

Pre-Braille Skills and Braille Literacy of Learners with Visual Impairment

Susan Vicente D. Villarente¹, Edmar B. Judilla²

¹University of Southeastern Philippines

²Gen. Santos City SPED Integrated School, Philippines

DOI: <https://doi.org/10.51244/IJRSI.2025.12040027>

Received: 22 March 2025; Accepted: 02 April 2025; Published: 02 May 2025

ABSTRACT

This study investigates the relationship between pre-braille skills and braille literacy among learners with visual impairments. Through descriptive-correlational research design, 35 learners in the Philippines from Regions 11, 12, and 13 were selected through purposive sampling. Pre-braille skills were assessed in concept development, motor skills, auditory processing, and tactual discrimination, while braille literacy was evaluated in reading, writing, and numeracy. Findings revealed very high proficiency in pre-braille skills, with auditory processing scoring the highest ($\bar{x} = 5.63$, $SD = 1.77$) and motor skills the lowest ($\bar{x} = 5.35$, $SD = 1.82$). Braille literacy results indicated high overall proficiency ($\bar{x} = 4.01$, $SD = 2.00$), with reading as the most substantial domain ($\bar{x} = 4.33$, $SD = 2.04$) and numeracy as the weakest ($\bar{x} = 3.53$, $SD = 1.99$). Spearman's correlation analysis showed a moderate positive relationship ($\rho = 0.516$, $p = 0.002$), emphasizing the critical role of pre-braille skills in literacy development. Strong auditory and tactual skills enhanced reading and writing performance, while weaker motor skills impacted numeracy. The study concludes that pre-braille skills significantly influence braille literacy, particularly in reading and writing. It recommends targeted interventions to improve numeracy and advanced writing skills and integrate multi-sensory instructional approaches.

Keywords: pre-braille skills, braille literacy, visual impairment, inclusive education, numeracy, multi-sensory learning

INTRODUCTION

Braille literacy is fundamental in empowering learners with visual impairment to access education, communicate effectively, and achieve independence. The development of Braille literacy is not an isolated process but builds upon foundational pre-Braille skills, including concept development, motor coordination, auditory skills, and tactual discrimination. These pre-Braille skills act as stepping stones, enabling learners to progress toward reading, writing, and numeracy proficiency using Braille.

Despite advancements in inclusive education globally and in the Philippines, Braille literacy rates are declining. This trend is attributed to an over-reliance on audio-based technologies like screen readers and audiobooks, which reduce the emphasis on traditional Braille instruction. Experts advocate for balancing traditional Braille and digital literacy to equip learners with comprehensive skills for the modern world (Helquist, 2016). Strengthening pre-Braille education remains critical in addressing these challenges, as it ensures learners are well-prepared for both traditional and digital learning modes.

In the Philippines, legislative measures such as Inclusive Education Act (2022) mandates inclusive education and the provision of resources like Braille materials for learners with disabilities. However, implementing these measures faces persistent challenges. The Department of Education (DepEd) acknowledges the shortage of resources, including trained teachers and Braille materials, as a significant barrier to fully supporting learners with visual impairments. Research further underscores the importance of tailored interventions for learners with visual impairment.

Villoria (2017) investigated the effects of pre-Braille instruction using modified Braille instruments on improving reading proficiency. The findings emphasized pre-Braille skills such as concept development, tactile exploration, and motor coordination in facilitating reading accuracy and comprehension. Similarly, Daned (2015) demonstrated the effectiveness of the Universal Design for Learning (UDL) and Braille in improving reading comprehension among learners with visual impairments in mainstream classes. The study revealed that targeted interventions could elevate learners from frustration to instructional reading levels, showcasing the value of inclusive teaching strategies. Additionally, Caga (2015) highlighted the impact of the chunking method using the Cranmer abacus to enhance mathematics performance. This study emphasized the role of structured, repetitive tasks in developing motor coordination and tactual discrimination, which are foundational pre-Braille skills necessary for literacy development.

These studies provide valuable insights into how specific teaching strategies and interventions improve literacy and academic skills. However, the correlation between pre-Braille skills and Braille literacy remains underexplored, particularly in regions 11, 12, and 13 in the Philippines. In Region 12, barriers such as a lack of trained educators and limited Braille resources have hindered the literacy development of learners with visual impairments. Addressing this gap requires a deeper understanding of how pre-Braille skills contribute to Braille literacy outcomes.

Therefore, this study examined the relationship between pre-Braille skills and Braille literacy among learners with visual impairment in regions 11, 12, and 13 in the Philippines. By investigating how foundational skills influence literacy, the research aims to inform policies and interventions that enhance educational outcomes for these learners. The findings would provide actionable recommendations for educators, policymakers, and stakeholders to support the literacy journey of learners with visual impairment, aligning with the broader goal of inclusive education.

The following primary hypotheses guided this study:

Null Hypothesis (H0): There is no significant relationship between pre-Braille skills and Braille literacy among learners with visual impairment in regions 11, 12, and 13 in the Philippines.

Alternative Hypothesis (H1): There is a significant relationship between pre-Braille skills and Braille literacy among learners with visual impairment in regions 11, 12, and 13 in the Philippines.

Thus, this study aimed to answer the following research questions:

1. What is the level of the pre-Braille skills of the learners with visual impairment in terms of the following?
 - 1.1. Concept development
 - 1.2. Motor skills development
 - 1.3. Auditory skills
 - 1.4. Tactual discrimination skills
2. What is the level of Braille literacy of the learners with visual impairment in terms of the following?
 - 2.1. Braille reading skills
 - 2.2. Braille writing skills
 - 2.3. Numeracy skills
3. Is there a significant relationship between pre-Braille skills and Braille literacy of learners with visual impairment?

MATERIALS AND METHODS

This study employed a descriptive correlational design, which is commonly used to investigate the relationships between variables without attempting to establish causation (Creswell & Creswell, 2017). This approach enables researchers to describe the nature and strength of associations between two or more variables, making it particularly suitable for educational studies focusing on understanding patterns or trends (Fraenkel, Wallen, & Hyun, 2019). The descriptive aspect allows for a detailed analysis of the studied

variables, while the correlational component identifies how these variables are related. This study uses the design to systematically examine the connection between pre-Braille skills—such as concept development, motor skills, auditory processing, and tactual discrimination—and Braille literacy, including reading, writing, and numeracy. By employing this design, the study captures meaningful insights into these relationships without making causal inferences.

The design used a structured survey questionnaire adapted for visually impaired learners. The questionnaire is divided into sections assessing pre-Braille skills and Braille literacy levels. Items related to pre-Braille skills focus on evaluating abilities in concept development, motor skills, auditory processing, and tactual discrimination, while the Braille literacy section measures reading, writing, and numeracy proficiency. Once data is collected, a correlation analysis is conducted to determine the strength and direction of relationships between the variables. For instance, the study examines whether stronger motor skills correlate with higher proficiency in Braille writing or if auditory processing influences Braille reading skills. This aligns with the recommendations of Creswell and Creswell (2017) and Fraenkel et al. (2019), who highlight the value of correlational research in identifying associations that can inform practical interventions. The findings will contribute to developing targeted strategies to enhance educational outcomes for visually impaired learners by pinpointing the most critical pre-Braille skills for literacy success.

The primary data for this study were collected from 35 learners with visual impairments selected from various schools in the Philippines from regions 11, 12, and 13. This approach ensured representation from diverse respondents across different educational levels, ranging from elementary to senior high school. By including respondents with different experience levels, the study aimed to capture a balanced understanding of the factors influencing Braille literacy. The demographic diversity among the 35 respondents provided a comprehensive analysis of their skill levels, ranging from foundational pre-Braille abilities to advanced Braille proficiency. While more experienced Braille users could influence the results, including respondents with less experience offered a broader perspective. Non-parametric techniques were employed to enhance the reliability of the findings as they are effective for smaller sample sizes and do not rely on the assumption of a normal distribution (Field, 2018; Pallant, 2020). This methodological approach ensures the generation of robust conclusions, even with the limited sample size, reinforcing the validity and insights of the study's findings.

The survey questionnaire used in this study was adapted and modified from established tools, including the Pre-Braille Assessment (Texas School for the Blind and Visually Impaired, 2007), the Early Tactile Learning Profile (Adkins et al., 2022), and the Expanded Core Curriculum Goal Bank (Texas School for the Blind and Visually Impaired, 2017). This instrument was designed to evaluate two primary areas: pre-Braille skills (20 items) and Braille literacy (15 items). Initially designed with a 5-point Likert scale, the questionnaire was revised to a 7-point scale based on expert validators' feedback. The experts suggested this modification to capture more nuanced responses and provide a finer level of granularity in the data. The revised scale ranged from "Strongly Disagree" to "Strongly Agree," included in the pre-Braille section.

A 7-point Likert scale is supported by its ability to capture detailed responses while maintaining reliability and validity. Recent studies have demonstrated that a 7-point scale allows for greater precision in capturing opinions and attitudes, making it ideal for research that seeks to measure subtle variations in responses (Chyung et al., 2017). This scale has also been shown to reduce central tendency bias and improve response reliability compared to shorter scales.

The instrument underwent validation by three experts in special education and Braille literacy, receiving an overall rating of 4.81 (Excellent). Validation details, including expert feedback and validation sheets, are provided in Table 1. Reliability was confirmed through Cronbach's alpha, with results ranging from "Acceptable" (0.70–0.79) to "Excellent" (≥ 0.90), ensuring the instrument's internal consistency. Interpretation tables for reliability and Likert scale ranges, detailed in Table 2, offer benchmarks for assessing responses.

Table 1. Reliability Interpretation Table

Cronbach's Alpha Value	Reliability Level	Interpretation
≥ 0.90	Excellent	The instrument has very high internal consistency. Suitable for high-stakes decisions.
0.80 – 0.89	Good	The instrument is reliable and consistent for most purposes.
0.70 – 0.79	Acceptable	The instrument has an acceptable level of reliability for exploratory research.
0.60 – 0.69	Questionable	The reliability is marginal and may require improvement in certain items.
0.50 – 0.59	Poor	The instrument has low reliability and is not ideal for use without revision.
< 0.50	Unacceptable	The instrument has very low reliability and should not be used.

As presented in Tables 2 and 3, the instrument went through a pilot testing phase to further ensure its credibility. This involved revising items based on feedback, applying the 7-point Likert scale, and confirming the instrument's reliability. The study utilized the scales for pre-Braille skills and Braille literacy to evaluate performance levels. For example, scores between 6.01 and 7.00 indicate an "Extremely High Level," while scores below 3.00 represent an "Extremely Low Level."

Table 2. Pre-Braille Skills Proficiency Levels

Score Range	Level of Proficiency	General Description
6.01 – 7.00	Extremely High Level	The learner demonstrates exceptional proficiency and exceeds expectations.
5.01 – 6.00	Very High Level	The learner shows strong proficiency with minor areas for improvement.
4.01 – 5.00	High Level	The learner performs well but requires some support to reach full potential.
3.01 – 4.00	Moderate Level	The learner demonstrates average proficiency with significant areas for improvement.
2.01 – 3.00	Low Level	The learner struggles with foundational skills and needs focused intervention.
1.01 – 2.00	Very Low Level	The learner shows minimal proficiency and requires substantial support.
0.01 – 1.00	Extremely Low Level	The learner exhibits little to no proficiency and needs intensive assistance.

Table 3. Braille Literacy Proficiency Levels

Score Range	Level of Proficiency	General Description
6.01 – 7.00	Extremely High Literacy	The learner demonstrates exceptional literacy skills, fully mastering advanced Braille contexts.

5.01 – 6.00	Very High Literacy	The learner shows strong Braille literacy with minor areas requiring additional attention.
4.01 – 5.00	High Literacy	The learner performs well in Braille literacy but needs targeted support for optimal proficiency.
3.01 – 4.00	Moderate Literacy	The learner demonstrates average literacy skills, with noticeable areas needing improvement.
2.01 – 3.00	Low Literacy	The learner struggles with basic Braille skills and needs focused and structured interventions.
1.01 – 2.00	Very Low Literacy	The learner shows minimal Braille literacy and requires substantial and consistent support.
0.01 – 1.00	Extremely Low Literacy	The learner exhibits little to no Braille literacy and needs intensive, one-on-one assistance.

As presented in Table 4, Spearman’s correlation was used to analyze the relationship between pre-Braille skills and Braille literacy. This approach, combined with a validated instrument, the revised Likert scale, and robust interpretation methods, ensures reliable data collection and meaningful insights into the development of Braille literacy among visually impaired learners.

Table 4. Spearman Correlation Interpretation Table

Spearman’s rho (r_s)	Strength of Correlation	Interpretation
± 0.00 to ± 0.19	Very weak or negligible	Little to no relationship
± 0.20 to ± 0.39	Weak	Small but definite relationship
± 0.40 to ± 0.59	Moderate	Substantial relationship
± 0.60 to ± 0.79	Strong	Strong relationship
± 0.80 to ± 1.00	Very strong	Very strong relationship or perfect

This study employed a purposive sampling technique to select 35 respondents with visual impairments. Purposive sampling, a non-probability method, involves deliberately choosing participants based on specific characteristics that align with the research objectives (Patton, 2015). This approach ensured that the sample included individuals whose attributes were essential for examining the relationship between pre-Braille skills and Braille literacy. The participants varied in gender, age, grade level, and years of Braille experience, providing a comprehensive representation of learners with visual impairments. This diversity enhanced the study’s ability to explore variations in pre-Braille skills and Braille literacy across different demographic groups.

Respondents were recruited with the assistance of SPED teachers and school administrators. Endorsement letters were sent to the regional director, school supervisors, and principals to secure authorization for data collection. These stakeholders facilitated access to eligible participants by coordinating with schools. The inclusion criteria required participants to be learners with visual impairments enrolled in elementary, junior high, or senior high school in the Philippines within regions 11, 12, and 13. Learners with additional disabilities that could significantly impact their ability to participate in the survey were excluded. This targeted

approach ensured that the sample was appropriate for addressing the study's research questions while maintaining the reliability of the findings.

The study procedure was executed systematically in multiple phases. A formal letter was sent to the original owner of the adapted instrument, requesting permission to use and modify the survey. Upon approval, the survey was refined based on the research objectives. Expert validation was conducted, followed by a pilot test to assess reliability using Cronbach's alpha. Letters were sent to the regional director, supervisors, and principals to secure permissions for data collection in region 11, 12 and 13. The finalized survey was distributed via Google Forms. SPED teachers or parents assisted respondents who could not complete the survey independently. This study underwent data cleaning, preparation, and statistical analysis.

The data were analysed using descriptive and inferential statistical methods to address the study's objectives. Descriptive statistics were used to summarize pre-Braille skills and Braille literacy, focusing on mean and standard deviation measures to provide an overview of the participants' skill levels. The mean captured the central tendency of the data, while the standard deviation highlighted the variability within the dataset. This approach addressed the first and second research questions by offering insights into the general trends and variations in pre-Braille and Braille literacy skills among the participants.

The reliability of the survey instrument was evaluated using Cronbach's alpha, as shown in Table 5, which demonstrated excellent internal consistency with values of 0.964 for pre-Braille skills and 0.948 for Braille literacy. These results confirmed the instrument's reliability for assessing the variables. The normality tests detailed in Table 6 were conducted using the Kolmogorov-Smirnov and Shapiro-Wilk tests to determine the appropriate statistical method for further analysis. The results revealed that the pre-Braille skills data significantly deviated from normality (Kolmogorov-Smirnov, $p = 0.002$; Shapiro-Wilk, $p < 0.001$), while the Braille literacy data showed slight deviation based on the Kolmogorov-Smirnov test ($p = 0.015$) but did not significantly deviate based on the Shapiro-Wilk test ($p = 0.073$).

Table 5. Reliability Coefficients (Cronbach's Alpha) for Pre-Braille and Braille Literacy Scales

Scale	Cronbach's Alpha
Pre-Braille Skills	0.964
Braille Literacy	0.948

Table 6. Normality Test Results for Pre-Braille Skills and Braille Literacy

Variable	Test	Statistic	df	Sig. (p-value)	Interpretation
Pre-Braille Skills	Kolmogorov-Smirnov	0.195	35	0.002	Data significantly deviate from normal distribution.
	Shapiro-Wilk	0.853	35	<0.001	Data significantly deviate from normal distribution.
Braille Literacy	Kolmogorov-Smirnov	0.166	35	0.015	Data slightly deviate from normal distribution.
	Shapiro-Wilk	0.944	35	0.073	Data do not significantly deviate from normality.

Given the non-normal distribution of the pre-Braille skills data, a non-parametric statistical method was necessary. Spearman's correlation was selected to address the third research questions by examining the relationship between pre-Braille skills and Braille literacy. Spearman's correlation is appropriate for ordinal data and Likert scale responses, as it does not assume a normal distribution or a linear relationship between variables (Pallant, 2020). By combining descriptive statistics, including mean and standard deviation, with Spearman's correlation for inferential analysis, the study comprehensively examined the relationship between

pre-Braille skills and Braille literacy. This approach ensured meaningful and reliable insights into the association between the two variables, contributing valuable information to special education.

Ethical principles were strictly adhered to throughout the study to protect the respondents' rights, welfare, and confidentiality. Written consent was obtained from all respondents or their legal guardians before they participated in the study. For younger learners or those with visual impairments who required additional support, consent was also sought from parents, guardians, or SPED teachers. Respondents' identities were kept anonymous; no personally identifiable information was collected or disclosed. All responses were coded and stored securely to ensure privacy and confidentiality. Participation in the study was entirely voluntary. Respondents were informed of their right to withdraw from the study at any point without any consequences. The study ensured that no physical, emotional, or psychological harm came to the respondents. SPED teachers or parents aided with learners who needed help completing the survey, minimizing stress or difficulty. Permission to conduct the study was secured from the regional director, school supervisors, principals, and the original owner of the adapted instrument. Data collection and analysis were conducted transparently, ensuring the integrity of the research findings. Proper acknowledgment was given to the sources of adapted instruments and literature used in the study. The study was designed to benefit learners with visual impairments by providing insights that could improve their pre-Braille and Braille literacy skills through targeted interventions or programs.

RESULTS AND DISCUSSION

This study investigated the relationship between pre-Braille skills and Braille literacy of learners with visual impairment to determine learners with visual impairment pre-Braille skills in concept development, motor skills, auditory skills, and tactual discrimination, and their level of Braille literacy in terms of reading, writing, and numeracy skills. Further, this study is also intended to analyze the significant relationship between pre-Braille skills and Braille literacy among learners with visual impairment.

Levels of Pre-Braille Skills of Learners with Visual Impairment

The descriptive statistics for concept development, as shown in Table 7, indicate that learners demonstrate consistently very high proficiency levels across all assessed items. The highest mean score (5.74, SD = 1.771) was observed for understanding spatial concepts, such as left, right, top, and bottom, reflecting learners' strong ability to process spatial relationships essential for Braille literacy. Conversely, the lowest mean score (5.26, SD = 2.049) was recorded for understanding basic shapes and their differences. This suggests this area may benefit from additional support to enhance further tactile shape recognition, a critical pre-Braille skill (Nahar et al., 2015). Moderate variability, evidenced by standard deviations ranging from 1.771 to 2.075, highlights individual differences in proficiency, particularly in recognizing time concepts ('before' and 'after') and categorizing objects. This finding aligns with Vygotsky's zone of proximal development (ZPD), which emphasizes the importance of guided learning to help learners develop these foundational skills (Azizah Awang et al., 2024). Additionally, Piaget's constructivist learning theory supports the role of active exploration in building spatial and conceptual understanding (Ng Ai Lee et al., 2021). The overall mean score for concept development was 5.45 (SD = 1.95), placing learners in a very high level of proficiency. This indicates that learners possess a solid foundation in concept development, a prerequisite for Braille literacy. However, score variability suggests the need for tailored interventions, particularly in shape recognition and time concepts, to ensure consistent progress across all learners.

Table 7. Level of Pre-Braille Skills in Terms of Concept Development

Concept Development	N	Mean	SD	Descriptive Equivalent
The learner can understand spatial concepts, such as left and right, and identify objects by their positions, like top and bottom.	35	5.74	1.771	Very High Level

The learner understands the basic shapes and their differences.	35	5.26	2.049	Very High Level
The learner can categorize objects based on their size.	35	5.40	2.032	Very High Level
The learner recognizes basic time concepts, such as 'before' and 'after.'	35	5.40	2.075	Very High Level
The learner can recognize and name familiar objects in their environment.	35	5.46	1.837	Very High Level
Overall	35	5.45	1.95	Very High Level

The descriptive statistics for motor skills development, as shown in Table 8, demonstrate that learners exhibit very high proficiency levels in all assessed items. The highest mean score (5.46, SD = 1.755) was observed for using fingers independently to grasp and release objects, reflecting well-developed fine motor skills crucial for tactile exploration and Braille writing. The lowest mean score (5.20, SD = 1.967) was recorded for sufficient hand and finger strength, indicating that this area might benefit from additional strengthening exercises to support prolonged Braille reading and writing tasks. The response variability, with standard deviations ranging from 1.755 to 1.967, suggests differences in individual motor skill levels. This highlights the importance of personalized motor skill development programs to ensure all learners achieve optimal proficiency. These findings align with Adkins et al. (2022), who emphasize the role of fine motor coordination in preparing learners for successful Braille literacy. Vygotsky's ZPD further supports the need for structured and guided practice to bridge gaps in motor skill readiness (Azizah Awang et al., 2024). The overall mean score for motor skills development was 5.35 (SD = 1.82), also categorized as very high level. This suggests that learners are well-prepared for the motor skills necessary for pre-Braille literacy. However, the variability in scores indicates the need for targeted interventions to ensure consistent skill development, particularly in hand and finger strength.

Table 8. Level of Pre-Braille Skills in Terms of Motor Skills Development

Motor Skills	N	Mean	SD	Descriptive Equivalent
The learner uses their fingers independently to grasp and release objects.	35	5.46	1.755	Very High Level
The learner shows coordinated hand and finger movements.	35	5.40	1.834	Very High Level
The learner has sufficient hand and finger strength for Braille tasks.	35	5.20	1.967	Very High Level
The learner can maintain a light touch necessary for Braille reading.	35	5.40	1.769	Very High Level
The learner demonstrates the ability to manipulate small objects with precision.	35	5.29	1.792	Very High Level
Overall	35	5.35	1.82	Very High Level

The descriptive statistics reveal that learners demonstrate a very high level of proficiency across most auditory skills assessed, as shown in Table 9. The highest mean score (5.94, SD = 1.626) was observed for distinguishing between loud and soft sounds, indicating that learners excel in basic auditory discrimination skills essential for pre-Braille learning. Similarly, repeating words or phrases just heard (Mean = 5.86, SD = 1.630) also reflects a very high level, emphasizing the learners' ability to process and recall auditory information. On the other hand, the lowest mean scores (5.37, SD = 2.073, and SD = 1.784) were recorded for following auditory instructions accurately and multi-step auditory instructions effectively, respectively. These findings suggest that while learners perform well, additional practice in processing and following complex auditory instructions may be beneficial. The variability, as reflected in standard deviations ranging from 1.626 to 2.073, highlights individual differences in auditory skill proficiency. These findings align with Vygotsky's Zone of Proximal Development, which emphasizes the importance of guided learning to help learners master complex skills like auditory processing. Furthermore, the multi-sensory learning theory supports integrating auditory and tactile learning, enhancing pre-Braille readiness (Argyropoulos & Papadimitriou, 2017). The overall mean score for auditory skills was 5.63 (SD = 1.77), categorized as very high level. This indicates that learners are generally proficient in auditory processing, a key foundation for Braille literacy. However, variability in performance across specific tasks suggests that tailored interventions focusing on following instructions and multi-step auditory processing could further enhance overall proficiency.

Table 9. Level of Pre-Braille Skills in Terms of Auditory Skills

Auditory Skills	N	Mean	SD	Descriptive Equivalent
The learner can follow auditory instructions accurately.	35	5.37	2.073	Very High Level
The learner can distinguish between loud and soft sounds.	35	5.94	1.626	Very High Level
The learner can repeat words or phrases they have just heard.	35	5.86	1.630	Very High Level
The learner follows multi-step auditory instructions effectively.	35	5.37	1.784	Very High Level
The learner shows the ability to differentiate between similar sounds.	35	5.63	1.750	Very High Level
Overall	35	5.63	1.77	Very High Level

As shown in Table 10, the descriptive statistics indicate that learners exhibit a very high level of proficiency in most tactual skills assessed. The highest mean score (5.54, SD = 1.821) was observed for distinguishing between different textures and detecting temperature differences through touch, highlighting learners' strong ability to process tactile information. Similarly, recognizing the weight differences of objects (Mean = 5.54, SD = 1.771) also reflects a very high level of proficiency, suggesting that learners excel in identifying the physical properties of objects using touch. Conversely, the lowest mean score (5.29, SD = 1.934) was recorded for the ability to discriminate between similar objects by touch. This finding suggests that learners may need additional activities to refine their tactile discrimination skills. The variability in responses, as indicated by standard deviations ranging from 1.770 to 1.934, reflects individual differences in tactual skill proficiency. These findings align with the multi-sensory learning theory, which emphasizes integrating tactile experiences to enhance learning (Argyropoulos & Papadimitriou, 2017). Furthermore, Vygotsky's ZPD supports the need for guided practice to help learners master advanced tactile discrimination skills (Azizah Awang et al., 2024).

The overall mean score for tactual skills was 5.46 (SD = 1.84), placing learners in a very high level of proficiency. This indicates that learners possess strong tactile processing skills essential for pre-Braille literacy, though targeted interventions could further improve their ability to discriminate between similar objects.

Table 10. Level of Pre-Braille Skills in Terms of Tactual Skills

Tactual Discrimination Skills	N	Mean	SD	Descriptive Equivalent
The learner can distinguish between different textures and detect temperature differences through touch.	35	5.54	1.821	Very High Level
The learner accurately identifies objects by recognizing them through touch.	35	5.43	1.770	Very High Level
The learner recognizes the shapes of objects by touch.	35	5.49	1.900	Very High Level
The learner shows the ability to discriminate between similar objects by touch.	35	5.29	1.934	Very High Level
The learner recognizes the weight differences of objects by touch.	35	5.54	1.771	Very High Level
Overall	35	5.46	1.84	Very High Level

The findings revealed in Table 11 that learners demonstrate consistently very high proficiency levels across all pre-Braille skill areas, as evidenced by overall mean scores ranging from 5.35 to 5.63. Auditory skills recorded the highest overall mean score (5.63, SD = 1.77), highlighting learners' strong ability to process auditory information, an essential foundation for Braille literacy. Tactual skills (Mean = 5.46, SD = 1.84) and concept development (Mean = 5.45, SD = 1.95) also reflect robust tactile and conceptual understanding proficiency. Motor skills development, with the lowest overall mean score (5.35, SD = 1.82), indicates that while learners are proficient, there is room for improvement, particularly in refining fine motor coordination and strength.

The variability in standard deviations across skill areas suggests differences in individual learner performance, particularly in concept development and motor skills, where variability was slightly higher. These findings align with Vygotsky's ZPD, emphasizing the need for guided interventions to help learners fully develop these foundational skills (Azizah Awang et al., 2024). Furthermore, the results support the Multi-sensory Learning Theory, which highlights integrating auditory, tactile, and motor experiences to prepare learners for Braille literacy (Argyropoulos & Papadimitriou, 2017).

Table 11. Summary of Level of Pre-Braille Skills

Skill Area	N	Mean	SD	Descriptive Equivalent
Concept Development	35	5.45	1.95	Very High Level
Motor Skills Development	35	5.35	1.82	Very High Level
Auditory Skills	35	5.63	1.77	Very High Level
Tactual Skills	35	5.46	1.84	Very High Level
Overall	35	5.47	1.85	Very High Level

The summary of overall performance, presented in Table 11, underscores the learners' readiness for Braille literacy. However, targeted support in areas with higher variability, such as motor skills and concept development, may further enhance their overall proficiency. The results indicate that learners possess the foundational pre-Braille skills necessary for Braille literacy, with consistently high proficiency across all skill areas. Tailored interventions in motor skills development and concept understanding can further enhance individual performance and ensure a more uniform level of readiness for Braille literacy.

Levels of Braille Literacy of Learners with Visual Impairment

The descriptive statistics for Braille reading reveal variations in learners' proficiency levels. As shown in Table 12, the highest mean score (4.69, SD = 2.055) was observed for accurately identifying Braille symbols, indicating a high level of proficiency. This aligns with the research by Wong, Peters, and Goldreich (2013), which highlights the importance of tactile discrimination and recognition of Braille symbols as foundational to Braille reading. Similarly, differentiating between various Braille characters also scored high (4.46, SD = 1.975), reflecting learners' growing familiarity with Braille text, as Floyd (2019) supported tactual discrimination as a critical skill in Braille reading. However, the lowest mean score (4.09, SD = 2.201) was recorded for identifying and reading Braille punctuation marks, categorized as a moderate level of proficiency. This finding suggests further emphasis on punctuation in Braille literacy programs. Studies by David et al. (2020) reinforce the importance of structured instruction in Braille syntax to enhance learners' comprehension and writing accuracy. Reading fluency (4.29, SD = 1.872) and comprehension (4.14, SD = 2.102) also scored within the high level, indicating learners are developing these advanced skills, though variability highlights differences in individual performance. These findings align with the multi-sensory learning theory, which advocates integrating tactile, auditory, and motor skills to develop comprehensive literacy (Ng Ai Lee, Eng Hock, & Hosshan, 2021). Additionally, the results reflect the principles of Vygotsky's ZPD, where scaffolding and guided practice are essential for mastering more complex aspects of Braille reading, such as fluency and punctuation (Azizah Awang et al., 2024).

Table 12. Level of Braille Literacy in Terms of Braille Reading

Braille Reading	N	Mean	SD	Descriptive Equivalent
The learner can identify Braille symbols accurately.	35	4.69	2.055	High Level
The learner reads Braille text fluently at an appropriate speed.	35	4.29	1.872	High Level
The learner can differentiate between various Braille characters.	35	4.46	1.975	High Level
The learner correctly identifies and reads Braille punctuation marks.	35	4.09	2.201	Moderate Level
The learner shows comprehension of Braille writing through accurate responses to questions.	35	4.14	2.102	High Level
Overall	35	4.33	2.04	High Level

The overall mean score for Braille reading is 4.33 (SD = 2.04), reflecting a high level of proficiency. Learners demonstrate strong skills in recognizing Braille symbols and differentiating characters, which is foundational

for Braille reading. However, areas such as punctuation and reading fluency show moderate variability, indicating the need for targeted interventions to address individual learner needs. This supports the findings of Martiniello (2019), who emphasized that structured motor and tactile skill training significantly impacts Braille reading proficiency. The results underscore the importance of integrating multi-sensory approaches in Braille instruction, as Argyropoulos and Papadimitriou (2017) emphasized, bridging gaps in fluency and comprehension. Tailored Braille punctuation and syntax interventions can further enhance learners' overall reading outcomes.

The descriptive statistics for Braille writing reveal varied levels of proficiency among learners. As shown in Table 13, the highest mean score (4.77, SD = 2.001) was observed for the learner's understanding of how to use a Braille writer, slate, and stylus to produce accurate symbols, reflecting a high level of proficiency. This finding aligns with research by Martiniello (2019), who emphasized the importance of motor coordination in using Braille writing tools. Learners proficient in motor skills demonstrate greater accuracy in producing clear Braille symbols, a foundation for effective writing. Conversely, the lowest mean score (3.37, SD = 1.972) was recorded for accurately using shortcuts in Braille writing, such as Braille contractions. This indicates a moderate level of proficiency, suggesting the need for more targeted instruction on advanced Braille writing techniques. Studies by David et al. (2020) highlighted that mastering contractions is essential for improving fluency and coherence in written Braille. Additionally, the ability to write complete words without errors (3.83, SD = 1.823) and at an appropriate speed (3.69, SD = 1.891) scored within the high level but reflected variability, emphasizing the need for practice in these areas. These findings align with Vygotsky's ZPD, which emphasizes guided practice and scaffolding to help learners develop advanced skills like writing fluently and using contractions (Azizah Awang et al., 2024). The results also support motor learning theory, which underscores the role of repetition and immediate feedback in refining motor precision for Braille writing (Strutzenberger, 2022).

Table 13. Level of Braille Literacy in Terms of Braille Writing

Braille Writing	N	Mean	SD	Descriptive Equivalent
The learner understands using a Braille writer, slate, and stylus to produce accurate symbols.	35	4.77	2.001	High Level
The learner writes complete words in Braille without errors.	35	3.83	1.823	High Level
The learner accurately uses shortcuts in Braille writing, known as Braille contractions, in their writing.	35	3.37	1.972	Moderate Level
The learner knows how to write numbers in Braille correctly.	35	4.26	2.201	High Level
The learner writes Braille at an appropriate speed.	35	3.69	1.891	High Level
Overall	35	4.18	1.98	High Level

The overall mean score for Braille writing is 4.18 (SD = 1.98), indicating a high level of proficiency. In contrast, learners excel in basic Braille writing tasks, such as using writing tools and producing accurate symbols, and advanced skills like contractions and writing fluency show room for improvement. These results highlight the importance of structured instruction and practice, as Martiniello (2019) suggested, to enhance learners' ability to write Braille efficiently. Moreover, incorporating multi-sensory approaches and scaffolding techniques, as emphasized by Argyropoulos and Papadimitriou (2017), can support learners in achieving mastery of Braille writing. Targeted interventions focusing on contractions and fluency can further improve their writing outcomes, ensuring learners are better prepared for academic and practical applications of Braille literacy.

The descriptive statistics for Braille numeracy indicate varied proficiency levels among learners. As shown in Table 14, the highest mean score (4.17, SD = 2.051) was observed for accurately reading and writing numbers in Braille, reflecting a high level of proficiency. This highlights learners' foundational skills in numeric literacy, which aligns with findings by Wong, Peters, and Goldreich (2013) that emphasize the importance of mastering basic numeric symbols for mathematical fluency in Braille. In contrast, the lowest mean score (3.09, SD = 1.961) was recorded for performing basic arithmetic calculations using Braille, such as addition, subtraction, multiplication, and division, indicating moderate proficiency. This finding suggests that learners require additional instructional support to build confidence and fluency in applying mathematical operations. Similarly, understanding and using Braille symbols for mathematical operations (3.46, SD = 1.884) and applying the Nemeth Code in real-world contexts (3.46, SD = 2.049) also reflect a high level of proficiency, though variability suggests some learners may need targeted interventions. The variability in standard deviations, ranging from 1.884 to 2.051, indicates individual differences in learners' numeracy skills. These results align with the principles of the multi-sensory learning theory, which emphasizes the integration of tactile, auditory, and motor skills to support numeric understanding (Argyropoulos & Papadimitriou, 2017). Furthermore, Vygotsky's ZPD underscores the importance of guided practice to help learners progress from basic to advanced numeracy skills (Azizah Awang et al., 2024).

Table 14. Level of Braille Literacy in Terms of Braille Numeracy

Numeracy Skills	N	Mean	SD	Descriptive Equivalent
The learner knows how to read and write numbers in Braille accurately.	35	4.17	2.051	High Level
The learner can accurately perform basic arithmetic calculations (addition, subtraction, multiplication, division) using Braille.	35	3.09	1.961	Moderate Level
The learner understands and uses Braille symbols for mathematical operations.	35	3.46	1.884	High Level
The learner can read and solve word problems written in Braille.	35	3.49	2.049	High Level
The learner can use the Nemeth Code for math problems and apply Braille in real-world tasks like budgeting and measurement.	35	3.46	2.049	High Level
Overall	35	3.53	1.99	High Level

The overall mean score for Braille numeracy is 3.53 (SD = 1.99), reflecting a high level of proficiency among learners. While learners demonstrate strong foundational skills in numeric literacy, arithmetic calculations and applying the Nemeth Code require additional instructional focus. These results support the findings by David et al. (2020), who emphasized the need for structured and guided instruction to enhance numeric fluency in Braille learners. As Argyropoulos and Papadimitriou (2017) suggested, integrating tactile and real-world problem-solving activities can further enhance learners' numeracy skills. Providing targeted interventions and scaffolding, especially in arithmetic operations and Nemeth Code applications, will help bridge gaps and improve overall proficiency in Braille numeracy.

The summary in Table 15 reveals that learners demonstrate a high level of proficiency across all areas of Braille literacy, with the highest mean score (4.33) observed in Braille reading. This suggests that learners are more proficient in recognizing and interpreting Braille text than in other areas. Braille writing and numeracy also show high levels of proficiency. However, numeracy has the lowest mean (3.53), indicating room for improvement, particularly in arithmetic calculations and the application of the Nemeth Code. The overall mean score for Braille literacy is 4.01, reflecting strong foundational skills across all areas. However, variability in standard deviations indicates individual differences among learners, emphasizing the need for targeted interventions in specific skill areas to ensure consistent progress. As supported by research (Argyropoulos &

Papadimitriou, 2017), incorporating structured and multi-sensory approaches can enhance learners' proficiency and prepare them for more advanced applications of Braille literacy.

Table 15. Summary of Level of Braille Literacy of Learners with Visual Impairment

Skill Area	N	Mean	SD	Descriptive Equivalent
Braille Reading	35	4.33	2.04	High Level
Braille Writing	35	4.18	1.98	High Level
Braille Numeracy	35	3.53	1.99	High Level
Overall	35	4.01	2.00	High Level

Relationship Between Pre-braille Skills and Braille Literacy

The results of Spearman's correlation analysis, as shown in Table 16, reveal a positive and statistically significant relationship between pre-Braille skills and Braille literacy among learners with visual impairments ($\rho = 0.516$, $p = 0.002$). Based on the Spearman Correlation Interpretation, this correlation indicates a moderately positive relationship, signifying a substantial connection between the two variables. This suggests that as learners' pre-Braille skills improve, their proficiency in Braille literacy increases significantly.

The statistical significance of these findings leads to the rejection of the null hypothesis, which stated that there is no significant relationship between pre-Braille skills and Braille literacy. Rejecting the null hypothesis confirms that pre-Braille skills play a vital role in literacy outcomes and are closely linked to Braille proficiency. This demonstrates that foundational skills in concept development, motor coordination, auditory processing, and tactual discrimination substantially contribute to a learner's ability to read, write, and perform numeracy tasks in Braille.

These findings align with the literature emphasizing the foundational role of pre-Braille skills in literacy outcomes. For instance, Floyd (2019) and Wong, Peters, and Goldreich (2013) highlight that tactual discrimination and motor coordination enhance reading accuracy and writing fluency in Braille. Similarly, Martiniello (2019) underscores the importance of fine motor skills in producing accurate Braille symbols. These studies affirm the interdependence of pre-Braille skills and Braille literacy for achieving literacy success. The results are also consistent with theoretical frameworks. Vygotsky's Zone of Proximal Development (ZPD) emphasizes the importance of guided learning to help learners master foundational skills essential for literacy (Azizah Awang et al., 2024). The multi-sensory learning theory also advocates for integrating tactile, auditory, and motor activities, further supporting the connection between pre-Braille skills and Braille literacy (Argyropoulos & Papadimitriou, 2017).

Table 16. Correlation Between Pre-Braille Skills and Braille Literacy

Variables	Spearman's rho (ρ)	Significance (p-value)	N	Remarks
Pre – Braille Skills	0.516	0.002	35	Moderate Positive Correlation
Braille Literacy	0.516	0.002	35	Moderate Positive Correlation

The moderate positive correlation between pre-Braille skills and Braille literacy underscores the critical importance of developing foundational skills to enhance literacy outcomes. Learners with stronger pre-Braille skills are more likely to excel in reading, writing, and numeracy in Braille. These results validate the need for structured pre-Braille interventions that focus on tactile, auditory, motor, and conceptual skill development. Moreover, integrating multi-sensory approaches, as recommended by Ng Ai Lee, Eng Hock, and Hossha

(2021), and scaffolding techniques, as emphasized by Vygotsky's ZPD, can help learners bridge gaps in skill development and achieve greater proficiency in Braille literacy. This connection between theory, practice, and findings highlights the need for tailored programs to address individual learner needs and improve overall literacy outcomes.

CONCLUSION

The findings revealed consistently that the learners with visual impairment have a high proficiency in pre-Braille skills, with an overall mean of 5.45, signifying a very high level. Concept development showed strengths in spatial understanding but highlighted a need for additional support in shape recognition and time concepts. Similarly, motor skills and auditory processing demonstrated strong results, with some variability indicating areas for tailored intervention. Tactual discrimination also presented very high proficiency levels but showed room for growth in distinguishing intricate textures and patterns. Braille's literacy assessment highlighted moderate proficiency in numeracy, with arithmetic calculations and Nemeth Code application identified as areas requiring improvement. The results of Spearman's correlation indicated a moderate positive relationship ($\rho = 0.516$, $p = 0.002$) between pre-Braille skills and Braille literacy, affirming the foundational role of pre-Braille competencies in literacy development. The null hypothesis was rejected, confirming the significant association between the variables. Therefore, learners with visual impairments generally possess strong foundational pre-Braille skills, especially in auditory processing and tactual discrimination. However, there is variability in motor skills, indicating a need for further refinement in fine motor coordination and hand strength. Although learners demonstrated high proficiency in Braille reading and writing, numeracy remains challenging. Difficulties in arithmetic operations and applying the Nemeth Code suggest gaps in teaching strategies. The significant positive correlation between pre-Braille skills and Braille literacy validates the importance of structured, multi-sensory approaches to skill development. The results confirm that pre-Braille competencies are critical for literacy success in academic and real-life contexts. Based on the results of the study, educators may consider focusing on targeted learning activities that address specific gaps in pre-Braille skills, particularly in shape recognition and time concepts. Explore enhancing numeracy instruction using tactile and multi-sensory approaches, incorporating tools like the Nemeth Code. School administrators may facilitate opportunities for teacher training programs to equip SPED educators with the necessary skills to deliver effective pre-Braille and Braille literacy instruction. Encourage resource allocation for learning materials and specialized training modules. Policymakers may promote collaboration among educational stakeholders to support pre-Braille skill development initiatives. Advocate for guidelines that prioritize inclusive education and address the specific needs of learners with visual impairments. Future researchers may explore further studies on the long-term impact of pre-Braille skill development on Braille literacy proficiency. Investigate additional variables, such as socio-emotional factors and environmental influences that may affect literacy outcomes. By addressing these recommendations, stakeholders have the opportunity to enhance the educational experiences of learners with visual impairments, fostering their academic success and independence.

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