Book and Draft, exhibit a negative correlation coefficient of $r = -0.16$. While this correlation is deemed weak, it implies that an increase in the value of Advanced Book is associated with a slight decrease in the value of Draft. This outcome can be attributed to the fact that fewer Advanced Books were read by third-grade students. In total, there were 207 Advanced Books read, averaging approximately five books per student. However, this quantity is considered substantial for elementary school students at the third-grade level.

The substantial number of Advanced Books read by these students may contribute to the observed negative correlation between Advanced Book and Draft. It is plausible that a higher exposure to advanced reading materials could potentially enhance students' writing performance, leading to more effective revision processes and thereby resulting in more polished drafts. Conversely, it is also possible that dedicating more time to reading Advanced Books may slightly diminish the quantity of words produced during the initial drafting phase.

Nonetheless, it is imperative to exercise caution in interpreting these correlations due to their weak magnitude, and further investigation is necessary to comprehensively understand the complexities of the relationship between Advanced Book exposure, drafting habits, and writing performances in the context of third-grade elementary school students.

Based on the aforementioned results, it becomes evident that the book reading exhibits the most substantial impact on Word Number. To gain deeper insights into how varying levels of book reading exposure influence writing performance, the researchers employed the Quantile Binning method. This technique involves dividing each 'Book category' into three distinct reading categories (i.e., low-count, medium-count, high-count). Subsequently, the mean 'Word Number' within each of these categories was compared to examine the potential relationship between book exposure levels and the quantity of words produced in written compositions.

Moving on to the statistical analysis, ANOVA was conducted to determine if statistically significant differences existed among the means of these three distinct reading categories of each book category (refer to Table 4). The ANOVA results ($F = 3.99$, $p\text{-value} = 0.026$, $\eta_p^2 = 0.177$) revealed significant variation in the book counts read by students in the ‘Bridge Book’ category. Given this p -value, which is less than 0.05 with the effect size of 0.177, we performed a post-hoc test to enhance the analysis’s rigor.

We conducted the post-hoc test using the Tukey HSD method to thoroughly understand the specific means of the ‘Bridge Book’ counts that significantly differed among the three categories: low-count, medium-count, high-count. This method allowed us to identify precisely which reading categories exhibited notable differences in their average book counts.

Table 5 showed that upon comparing the low-count and high-count categories of Bridge Book exposure, a noteworthy mean difference of 269.40 was observed, with a p -value of 0.04, indicating statistical significance. This finding suggests that the mean Word Number for the high-count category of Bridge Book exposure is significantly higher than the mean Word Number for the low-count category (see Table 4). This observation indicates that the extent of Bridge Book engagement may have a notable impact on the quantity of words produced in written compositions, particularly when contrasting the low-count and high-count exposure categories.

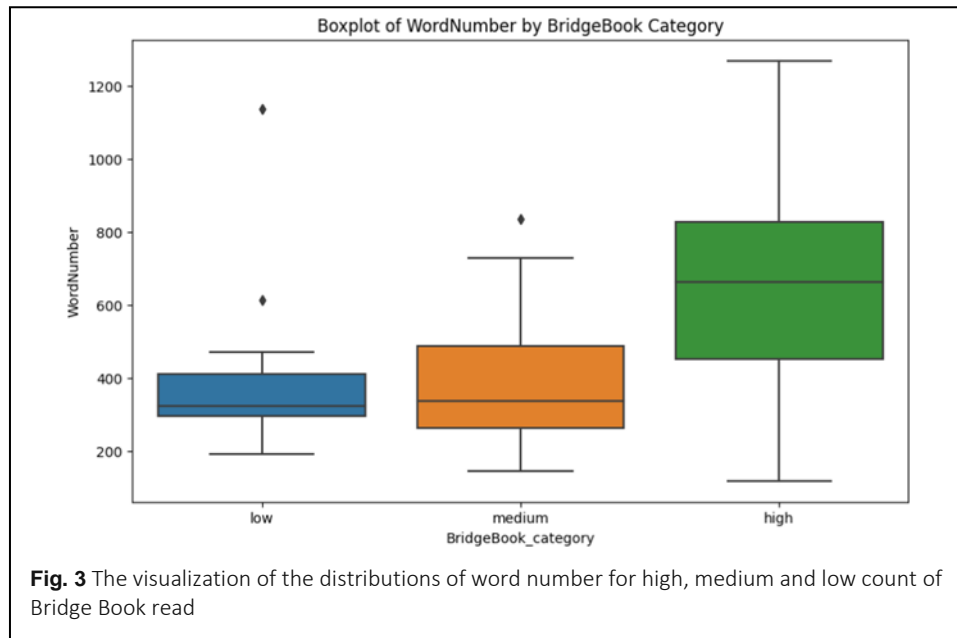
Figure 3 offers a visual presentation of the distributions of Word Number across each category of Bridge Book, utilizing box plots to showcase the central tendency (median), spread (quartiles), and potential outliers in Word Number for each exposure category. The incorporation of these graphical tools enhances the clarity and interpretability of our findings, providing valuable insights into the relationship between Bridge Book exposure and Word Number across different exposure categories.

Table 4 Analysis of variance (ANOVA) outcomes and mean word number across Quantile Bins for book categories

Book category	Low-count	Medium-count	High-count	F	p-value	η_p^2
PictureBook	428.00	529.46	538.50	0.53	0.591	0.027
BridgeBook	401.38	413.61	670.78	3.99	0.026	0.177
BasicBook	530.84	497.76	472.42	0.12	0.886	0.006
MiddleBook	609.46	495.23	401.78	1.64	0.206	0.081
AdvancedBook	532.07	545.40	396.00	0.89	0.417	0.046

Table 5 The post-hoc test by using Tukey HSD method for Bridge Book reading categories

Multiple Comparison of Means Tukey HSD, FWER = 0.05					
	Book-count	meandiff	p-value	reject	
	low-count	medium-count	12.23	0.993	False
	low-count	high-count	269.40	0.045	True
	medium-count	high-count	257.17	0.058	False



Discussion

This study aimed to explore the effects of habitual-voluminous book reading activities on students' writing skills, particularly focusing on a unique context in Taiwan, where no previous research has been conducted in this domain. The research also utilized technology to systematically track the number of books read by students over three years, providing a detailed analysis of how consistent book engagement impacts writing performance.

Our findings revealed significant correlations between different book categories and various writing performance metrics. Picture Book exposure was positively correlated with word production and revision quality, highlighting the potential benefits of early engagement with Picture Books in fostering writing skills. This is consistent with previous research emphasizing the importance of early literacy activities in enhancing language development (Morrow, 2009; Neuman, 2011). However, the negative correlation between Picture Book exposure and initial draft quality suggests that while these books improve revision skills, they might not directly enhance the quality of initial drafts.

Bridge Books also demonstrated a positive impact on word count, indicating that students exposed to these books tend to produce more written content. However, the negative correlations with draft and revision quality suggest a trade-off between the quantity and quality of writing. This finding aligns with earlier studies suggesting that while extensive reading can increase writing fluency, it may not always lead to improvements in writing quality (Krashen, 2004; Lee, 2005). The complexity of this relationship warrants further

investigation into the specific characteristics of Bridge Books that influence these outcomes.

Basic Books showed a positive correlation with word count and revision quality but a negative correlation with initial draft quality. These results suggest that while Basic Books can enhance writing output and revision skills, they might not contribute significantly to the initial quality of writing. This finding is in line with previous studies that highlight the role of scaffolded reading materials in supporting writing development (Elley, 1991; Stanovich, 1986).

Middle Books and Advanced Books presented similar patterns, with positive correlations for revision quality and negative correlations for word count and draft quality. These results suggest that more advanced reading materials may encourage students to focus on refining their written work during revisions, leading to more polished compositions. However, the initial drafting process might suffer, potentially due to the cognitive demands of understanding and integrating more complex content (Shanahan & Shanahan, 2008).

The use of Quantile Binning and ANOVA provided further insights into the impact of different levels of book exposure. Notably, Bridge Books exhibited a significant variation in word count across different exposure levels, underscoring the importance of book quantity in influencing writing output. The post-hoc analysis confirmed that high-count exposure to Bridge Books significantly increased word production, highlighting the role of habitual-voluminous book reading in enhancing writing fluency.

Conclusion

In conclusion, this study underscores the complex relationship between habitual-voluminous book reading and writing performance among third-grade students. Picture Books and Basic Books emerged as popular categories with substantial read counts, positively influencing word production and revision quality. However, the findings also revealed potential trade-offs between the quantity and quality of writing, particularly with Bridge Books and more advanced reading materials.

These insights have significant implications for educational practices and interventions aimed at improving writing skills. Educators should consider incorporating a balanced mix of reading materials, tailored to enhance both writing quantity and quality. Early exposure to Picture Books and basic reading materials can foster initial engagement and build foundational skills, while more Advanced Books can be gradually introduced to refine students' writing during revisions.

Future research should delve deeper into the specific mechanisms underlying these relationships, exploring factors such as book content, student engagement, and cognitive processing. Longitudinal studies with larger sample sizes and diverse contexts can provide

a more comprehensive understanding of how habitual-voluminous book reading activities influence writing development over time.

Overall, this study contributes to the growing body of literature on the benefits of habitual-voluminous book reading, offering valuable insights into how different types of books can shape writing proficiency in young learners. By understanding the nuanced interplay between reading and writing, educators can better support students in developing strong literacy skills that are crucial for academic success.

Limitation and future works

The limitations of this research stem from various aspects of the findings. Firstly, while investigating the correlation between Basic Book exposure and writing performance, it was found that reading Basic Books was positively linked to both word count and writing quality during the revision process. However, an opposing association was observed in terms of initial draft quality, where a higher frequency of reading Basic Books correlated with lower writing quality in the early drafting stages. This highlights a potential trade-off between quantity and initial draft quality. Similarly, the exploration of Middle Book exposure indicated positive correlations with writing quality during revision but negative associations with word count and draft quality, suggesting a potential conflict between quantity and quality of writing during the drafting phase. The analysis of Advanced Book exposure revealed positive correlations with writing quality during revision but negative correlations with word count and draft quality, implying a focus on revision potentially at the expense of initial draft length and quality. These patterns elucidate the intricate balance between habitual-voluminous book reading and writing performances. Moreover, while the study identifies potential relationships and correlations, it does not definitively establish causation, necessitating further research to elucidate the underlying mechanisms driving these outcomes. In a future study, the analysis on the impact of each reading category of books on writing performance is worth conducting.

Furthermore, the study's focus on third-grade elementary school students may limit the generalizability of findings to other age groups or educational levels. Additionally, the study does not delve into potential limitations or biases inherent to this analytical method. Overall, these limitations underscore the need for more comprehensive investigations and broader contexts to fully understand the complexities of the relationship between habitual-voluminous book reading and writing performance in educational settings.

Abbreviations

IDC: Interest Driven Creator; MSSR: Modeled Sustained Silent Reading; EPER: Edinburgh Project On Extensive Reading; ELRP: English Language Reading Programme; ELTSP: English Language Teaching Support Programme; ZELIP: English Language Improvement Project in Zanzibar; HKERS: Extensive Reading Scheme in English in Hong Kong; ANOVA: Analysis of Variance; HSD: Honest Significant Difference.

Acknowledgements

The authors would like to thank the Ministry of Science and Technology of the Republic of China, Taiwan, for financial support (MOST 108-2511-H-008-012-MY3), and Research Center for Science and Technology for Learning, National Central University, Taiwan. The authors would also like to thank the director of the experimental school Audrey Lin who has supported us in conducting the research, the research assistants and the graduate students who assisted the implementation of the MSSR with the supporting technology-enhanced system, data collection and analysis.

Authors' contributions

Melissa Mustika is the main author of this paper, she is assisting the writing research team and the development of the curriculum and technology enhanced learning of the Writing for Tomorrow system.

Kannan Nataraj is the supporting author of this paper who supports this paper in the data analysis and data mining part.

Charles Y. C. Yeh assisted the design and improvement curriculum of IDC school and the technical operation of Writing for Tomorrow, Reading for Tomorrow, Math Island and other supporting technology enhanced learning systems for the school.

Tak-Wai Chan is the advisor of this research project and the main designer of the reading and writing curriculum. He is also the leader of the whole research projects in the lab.

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Funding

This work is funded by the National Science and Technology Council, Taiwan (NSTC 112-2410-H-008-020-MY3) and Research Center for Science and Technology for Learning, National Central University, Taiwan.

Availability of data and materials

The data and materials are available by request.

Declarations

Competing interests

The authors declare that they have no competing interests.

Received: 7 October 2023 Accepted: 4 June 2024

Published online: 1 January 2025 (Online First: 8 July 2024)

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