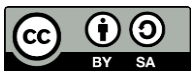
IDEAS

Journal of Language Teaching and Learning, Linguistics and Literature

ISSN 2338-4778 (Print)
ISSN 2548-4192 (Online)

Volume 13, Number 1, June 2025
pp. 1575 - 1591



Issued by English study program of IAIN Palopo

Rethinking Educational Practices: Handwriting and Its Role in Multisensory Language Learning

Sri Rejeki[1], Angela Bayu Pertama Sari[2], Dwi Iswahyuni[3], Devita Widyaningtyas
[1,2,3,4]Universitas Bina Sarana Informatika
Corresponding E-Mail: sri.sjr@bsi.ac.id

Received: 2025-05-23 Accepted: 2025-06-26
DOI: 10.24256/ideas. v13i1.6777

Abstract

Rapid development of digital technology has changed the educational practices, including the way students learn languages. This research aims to explore perceptions, experiences and challenges faced by the students in using handwriting as a part of multisensory learning strategy in online English class. This research employs a convergent mix-method approach whereas the data were gathered from 21 (n: 21) Indonesian university students majoring in Information system through Likert scale questionnaire and open-ended questions. The result of statistics and thematic analysis shows that most of respondents felt the cognitive benefits from handwriting, including improved memory, focus, grammar comprehension and learning engagement. Regression analysis with R-squared 0.903, Adj. R-squared 0.824 and Pro (F-statistics): 0.000210 showed that feeling comfort in handwriting has significant positive impact on memory ability; while challenges, including feeling tired and time required do not significantly reduce its cognitive benefits. This research supports multisensory learning theory (VAKT) and reinforces previous findings showing that handwriting activates wider brain networks compared with typing. Importantly, this study demonstrates that handwriting remains relevant in digital era and should be practically applied as integral component of online learning environments. Educators are encouraged to purposefully incorporate handwriting-based activities to promote a more holistic, deeper cognitive processing, and effective online learning experience.

Keywords: *cognitive strategy, handwriting, language learning, multisensory, online learning*

Introduction

Rapid advances in digital technology over the past two decades have significantly transformed education, especially how students interact with learning materials. One notable shift is the transition from handwriting to digital tools, such as laptops and smartphone (Rønningsbakk, 2022; Wollscheid et al., 2016). At many universities, students now prefer typing over handwriting for taking notes,

completing assignments, and even during exams. While this shift offers increased access and efficiency, it also raises concerns about the long-term cognitive and sensorimotor consequences of reduced handwriting, particularly in the context of language learning.

This concern is rooted in the fact that handwriting is more than a simple motor ability-it requires the use of multiple senses by means of physical movement, visual letter formation, and maintaining cognitive focus. An increasing number of studies has highlighted the distinct benefits of handwriting, particularly for young learners, such as better memory retention, enhanced motor coordination, emotional bonds and deeper learning (Kiefer & Spitzer, 2023; Wiley & Rapp, 2021; Diaz et al, 2025). These benefits cannot be easily replicated by tying or other digital alternatives.

Despite existing research, the significance of handwriting within educational settings has been steadily diminishing. This trend is partly due to time constrains in modern curricula and the perceptions that handwriting is no longer relevant in the digital era (Hildreth, 1963; Wallace & Schomer, 1994). Consequently, many educational programs emphasize digital learning tools, such as applications, videos and web-based platform, neglecting the cognitive benefits and retention advantages that handwriting can provide.

This shifting raises several important considerations: (1) does handwriting still have place in modern educational sector, especially in learning second language, (2) what are the role of the handwriting in facilitating language mastery, both verbal and written language, and (3) what are the contributions of handwriting in learning process which involve visual, kinesthetic, and cognitive aspect at the same time? These questions are increasingly relevant in light of research indicating a decline in handwriting skills among students and a tendency towards typing, even though manual note-taking typically leads to greater cognitive processing (Mueller & Oppenheimer, 2014; Aragón-Mendizábal et al., 2016).

In contrast to the increased dependence on typing, research indicates that students who take notes by hand or manually rewrite information exhibit a deeper comprehension of the material compared to those who solely read or type it (Desselle & Shane, 2018; Ihara, et al., 2021). This highlights the importance of reconsidering and possibly reintroducing handwriting into language learning techniques - not as a substitute for digital tools, but as an additional method that enhances a more comprehensive educational experience.

Again, this backdrop, the present study seeks to examine three main elements: (1) how students perceive handwriting in the context of online English learning, (2) their individual experiences and habits regarding handwriting as a learning technique, and (3) the obstacles they encounter while participating in handwriting exercises in a digital setting. The research involves 23 Indonesian university students majoring in information systems who are taking an online English subject.

ISSN 2338-4778 (Print)
ISSN 2548-4192 (Online)

While constrained by the number of participants and the breadth of the research, this study adds both theoretically and practical value. It depends the understanding of the significance of handwriting within technology-enhanced language acquisition and provides useful recommendations for educators and those involved in curriculum design. It is suggested that future research should include a wider range of participants to further validate and expand these findings.

Literature review

Multisensory learning theory posits that learning becomes more effective when multiple sensory modalities; visual, auditory, kinesthetic, and tactile (VAKT); are engaged simultaneously. This integrated approach enhances attention, retention, and comprehension. Benefits of multisensory learning include enhanced early literacy (Neumann, 2012), improved cognitive functioning (Shenoy & Kumar, 2024), more effective learning environments (Ghisio et al., 2017), and increased neural plasticity (Paraskevopoulos et al., 2012). However, challenges such as cognitive overload, potential distractions, and mismatches with individual learning preferences must also be considered (Rau et al., 2020).

Handwriting plays a crucial role within the multisensory framework. It involves visual, motoric, and tactile inputs that promote deeper cognitive engagement. Research by James & Engelhardt (2012) found that the physical act of writing strengthens neural connections related to memory and language processing. Handwriting also supports the development of phonological and orthographic representations in the brain, which are foundational for both written and verbal language (Berninger & Richards, 2010).

In the context of language learning, handwriting activities such as note-taking, copying, and rewriting provide extended processing time and foster metalinguistic awareness. Mueller & Oppenheimer (2014) showed that handwriting led to deeper understanding of vocabulary and language structure compared to typing, due to more effortful encoding processes. Additional studies (e.g., Guan et al., 2021; Donna & Veiny, 2017) underscore handwriting's benefits in visual-motor coordination, word recognition, and feedback awareness—especially for novice learners.

Neuroscientific evidence further supports these claims. Ihara et al. (2021) found that students who learned foreign words through handwriting (using both ink and digital pens) exhibited stronger N400 effects; markers of semantic processing and memory formation; than those who used keyboards. Similarly, Askvik et al. (2023) showed that handwriting activated theta and alpha brain waves associated with memory integration and sensorimotor coordination, while typing did not.

Studies in early childhood education echo these findings. Mayer et al. (2020) found that preschoolers who practiced letter formation by hand had better letter recognition than peers using virtual keyboards. Likewise, Medwell & Wray (2007) criticized the undervaluation of handwriting in literacy education, emphasizing the

need to reexamine its role in developing composition and cognitive skills.

Although existing studies have demonstrated the cognitive, neural, and linguistic benefits of handwriting; especially within early education and experimental settings; there is a noticeable gap in research exploring how university students perceive and experience handwriting in digital learning contexts, particularly in second language (L2) acquisition. Most prior research has focused either on children or on laboratory-based cognitive measurements, leaving a gap in understanding the subjective experiences, habits, and challenges of adult learners in real-world online classrooms.

Furthermore, with the rapid digitalization of higher education, particularly since the COVID-19 pandemic, there has been a shift toward typing and screen-based learning activities. While efficient, this trend may unintentionally deprioritize multisensory learning strategies, including handwriting, that contribute to deeper processing and long-term retention.

This study aims to address this gap by examining the perceptions, experiences, and challenges of university students; specifically, those majoring in Information Systems; regarding the use of handwriting in online English classes. The findings are expected to inform more holistic and effective language learning strategies by integrating both technological and traditional methods.

Method

This research employs convergent mixed-method design between quantitative and qualitative to conduct depth exploration on perception and experiences of university students on handwriting as a tool in language learning. Quantitative approach is used to gather the data from 5-likert scale questionnaire which is distributed digitally to the students by using google form, while qualitative approach is used to seek deeper information through written response-questionnaire which is distributed online by using google form as well.

The Likert scale questionnaire and written response questionnaire were distributed at the same time, so the researcher did not wait the result of 5 Likert scale questionnaire to collect written response questionnaire. Questions in Likert scale and written response questionnaire are different but it is evaluated parallel and compared. Because of that reason, convergent design is more suitable for this research because it integrates two standalone perspectives but standalone together.

The respondents of this research are first semester students who are majoring in information system who take English I subject and they are asked to do the tasks by writing manually. The respondents were selected because they were accustomed to working with digital tools and platforms, which make their perspective particularly valuable in evaluating the integration of handwriting into online environments. Furthermore, information systems students are expected to engage with both technical and cognitive skills, which make them an ideal group to observe

ISSN 2338-4778 (Print)
ISSN 2548-4192 (Online)

the multisensory impact of handwriting on language learning.

In addition, the respondents were chosen by employing purposive sampling because they already had direct experience in this handwriting method. The respondents were asked to write the responses of the questions on their paper, take a picture of it, then share it on group WhatsApp. There were 25 university students who enrolled in English I class but there were only 21 of them who participated in this research because four other students who enrolled the class were not active. Those respondents are 9 female and 11 male and all of them are in first semester when they fill the questionnaire. All of them are less than 20 years old.

This research uses two types of instruments to collect the data and those are 5 Likert scale questionnaire, and written response questionnaire. The questionnaire is divided into five sections and those are respondent identity, handwriting experience, their perceptions on benefits of handwriting, challenges in handwriting, and opinion. Section 2 to 5 are in the form of 5 Likert scale and section 6 is mixed between open and closed-ended questionnaire. The questionnaire is used to gather the data about the perception of the students on handwriting in cognitive aspect, multisensory and learning effectiveness. While, open and closed ended questionnaire are to explore the detailed experiences relates to the role of handwriting in memory, comprehension, and multisensory involvement.

The procedure used in conducting this research is started by data gathering and data analyzing. All data were gathered at the same time by employing google form. After that, the data were analyzed. Data from 5 Likert scale are in the form of quantitative and it is analyzed by employing descriptive statistics to identify the trend of students' perception and regression linear to explore the relation between handwriting intensity and cognitive benefits. Furthermore, data from open and closed-ended questionnaire are qualitative data which then transcribed and analyzed by employing thematic approach to find the pattern of the perception on benefits of handwriting. Then, the last technique in analyzing the data is integration whereas those results are compared to find out whether general perceptions support personal narration.

Results

The 5 Likert scale questionnaire were responded by 21 respondents with demographics 12 male and 9 female respondents which most of them are in their 21 years old. The results are described below. First of all, the data from 5 Likert scale questionnaire were separated and then analyzed descriptively.

Challenges

There are four statements relates to the challenges faced by respondents when they do their tasks by handwriting in online English class. The first data shows that 47.6% respondents gave neutral response for the statements of feeling tired after long period of handwriting while 38.1% and 9.5% of them gave agree and strongly

agree for the statement. In addition, 4.8% of the respondents assumed that they did not feel tired physically after doing long period handwriting.

There are no respondents who give answer for strongly disagree and disagree for the statements about their senses in giving responses to handwriting activities and time. Most of the respondents agree that there are some different responses given by their body when they do write with 52.4% and 14.3% for agree and strongly agree respectively. Similar result is also shown in statement about time. As many as 47.6% for agree and 33.3% strongly agree were chosen by respondents that handwriting takes longer time than typing. Although 19% of them give neutral answer about the time in handwriting, but more than half of respondents mentioned give neutral answer about the senses involved in handwriting activities. Only 38.1% and 4.8% who are agree and strongly agree with the statement that handwriting activities involves more senses than typing.

Furthermore, another open-ended question about challenges in handwriting is about the importance of senses, including visual, hand and body movements in learning process. All 21 respondents have their responses on these questions and it was quite varied. The responses are very important with 11 responses, quite important with two responses, important with five responses and unclear with three responses. Following are some excerpts from those responses.

> Very important because by handwriting method, I feel easier to memorize materials because it repeats the materials. I cannot replace handwriting with typing. (R2)
> In my opinion, it is important because I feel easier to memorize and understand the materials by writing. If typing, I think I am less satisfying in learning (R9).

Table 3. Challenges in Handwriting

No	Statements	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	I feel tired physically when do handwriting in long period	0	4.8%	47.6%	38.1%	9.5%
2	I feel there are some differences of responses given by my body when I do handwrite than	0	0	33.3%	52.4%	14.3%

ISSN 2338-4778 (Print)
ISSN 2548-4192 (Online)

	typing, for example visual and hand movement, visual concentration or other physical involvement.					
3	I feel handwriting activities involve more senses than typing	0	4.8%	52.4%	38.1%	4.8%
4	Handwriting takes longer time than typing	0	0	19%	47.6%	33.3%

Experiences

There are two statements in 5 Likert scale questions and those are about frequency and feeling comfort. The data results that more than 14% of the respondents give strongly disagree and disagree for the frequency while 38.1% for neutral perspective, 33.3% and 14.3% for agree and strongly agree for the statement that the respondents are often asked to do the task by handwriting during the class. Unlike previous statement, the statement about feeling comfort when doing the task by handwriting gets highest response from respondents with 47.6% compared with other responses. It gets 23.8% for agree, 23.8 for strongly agree and 4.8% for disagree.

Table 2. Experiences in handwriting

No	**Statements**	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1	I am often asked to do the task by handwriting during the class	9.5%	4.8%	38.1%	33.3%	14.3%
2	I feel comfortable doing the task by handwriting	0	4.8%	47.6%	23.8%	23.8%

Respondents mentioned that some senses involve in handwriting activities. This question is in open ended question because respondents have to give their answers by explaining, not giving yes or no as an answer. From 21 respondents, there is one who did not give answer, meanwhile 20 respondents gave answered by mentioning one to four categories. From the given answers, it is grouped into five

groups with different number of responses and those are visual with 19 responses, thought with three responses, hand movement with 18 responses, mouth with one response, and auditory with four responses. Below are some excerpts from those responses.

> Senses which often we use when we do handwriting are visual, auditory and touch (R14) Visual, hand movement, and auditory (R15)

Perception

There are four statements in 5 Likert scale questions about perception and those are memorizing, focus, grammar, and engagement. The results of the statistics are as follow.

Table 1. Perception of the students on handwriting

No	Statements	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Handwriting helps me to memorize materials better.	0	4.8%	9.5%	47.65%	38.1%
2	Handwriting makes me more focus during learning process	4.8%	4.8%	19%	57.1%	14.3%
3	Handwriting improves my engagement in learning	0	0	9.5%	61.9%	28.6%
4	Handwriting helps me to more understand structure or grammar in English task	0	0	19%	52.4%	28.6%

In general, the data shows that the respondents agree with the given statements on their perceptions of handwriting relates to their ability to memorize, focus, engagement and understand grammar in English. Most of the respondents mentioned agree and strongly agree that handwriting helps them to memorize material better with 47.65% and 38.1% respectively. However, 4.8% or 1 respondent disagree that handwriting does not help her to understand the material better.

ISSN 2338-4778 (Print)
ISSN 2548-4192 (Online)

Similar result is also showed in the second statement whereas more than 70% of respondents mentioned that they are agree and strongly agree with the statement that handwriting makes them more focus during learning process with 57.1% and 14.3% respectively. However, two respondents give opposite answers. They are strongly disagreeing and disagree with the statement that handwriting makes them more focus during learning process with 4.8% each.

The other two statements give similar data whereas more than 80% of the respondents give agree and strongly agree for the statements that handwriting improves their engagement in learning and helps them to more understand grammar in English. Unlike two previous statements, there are no respondents who give motion disagree and strongly disagree in these two statements.

In the end of the questionnaire, there is session for opinion of the respondents. There are six questions on it. The first is about handwriting should remain as a part of learning process in digital era. All respondents mentioned that handwriting should remain a part of the learning process in the digital era. Following are some excerpts for these responses.

> Yes, especially English vocabulary because we need to memorize English words and write them correctly. Memorizing vocabulary can be easier by using handwriting (R3).
> Yes, because it is also very important in helping us to recall the material that has already been learned (R21).

Second open-ended question in opinion session is about the feeling of recalling information easier after handwriting rather than just typing. There are three answers from the respondents on this matter and those are agreed, neutral and disagree. Fifteen respondents mentioned that they are agree with the statement, three respondents chosen disagree and four respondents answered as neutral for the statement. Following are some excerpts from it.

> Yes, I find it easier to remember because it feels like repeating the material twice, first by reading then by writing it down. For English writing, it is also practicing unfamiliar word recall because when it is typing, it is usually helped by autocorrect (R1)
> Neutral, because that matter cannot be considered only in that way (R4)

Third open ended question in opinion session is about the role of part of body. Does the respondent feel that part of his/her body more active and contribute to understanding the material while handwriting is the full question for number three

of open-ended question. It resulted that all respondents admitted that there are some parts of their body more active while doing handwriting. In addition, it also gives contribution in understanding the materials. From 21 respondents who filed the questionnaire, some respondents gave double answers. Nine respondents explicitly mentioned that their eyes are more active, ten respondents mentioned that their fingers are more active, one respondent mentioned his brain is more active and the rest respondents, five, gave unclear responses.

Regression Analysis

Then, the researcher did linear regression from 21 entries and 10 variables which cover experiences (frequency and comfort), perception (remembering, focus, engagement and grammar) and challenges (senses, time, tired and physical responses). In this analysis, perception (remembering) as dependent variable while other variables as predictors. It resulted as follows:

OLS Regression Results

Dep. Variable:	Persepsi_Mengingat	R-squared:	0.903
Model:	OLS	Adj. R-squared:	0.824
Method:	Least Squares	F-statistic:	11.43
Date:	Thu, 22 May 2025	Prob (F-statistic):	0.000210
Time:	08:35:16	Log-Likelihood:	-0.40858
No. Observations:	21	AIC:	20.82
Df Residuals:	11	BIC:	31.26
Df Model:	9		
Covariance Type:	nonrobust		

Figure 1 Regression Result Part 1

ISSN 2338-4778 (Print)
ISSN 2548-4192 (Online)

	coef	std err	t	P>|t|	[0.025	0.975]
const	1.6244	0.912	1.781	0.103	-0.383	3.632
Pengalaman_Frekuensi	-0.5102	0.110	-4.655	0.001	-0.751	-0.269
Pengalaman_Kenyamanan	0.7080	0.181	3.901	0.002	0.309	1.107
Persepsi_Fokus	0.2405	0.097	2.485	0.030	0.027	0.454
Persepsi_Keterlibatan	0.2723	0.208	1.306	0.218	-0.187	0.731
Persepsi_TataBahasa	0.5622	0.166	3.394	0.006	0.198	0.927
Tantangan_Indera	-0.4600	0.179	-2.565	0.026	-0.855	-0.065
Tantangan_Waktu	-0.3891	0.161	-2.415	0.034	-0.744	-0.034
Tantangan_Lelah	0.3625	0.158	2.287	0.043	0.014	0.711
Tantangan_ResponFisik	-0.1916	0.170	-1.124	0.285	-0.567	0.183

Omnibus:	1.791	Durbin-Watson:	2.308
Prob(Omnibus):	0.408	Jarque-Bera (JB):	0.607
Skew:	0.351	Prob(JB):	0.738
Kurtosis:	3.449	Cond. No.	144.

Figure 2 Regression Result Part 2

The result from linear regression showed that built model to predict perception (remembering) based on some variables (experiences, perceptions and challenges) have high level of accuracy with R-squared 0.903. It means that 90.3% variation in perception (remembering) can be explained by other independents variables in the model. Statistically, this model is significant with p=0.000.

Other variables are found significantly influential on perception (remembering). Experiences (frequency) has significant negative influence with (β = -0.510, p = 0.001) which shows that the more someone does this activity, the more their perception of their ability to remember tends to decrease. On the contrary, experience (comfort) has positive influence (β = 0.708, p = 0.002) which indicate that it increases perception on the ability to remember. In addition, perception (focus) (β = 0.241, p = 0.030) and perception (grammar) (β = 0.562, p = 0.006) also have significant positive relations with perception (remembering).

On the other hand, some challenges are found have negative impacts. Challenges (senses and time) decreases the perception (remembering) significantly with (β = -0.460, p = 0.026) and (β = -0.389, p = 0.034) respectively. Challenges (tired) actually shows positive relation with β = 0.363, p = 0.043 which reflects that there is motivation or higher emotional involvement even though the activity is tiring. Other variable, including perception (engagement) and challenges (physical responses) do not show significant influence.

Discussion

The result of this research emphasizes that handwriting has significant role in the process of language learning, especially in the context of English comprehension and mastery virtually. The findings of this research in line with the previous research which focuses on cognitive Excellency from handwriting than typing. Mueller and Oppenheimer (2014) mentioned that students who take notes by handwriting have deeper understanding of the concepts than those who are typing. This finding is confirmed with the data in this research whereas most of the respondents stated that handwriting help them to memorize materials, focus on learning, and understand the structure and grammar in English tasks.

Furthermore, Ihara et al (2021) measured brain activities by using EEG find that students who study by handwriting show stronger semantic activities and form deeper memory compared with those respondents who typed. In the context of this research, although the respondents admitted that they feel physically tired and spent longer time when doing handwriting, they keep show cognitive perception on multisensory contribution from the activities. Sensory activities, such as hand movement, visual, and simultaneous cognitive involvement create holistic learning process.

Furthermore, linear regression analysis in this research shows that feeling comfort in handwriting has significant positive impacts on the ability to memorize ($\beta = 0.708$, $p = 0.002$) while excessive handwriting frequency gives negative impact ($\beta = -0.510$, $p = 0.001$). This shows that the quality of handwriting experience is more important that its quantity. In addition, perception on focus ($\beta = 0.241$) and the knowledge about grammar ($\beta = 0.562$) also significantly increase the ability to memorize. Interestingly, physically tired which was felt by the respondents when they do handwrite activities has positive correlation with memorization, which likely indicates higher emotional or mental involvement during the process ($\beta = 0.363$, $p = 0.043$).

The data integration from quantitative and qualitative are implemented in result interpretation. The used approach is convergent parallel design whereas quantitative data from questionnaire and qualitative data from open-ended were gathered at the same time, analyzed separately, then compared to get comprehensive understanding. The result from questionnaire shows that most of respondents feel that the handwriting activities help them in memorizing the materials, focus during learning and understand the language structure and grammar.

This finding is strengthened by qualitative whereas the students share their personal experiences about how handwriting activities strengthen their memory, help them concentrate, and increase engagement in online learning. This integration also reveals that although respondents felt physically tired when writing for long time, they kept admit the presence of deeper emotional and sensorics involvement during the learning process. Therefore, qualitive data gives contexts and depths

ISSN 2338-4778 (Print)
ISSN 2548-4192 (Online)

toward quantitative data. In addition, it also explains some results which seems contradictive, including high comfort, but perception of benefits decreases if the frequency is too high. The integration of these two types of data strengthens the conclusion that handwriting activities is still relevant and effective in supporting language learning process in digital era.

This research also supports the concept of multisensory learning (VAKT: Visual, Auditory, Kinesthetic, Tactile) as mentioned by Neumann (2012) and Paraskevopoulos et al (2012) which mentioned that involvement of some senses in learning process can escalate literacy ability and brain flexibility (neuroplasticity). In this research, almost all respondents mentioned that handwriting involve visual, hand movement, and in some cases, auditory element and active mind at the same time whereas it shows that they do not rely only on one sense but involve the whole body during the learning process.

Although digital technology has changed various aspects in educational sectors, this finding emphasizes that the role of handwriting is not completely replaced. Moreover, as stated by Kiefer and Spitzer (2023) that handwriting experiences enable to form strong literacy foundation and improve general cognitive function. Therefore, integrating conventional method, such as handwriting, to digital class needs to be considered as hybrid learning approach that strengthens learning effectiveness.

Conclusion

Based on the findings and analysis in this research, it can be concluded that handwriting remain significant role in language learning, especially in the online learning context. Handwriting activities is proven to be able to improve the ability to memorize, focus, knowledge about grammar, and engagement in learning process. The results from quantitative and qualitative support each other that multisensory involvement in handwriting strengthen cognitive process and deepens information processing.

Statistically analysis shows that feeling comfort in handwriting positively influences the ability to memorize, while perception on focus and knowledge about grammar also support memory improvement. On the other hand, challenge, such as feeling tired and needed time are not significantly decrease the benefits of handwriting; indeed, feeling tired can be indicator from higher emotional involvement in learning process.

Therefore, this research gives theoretically contribution that handwriting should not be left out, but rather integrated in a balanced way with digital technology as a part of multisensory learning. Practically, these results give recommendations for educators and curriculum developers to remain allocate space in language learning which involve handwriting activities. This is especially important for improving literacy, strengthening memory, and building complex

brain connection through an approach that combined visual aspects, motoric and cognitive at the same time.

This research also has limitation in terms of the number of participants and the non-experimental approach, so it is recommended to conduct further study which involve bigger participants and integrate neurologic approach or experimental measurement to strengthen validity of the findings. Nevertheless, the results of this research have shown that handwriting activities remain relevant and efficient in today's digital education system.

References

Aragón-Mendizábal, E., Delgado-Casas, C., Navarro-Guzmánm, J. I., Menacho-Jiménez, I., & Romero-Oliva, M. F. (2016). A comparative study of handwriting and computer typing in note-taking by university students. Comunicar, 24(48). https://doi.org/10.3916/C48-2016-10

Berninger, V., & Richards, T. (2010). Inter-relationships among behavioral markers, genes, brain and treatment in dyslexia and dysgraphia. Future Neurology, 5(4), 597–617. https://doi.org/10.2217/fnl.10.22

Bani, M., & Masruddin, M. (2021). Development of Android-based harmonic oscillation pocket book for senior high school students. JOTSE: Journal of Technology and Science Education, 11(1), 93-103.

Desselle, S. P., & Shane, P. A. (2018). Laptop versus longhand note taking in a professional doctorate course: Student performance, attitudes, and behaviors. INNOVATIONS in Pharmacy, 9(3), 1.

Diaz, M., Mendoza-García, A., Ferrer, M. A., & Sabourin, R. (2025). A survey of handwriting synthesis from 2019 to 2024: A comprehensive review. Pattern Recognition, 162. https://doi.org/10.1016/j.patcog.2025.111357

Ghisio, S., Alborno, P., Volta, E., Gori, M., & Volpe, G. (2017, November). A multimodal serious-game to teach fractions in primary school. In Proceedings of the 1st ACM SIGCHI International Workshop on Multimodal Interaction for Education (pp. 67-70).

Guan, C. Q., Li, Y., Meng, W., & Morett, L. M. (2021). Curved vs. Straight-Line Handwriting Effects on Word Recognition in Typical and Dyslexic Readers Across Chinese and English. Frontiers in Psychology, 12. https://doi.org/10.3389/fpsyg.2021.745300

Harsismanto, J., Fredrika, L., Wati, N., Padila, Suryani, D., & Yandrizal. (2021). Effectiveness of playing origami intervention on improvement of fine motor development preschool children. Indian Journal of Forensic Medicine and Toxicology, 15(1), 1107–1112. https://doi.org/10.37506/ijfmt.v15i1.13565

Hildreth, G. (1963). Simplified handwriting for today. The Journal of Educational Research, 56(6), 330-333.

Husnaini, H. (2022). Development of Self Esteem-Oriented Micro Teaching Materials

ISSN 2338-4778 (Print)
ISSN 2548-4192 (Online)

for IAIN Palopo English Education Students. IDEAS: Journal on English Language Teaching and Learning, Linguistics and Literature, 10(1), 538-560.

Ismayanti, D., Said, Y. R., Usman, N., & Nur, M. I. (2024). The Students Ability in Translating Newspaper Headlines into English A Case Study. IDEAS: Journal on English Language Teaching and Learning, Linguistics and Literature, 12(1), 108-131.

Ihara, A. S., Nakajima, K., Kake, A., Ishimaru, K., Osugi, K., & Naruse, Y. (2021). Advantage of handwriting over typing on learning words: evidence from an N400 Event-Related Potential Index. Frontiers in Human Neuroscience, 15. https://doi.org/10.3389/fnhum.2021.679191

James, K. H., & Engelhardt, L. (2012). The effects of handwriting experience on functional brain development in pre-literate children. Trends in Neuroscience and Education, 1(1), 32–42. https://doi.org/10.1016/j.tine.2012.08.001

Kiefer, M., & Spitzer, M. (2023). HOW HANDWRITING SHAPES LITERACY ACQUISITION AND GENERAL COGNITION: Phenomena and Cognitive Mechanisms. In Routledge International Handbook of Visualmotor Skills, Handwriting, and Spelling: Theory, Research, and Practice. https://doi.org/10.4324/9781003284048-11

Marano, G., Kotzalidis, G. D., Lisci, F. M., Anesini, M. B., Rossi, S., Barbonetti, S., Cangini, A., Ronsisvalle, A., Artuso, L., Falsini, C., Gaetani, E., & Mazza, M. (2025). The Neuroscience Behind Writing: Handwriting vs. Typing—Who Wins the Battle? Life, 15(3). https://doi.org/10.3390/life15030345

Mayer, C., Wallner, S., Budde-Spengler, N., Braunert, S., Arndt, P. A., & Kiefer, M. (2020). Literacy Training of kindergarten children with pencil, keyboard or tablet stylus: The influence of the writing tool on reading and writing performance at the letter and word level. Frontiers in Psychology, 10. https://doi.org/10.3389/fpsyg.2019.03054

Medwell, J., & Wray, D. (2007). Handwriting: What do we know and what do we need to know? Literacy, 41(1), 10–15. https://doi.org/10.1111/j.1467-9345.2007.00453.x

Mueller, P. A., & Oppenheimer, D. M. (2014). The pen is mightier than the keyboard: Advantages of longhand over laptop note taking. Psychological Science, 25(6). https://doi.org/10.1177/0956797614524581

Masruddin, M., & Nasriandi, N. (2022). Lexical and Syntactical Errors Performed by Junior High School Student in Writing Descriptive Text. IDEAS: Journal on English Language Teaching and Learning, Linguistics and Literature, 10(1), 1094-1100.

Masruddin, M., Amir, F., Langaji, A., & Rusdiansyah, R. (2023). Conceptualizing linguistic politeness in light of age. International Journal of Society, Culture & Language, 11(3), 41-55.

Masruddin, Hartina, S., Arifin, M. A., & Langaji, A. (2024). Flipped learning: facilitating student engagement through repeated instruction and direct feedback. Cogent Education, 11(1), 2412500.

Neumann, M. M., Hyde, M. B., Neumann, D. L., Hood, M., & Ford, R. M. (2012). Multisensory methods for early literacy learning. In Beyond the Lab: Applications of Cognitive Research in Memory and Learning.

Papadopoulos, I., Hall, A. H., Sekoulla, D., & Gao, Q. (2025). Examining Preschool Educators' Beliefs About Authentic Early Writing Experiences. Early Childhood Education Journal. https://doi.org/10.1007/s10643-025-01870-6

Paraskevopoulos, E., Kuchenbuch, A., Herholz, S. C., & Pantev, C. (2012). Evidence for training-induced plasticity in multisensory brain structures: An meg study. PLoS ONE, 7(5). https://doi.org/10.1371/journal.pone.0036534

Raymundo, N. M., & Cermak, S. A. (2023). An Overview of Digital Applications for Teaching Handwriting. Journal of Occupational Therapy, Schools, and Early Intervention. https://doi.org/10.1080/19411243.2023.2283698

Rønningsbakk, L. (2022). How Does the Shift from Handwriting to Digital Writing Technologies Impact Writing for Learning in School? In Lecture notes in computer science (pp. 231–240). https://doi.org/10.1007/978-3-031-15273-3_26

Seyll, L., & Content, A. (2022). Letter-Like Shape Recognition in Preschool Children: Does Graphomotor Knowledge Contribute? Frontiers in Psychology, 12. https://doi.org/10.3389/fpsyg.2021.726454

Shenoy, P., & Kumar, T. (2024). A Human-centred Tactile Perception Device for Enhanced Learning. Procedia CIRP, 128, 43-48.

Shibata, H., & Omura, K. (2018). Reconsideration of the effects of handwriting: Comparing cognitive load of handwriting and typing. ITE Transactions on Media Technology and Applications, 6(4), 255-261.

Subarkah, M. Z., Sulandari, W., & Respatiwulan, R. (2024). Implementation of transfer learning in convolutional neural network architecture for android-based handwriting quality detection. AIP Conference Proceedings, 3095(1). https://doi.org/10.1063/5.0204724

Sut, A. L. S., Wah, L. L., Min, L. H., & Chen, O. S. (2022). Revisiting Handwriting Fundamentals Through an Interdisciplinary Framework. Malaysian Journal of Medical Sciences, 29(1), 18–33. https://doi.org/10.21315/mjms2022.29.1.3

Tucha, O., Tucha, L., & Lange, K. W. (2008). Graphonomics, automaticity and handwriting assessment. In Literacy (Vol. 42, Issue 3). https://doi.org/10.1111/j.1741-4369.2008.00494.x

Wallace, R. R., & Schomer, J. H. (1994). Simplifying handwriting instruction for the 21st century. Education, 114(3), 413-418.

https://www.questia.com/library/journal/1G1-15524393/simplifying-handwriting-instruction-for-the-21st-century

ISSN 2338-4778 (Print)
ISSN 2548-4192 (Online)

Wiley, R. W., & Rapp, B. (2021). The effects of handwriting experience on literacy learning. Psychological science, 32(7), 1086-1103.

Wollscheid, S., Sjaastad, J., Tømte, C., & Løver, N. (2016b). The effect of pen and paper or tablet computer on early writing – A pilot study. Computers & Education, 98, 70–80. https://doi.org/10.1016/j.compedu.2016.03.008