

Applications of Dermatoglyphics in Early Childhood Education: A Review

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Abstract. This study investigated the applications of dermatoglyphics in Nigerian early childhood education through a mixed-methods approach. Research examined the correlations between fingerprint patterns and learning abilities in 720 children (ages 3-8), assessed educator awareness through surveys of 840 professionals, analysed existing implementations, and identified challenges associated with their implementation. Findings revealed significant correlations between specific dermatoglyphic features and learning domains: whorls and high ridge counts were associated with mathematical and visual-spatial abilities, while loops correlated with verbal-linguistic strengths. Most educators (76.2%) expressed interest, although they had limited awareness (23.7%). Current applications primarily exist in elite private institutions, raising concerns about equity. Implementation challenges include resource limitations, knowledge gaps, cultural factors, and ethical considerations regarding deterministic interpretation. The research supports dermatoglyphics as a potentially valuable complementary assessment approach when implemented within culturally appropriate, ethically sound frameworks. Recommendations include policy development, phased implementation, teacher training initiatives, and further research on longitudinal validity and culturally appropriate applications. The study contributes Nigeria-specific correlational data, cultural contextualisation frameworks, and practical implementation guidance for educational stakeholders.

Keywords: Dermatoglyphics; Early childhood education; Learning assessment; Nigeria; Cognitive correlations; Educational innovation; Personalised learning; Fingerprint patterns.

INTRODUCTION

Dermatoglyphics, the scientific study of fingerprint, palm, and sole patterns, has emerged as a promising interdisciplinary field with potential applications beyond traditional forensic identification. These unique ridge patterns form during the critical first trimester of fetal development, specifically between the 13th and 19th weeks of gestation, and remain unchanged throughout an individual's lifetime. The fundamental biological connection between dermatoglyphic patterns and neurological development offers a compelling avenue for exploring correlations with cognitive abilities, as both systems develop simultaneously from the same embryonic tissue.

In the context of Nigerian early childhood education, traditional assessment methodologies have long struggled to provide comprehensive, individualised insights into children's learning potential. Existing approaches predominantly rely on standardised tests and observation-based evaluations, frequently failing to capture the nuanced neurological and genetic factors that significantly influence learning aptitudes. Recent research indicates that approximately 37% of Nigerian children experience undiagnosed learning difficulties during their early formative years, with identification typically occurring only after persistent academic underperformance.

The current educational landscape in Nigeria is characterised by significant challenges, including rapidly increasing student-teacher ratios—averaging 45:1 according to the Nigerian Educational Research and Development Council—and limited resources that constrain personalised learning approaches. These systemic constraints create an urgent need for efficient, scientifically grounded methods of identifying learning predispositions early in a child's educational journey.

Emerging research suggests that dermatoglyphic patterns may offer valuable insights into individual cognitive profiles. The shared embryological origins of neurological structures and epidermal ridge patterns provide a biological foundation for exploring potential correlations between fingerprint characteristics and learning abilities. Specific genetic markers influencing both dermatoglyphic formation and neurological development have been identified, including genes such as NOTCH1, PAX6, and BMP4, which demonstrate interconnected developmental processes.

Despite the promising potential, the application of dermatoglyphics in educational contexts remains significantly underdeveloped, particularly within Nigerian populations. The existing literature reveals substantial gaps in research, with only a handful of studies examining dermatoglyphic patterns and educational attributes. These limitations are particularly pronounced in early childhood education, where most existing research focuses on school-age children rather than younger learners.

The present study addresses these critical research gaps by conducting a comprehensive investigation into the applications of dermatoglyphics in Nigerian early childhood education. By employing a mixed-methods approach, the research aims to systematically examine the scientific validity of dermatoglyphic analysis as a tool for understanding learning predispositions. The study seeks to bridge existing knowledge gaps by providing population-specific insights, developing culturally appropriate implementation frameworks, and exploring the potential of dermatoglyphics as a complementary assessment approach.

The significance of this research extends beyond the realm of academic inquiry. By potentially offering a more nuanced understanding of individual learning profiles, this study could contribute to more personalised, equitable educational

practices. The research holds particular importance in the Nigerian context, where resource constraints and diverse learning needs necessitate innovative, cost-effective assessment approaches that support the early identification of learning potential and challenges.

Through a rigorous examination of dermatoglyphic patterns, correlations with cognitive abilities, and practical implementation considerations, this study aims to provide educational stakeholders with evidence-based insights that could transform early childhood assessment practices. The research represents a critical step toward developing more responsive, individualised educational approaches that recognise and nurture the unique learning potential of every child.

METHODOLOGY

Research Design. This study employed a mixed-methods research design, integrating quantitative and qualitative approaches to examine the applications of dermatoglyphics in Nigerian early childhood education. The sequential explanatory design began with quantitative data collection, followed by qualitative inquiry to contextualise findings.

For the quantitative component, a correlational cross-sectional design was used to examine the relationships between dermatoglyphic patterns and learning attributes among Nigerian children. The survey research method assessed Nigerian educators' knowledge and perspectives regarding dermatoglyphic applications.

Case study methodology formed the qualitative component, examining existing applications in selected Nigerian early childhood settings. Focus group discussions with stakeholders and content analysis of policy documents completed the methodological framework.

This integrated design addressed individual methodological limitations, with quantitative methods providing measurable findings while qualitative approaches captured contextual nuances. The research employed both deductive and inductive reasoning processes, with methodological triangulation enhancing the research's rigour.

Population and Sampling Technique. The research population encompassed multiple stakeholder groups, including Nigerian children aged 3-8

years, early childhood educators, administrators, parents, and policy representatives.

For the correlational component, 720 Nigerian children aged 3-8 years attending formal early childhood programs were selected using a multi-stage sampling approach. The process began with the stratified random sampling of facilities across Nigeria's six geopolitical zones, followed by the systematic selection of classrooms and the purposive sampling of children. This sample size was calculated using Yamane's formula, with a 95% confidence level and a 3.6% margin of error.

For the educator survey, 840 participants were identified through stratified random sampling across facility types (public, private, faith-based, community), geographical locations (urban, suburban, rural), and professional roles. The sample size was determined using the Cochran formula with a finite population correction.

Qualitative case studies employed purposive sampling to identify eight facilities implementing dermatoglyphic approaches. Selection criteria included geographical distribution, varied facility types, different implementation durations, and diverse application models.

Focus group participants were selected through maximum variation sampling, with twelve sessions (each with 6-8 participants) comprising separate groups for educators, administrators, parents, and policy representatives across different regions.

The inclusion criteria for child participants specified an age range, current enrollment, parental consent, and the absence of significant developmental disabilities. Educator participants were required to have at least one year of professional experience. Case study sites required a minimum of six months' implementation of dermatoglyphic approaches.

Research Instruments. Multiple research instruments collected comprehensive data addressing different aspects of dermatoglyphic applications in Nigerian early childhood education.

For dermatoglyphic data collection, the CY-100 digital scanner, equipped with analysis software, captured detailed fingerprint images. The standardised Dermatoglyphic Assessment Protocol guided the collection process, establishing uniform procedures for hand cleaning, digit positioning, and scan capture.

A cognitive assessment was employed using the Nigerian Early Learning Assessment Tool (NELAT), which provides a multidimensional evaluation of learning attributes. Developed by Ibrahim and Maxwell (2022), this instrument specifically addressed Nigerian cultural contexts, with normative data established across diverse Nigerian populations. The assessment comprised eight subtests that measured verbal ability, numerical reasoning, visual-spatial processing, memory, attention, motor coordination, social cognition, and creative thinking.

The Educator Observational Rating Scale captured teacher observations of learning behaviours. Babatunde and Williams (2020) designed this instrument specifically for Nigerian early childhood settings, focusing on observable behaviours rather than inferred abilities. The scale included 42 items across six domains with demonstrated inter-rater reliability coefficients ranging from 0.78 to 0.85.

The Dermatoglyphics in Education Perception Questionnaire assessed educator perspectives. Developed by Johnson, Nwankwo, and Oladele (2024), this 38-item questionnaire assessed demographic background, knowledge of dermatoglyphics, attitudes toward biological approaches to assessment, and perceptions regarding the feasibility of implementing these approaches. Construct validity received support through confirmatory factor analysis (CFI = 0.92, RMSEA = 0.056), with reliability coefficients ranging from 0.83 to 0.88 across different sections.

Qualitative data collection utilised the Educational Innovation Implementation Interview Protocol for case studies and the Dermatoglyphics Application Discussion Guide for focus groups. Document analysis employed the Educational Policy Analysis Framework to examine policy and curriculum documents across five dimensions.

Each instrument underwent adaptation for the Nigerian context through pilot testing with target populations. Forward and backwards translation procedures ensured linguistic equivalence between English and major Nigerian languages. Cultural validation extended beyond translation to address conceptual and contextual appropriateness.

Data Collection Procedure. Data collection followed a systematic, sequential approach across multiple research sites. Preliminary preparation

secured necessary approvals from the Nigerian Educational Research and Development Council, state education ministries, and institutional leadership. Twenty research assistants underwent intensive five-day training covering all protocols.

The sequence began with surveying 840 educators across 142 facilities. Paper questionnaires were primarily used, with electronic versions available where technological infrastructure permitted.

For dermatoglyphic data collection, scanning stations were established at each participating facility. The process followed standardised protocols, with research assistants explaining procedures using age-appropriate language. Cognitive assessment sessions lasted no more than 45 minutes and were conducted in the child's preferred language (English or a relevant Nigerian language) in quiet, familiar spaces.

Teacher observations using the Educator Observational Rating Scale required preliminary training for participating educators. Following training, teachers completed observations over two weeks, documenting children's typical behaviours across multiple contexts.

Case study data collection employed a comprehensive approach examining existing dermatoglyphic applications. Research assistants conducted structured observations over three consecutive days at each site, documenting physical resources, assessment procedures, information communication approaches, and educational applications. Semi-structured interviews captured perspectives from multiple stakeholders.

Focus group discussions took place after the quantitative data collection phases. Sessions followed structured discussion topics while allowing exploration of emergent themes. Audio recording with participant permission captured discussions for subsequent transcription and analysis.

Data management procedures ensured security throughout the collection process. Each participant received a unique identification code, with physical forms stored in locked containers and digital data encrypted and backed up to secured servers.

Quality assurance measures included field supervision, random verification checks, and regular team debriefing sessions. The entire data collection process spanned four months, with geo-

graphic sequencing to accommodate efficient team deployment across Nigeria's six geopolitical zones.

Ethical Considerations. Institutional ethical approval provided formal oversight for the research, with full review and approval from the Research Ethics Committee at the University of Nigeria, Nsukka, and additional approvals from state-level educational research committees.

Informed consent procedures received particular attention given the involvement of young children and the collection of biometric data. Parents received comprehensive information sheets explaining the research purpose, procedures, potential benefits and risks, data handling protocols, and withdrawal rights. Face-to-face information sessions supplemented written materials, with versions available in English and the major Nigerian languages.

Child assent complemented parental consent, recognising children's agency. Age-appropriate explanations used child-friendly language and visual aids. Research assistants received training in recognising reluctance or discomfort, with clear protocols for respecting children's decisions regardless of parental consent.

Special considerations apply to dermatoglyphic data due to its biometric nature. The protocol explicitly limited use to the current study, with prohibitions against inclusion in any biometric database or identification system. Enhanced encryption and access limitations protected fingerprint images, with parents receiving explicit information about these specialised protections.

Cultural sensitivity guided participant interactions. Research protocols incorporated appropriate cultural practices regarding interactions with children, respected norms around physical contact during data collection, and acknowledged cultural authority structures within educational settings. Research assistants from diverse Nigerian cultural backgrounds provided guidance on regionally specific considerations.

Reciprocity with participants formed an integral part of the ethical component. Participating schools received educational resources selected in consultation with school leadership. Summary findings, presented in accessible language, were made available to all participating schools and families. Professional development workshops on child development and assessment practices provided immediate benefit to participating educators.

RESULTS AND ANALYSIS

Demographic Information of Respondents. The child participants totalled 720, with a balanced distribution across age categories: 3-4 years (31.8%, n = 229), 5-6 years (36.4%, n = 262), and 7-8 years (31.8%, n = 229). The gender distribution achieved near parity, with 49.7% female (n = 358) and 50.3% male (n = 362). Geographical representation spanned all six geopolitical zones of Nigeria: North-Central (15.8%, n = 114), North-East (12.5%, n = 90), North-West (21.4%, n = 154), South-East (14.2%, n = 102), South-South (13.9%, n = 100), and South-West (22.2%, n = 160).

Institutional diversity was reflected in the sample, with children drawn from public facilities (42.8%, n = 308), private institutions (38.3%, n = 276), faith-based programs (10.6%, n = 76), and community-based initiatives (8.3%, n = 60).

Educator participants totalled 840, with female educators comprising 73.6% (n=618) and male educators making up 26.4% (n=222). Professional experience ranged from 1-5 years (41.2%, n=346), 6-10 years (32.7%, n=275), 11-15 years (16.4%, n=138), to over 15 years (9.7%, n=81). Educational qualifications included a National Certificate in Education (38.6%, n = 324), Bachelor's degrees (42.5%, n = 357), Master's degrees (8.1%, n = 68), and other qualifications (10.8%, n = 91).

Analysis of Dermatoglyphic Patterns. Pattern type frequencies showed loops as the predominant

type (62.4%), with ulnar loops (58.7%) being substantially more common than radial loops (3.7%). Whorls constituted 28.7% of patterns, distributed across plain whorls (15.3%), central pocket whorls (7.4%), double loop whorls (4.6%), and accidental whorls (1.4%). Arches represented 8.9% of patterns.

Pattern distribution varied across fingers. The index finger exhibited the highest pattern diversity, with loops (52.6%), whorls (34.8%), and arches (12.6%) being the most prevalent patterns. The little finger showed the lowest diversity, with loops strongly predominating (78.4%).

Quantitative parameters included total ridge count (TRC) with a mean value of 134.7 (SD=24.6), absolute finger ridge count (AFRC) averaging 172.3 (SD=32.4), and pattern intensity index (PII) with a mean value of 12.4 (SD=1.8).

Gender differences appeared subtle but statistically significant. Female participants demonstrated higher frequencies of arch patterns (10.4% vs. 7.4%, $p < 0.05$) and lower frequencies of whorl patterns (26.3% vs. 31.1%, $p < 0.05$) compared to males. Females averaged lower total ridge counts (mean difference of 8.2 ridges, $p < 0.01$).

Regional variations revealed that Northern zones showed higher frequencies of arch patterns (average 10.3%) compared to Southern zones (average 7.7%, $p < 0.05$). The South-Western zone demonstrated the highest frequency of whorl patterns (32.4%).

Table 1 – Frequency Distribution of Dermatoglyphic Patterns Across Different Fingers in Nigerian Early Childhood Sample (N=720)

Pattern Type	Thumb	Index Finger	Middle Finger	Ring Finger	Little Finger	Overall
Arch (Plain)	41 / 5.7%	76 / 10.6%	65 / 9.0%	28 / 3.9%	32 / 4.4%	242 / 6.7%
Arch (Tented)	12 / 1.7%	14 / 1.9%	7 / 1.0%	9 / 1.3%	4 / 0.6%	46 / 1.3%
Loop (Ulnar)	409 / 56.8%	354 / 49.2%	486 / 67.5%	481 / 66.8%	526 / 73.1%	2256 / 62.7%
Loop (Radial)	14 / 1.9%	25 / 3.5%	18 / 2.5%	11 / 1.5%	8 / 1.1%	76 / 2.1%
Whorl (Plain)	138 / 19.2%	132 / 18.3%	87 / 12.1%	127 / 17.6%	97 / 13.5%	581 / 16.1%
Whorl (Central)	61 / 8.5%	68 / 9.4%	39 / 5.4%	41 / 5.7%	29 / 4.0%	238 / 6.6%
Whorl (Double)	36 / 5.0%	42 / 5.8%	15 / 2.1%	19 / 2.6%	18 / 2.5%	130 / 3.6%
Whorl (Accid.)	9 / 1.3%	9 / 1.3%	3 / 0.4%	4 / 0.6%	6 / 0.8%	31 / 0.9%
Total	720 / 100%	720 / 100%	720 / 100%	720 / 100%	720 / 100%	3600 / 100%

Correlation Between Dermatoglyphic Patterns and Learning Abilities. Mathematical reasoning abilities demonstrated strong correlations with specific parameters. Total ridge count showed a moderate positive correlation with mathematical

reasoning scores ($r=0.43$, $p < 0.001$). Double loop whorls on the index and ring fingers correlated strongly with mathematical performance ($r=0.39$, $p < 0.001$).

Verbal and linguistic abilities showed different correlation patterns. Ulnar loop patterns demonstrated positive correlations with verbal fluency ($r=0.32$, $p<0.01$) and vocabulary assessment ($r=0.35$, $p<0.01$). The atd angle showed a significant negative correlation with phonological processing ($r=-0.28$, $p<0.01$).

Visual-spatial processing showed strong correlations with the pattern intensity index ($r = 0.46$, $p < 0.001$). Whorl patterns on the thumb and ring finger demonstrated strong correlations with spatial reasoning ($r=0.42$, $p<0.001$) and visual pattern recognition ($r=0.38$, $p<0.001$).

Memory function assessments correlated with asymmetry indices. Greater bilateral asymmetry correlated with working memory performance

($r=0.34$, $p<0.01$). Central pocket whorls on the index finger correlated positively with visual memory ($r=0.37$, $p<0.001$).

Fine motor coordination demonstrated strong correlations with ridge count on the thumb and index finger ($r=0.41$, $p<0.001$ for precision; $r=0.38$, $p<0.001$ for graphomotor control).

Multiple regression analysis revealed that dermatoglyphic variables collectively accounted for 18-31% of the variance in performance across different cognitive domains after controlling for demographic factors. The strongest predictive relationships appeared for mathematical reasoning (31% variance explained) and visual-spatial processing (29% variance explained).

Table 2 – Correlation Coefficients Between Selected Dermatoglyphic Parameters and Learning Domains (N=720)

Dermatoglyphic Parameter	Mathematical Reasoning	Verbal-Linguistic	Visual-Spatial	Memory Function	Fine Motor	Attention
Total Ridge Count	0.43**	0.26*	0.39**	0.32**	0.41**	0.36**
Pattern Intensity Index	0.37**	0.22*	0.46**	0.29**	0.33**	0.31**
Absolute Finger Ridge Count	0.40**	0.28**	0.38**	0.34**	0.38**	0.34**
Asymmetry Index	0.22*	0.18	0.25*	0.34**	0.20*	0.29**
Whorl Pattern Frequency	0.39**	0.15	0.42**	0.27**	0.35**	0.30**
Loop Pattern Frequency	-0.21*	0.35**	-0.26**	-0.13	-0.22*	-0.17
Arch Pattern Frequency	-0.21*	-0.13	-0.20*	-0.16	-0.19*	-0.18
ATD Angle	-0.19*	-0.28**	-0.22*	-0.15	-0.23*	-0.18

Notes: * $p<0.05$, ** $p<0.01$

Analysis of Nigerian Educators' Awareness and Current Applications. Among 840 educators surveyed, only 23.7% ($n = 199$) reported any prior familiarity with dermatoglyphics. Awareness varied by region, with higher familiarity in South Western Nigeria (31.5%) compared to North-eastern areas (14.2%, $p < 0.01$). Urban educators demonstrated substantially greater awareness (29.4%) compared to their rural counterparts (16.8%, $p < 0.001$).

Only 8.3% of respondents ($n = 70$) could provide an accurate definition of dermatoglyphics. Common misconceptions included confusion with palm reading (17.3%) and graphology (12.5%). Knowledge regarding biological foundations appeared particularly limited, with just 11.2% of educators correctly identifying the embryonic period when fingerprints form.

After receiving standardised information, 72.4% of educators expressed positive interest in learning more, 63.8% indicated willingness to consider implementation if provided with training, and 68.5% believed dermatoglyphics might provide valuable complementary information to existing assessment approaches.

Current applications are in use within eight private educational institutions across Nigeria's urban centres, primarily in Lagos, Abuja, and Port Harcourt. The most comprehensive model incorporates systematic dermatoglyphic analysis for all children at entry, with results informing classroom placement, teaching strategy selection, and parent guidance. Less formalised applications appear in approximately fifteen additional schools, where dermatoglyphic analysis occurs on an optional basis, typically at the request of parents.

Application focus varies, with some institutions emphasising early identification of learning challenges, others focusing on talent identification, and a smaller number employing dermatoglyphic insights for behaviour management approaches.

Within the public education sector, dermatoglyphic applications remain virtually non-existent. Several factors contribute to this absence, including resource constraints, limited awareness among public education administrators, and policy frameworks prioritising standardised assessment approaches.

Testing of Hypotheses

Hypothesis 1 proposed a statistically significant correlation between specific dermatoglyphic patterns and learning aptitudes. Correlation analysis revealed significant relationships across multiple parameters and domains. Total ridge count demonstrated significant correlation with mathematical reasoning ($r=0.43$, $p<0.001$). Whorl patterns showed a significant correlation with visual-spatial abilities ($r = 0.42$, $p < 0.001$). Loop patterns correlated positively with verbal-linguistic abilities ($r = 0.35$, $p < 0.01$). Multiple regression analysis confirmed that dermatoglyphic parameters explained a significant amount of variance beyond demographic factors (18-31% additional variance). Hypothesis 1 was accepted.

Hypothesis 2 proposed that educators have limited awareness despite positive attitudes toward innovative assessment methods. Survey results confirmed very limited awareness (23.7%) and knowledge (mean score 2.9/10), with just 8.3% able to provide accurate definitions. However, after receiving information, 72.4% expressed positive interest, and 76.2% indicated interest in professional development. Hypothesis 2 was accepted.

Hypothesis 3 proposed that integrated dermatoglyphic analysis would improve the identification of learning predispositions. Traditional assessment alone demonstrated 62.4% alignment with subsequent teacher identification after six months. A combined assessment incorporating dermatoglyphic indicators demonstrated significantly improved predictive accuracy (78.2% alignment, $p < 0.001$). This improvement appeared particularly pronounced for children with less typical learning profiles. Hypothesis 3 was accepted.

Hypothesis 4 proposed that cultural factors would significantly influence interpretation and application. Qualitative analysis identified multiple Nigeria-specific factors, including distinctive interpretations related to cultural beliefs about inherent characteristics (identified in 68% of focus groups) and religious perspectives that affect acceptance (varying significantly by region, $p < 0.01$). Hypothesis 4 was accepted.

Hypothesis 5 proposed that structured implementation could enhance personalisation without substantial resources. Resource assessment revealed variation in implementation costs, ranging from high-resource models (averaging an initial investment of ₦1,350,000 plus ₦420,000 annual maintenance) to streamlined approaches (averaging an initial investment of ₦580,000 plus ₦180,000 annual maintenance). Low-resource implementation models demonstrated significant improvements in personalised learning indicators despite modest resource investment. Hypothesis 5 received qualified acceptance with conditions regarding the implementation approach.

The research provides unprecedented insights into the potential applications of dermatoglyphics in Nigerian early childhood education, revealing complex and nuanced relationships between fingerprint patterns and cognitive abilities. The study's findings demonstrate statistically significant correlations between specific dermatoglyphic characteristics and multiple learning domains, with the most pronounced associations observed in mathematical reasoning, verbal-linguistic abilities, and visual-spatial processing.

Key Findings and Cognitive Correlations. The analysis revealed that dermatoglyphic variables can explain 18-31% of the variance in cognitive performance after controlling for demographic factors. Mathematical reasoning showed the strongest correlations, with total ridge count and double loop whorls exhibiting particularly significant relationships. Notably, ulnar loop patterns demonstrated meaningful connections with verbal abilities, while pattern intensity index strongly correlated with visual-spatial processing.

These findings contribute critical empirical evidence to the emerging field of educational dermatoglyphics, particularly within the Nigerian context. The moderate strength of correlations suggests that dermatoglyphic patterns should be understood as one of multiple factors influencing

learning attributes, rather than deterministic predictors of cognitive potential.

Educator Awareness and Implementation Challenges. The study uncovered a significant gap between the potential value of dermatoglyphic analysis and current implementation capacity. Only 23.7% of educators reported prior familiarity with dermatoglyphics, with merely 8.3% able to provide accurate definitions. However, the research revealed an encouraging openness to innovative assessment approaches, with 72.4% of educators expressing interest after receiving information about dermatoglyphic applications.

Cultural and Contextual Significance. Cultural contextualisation emerged as a critical factor in meaningful implementation. The research identified diverse Nigerian perspectives regarding inherent characteristics, religious views, and educational values that significantly influence both acceptance and application of dermatoglyphic insights. This finding highlights the importance of developing culturally sensitive frameworks that are tailored to local educational and social contexts.

Practical Implications. The study suggests dermatoglyphic analysis holds most promise as a complementary assessment approach rather than a standalone method. When integrated with traditional techniques, these insights significantly improved early identification of learning predispositions, particularly for children with less typical learning profiles that conventional assessment methods might overlook.

Unique Contributions. This research makes several groundbreaking contributions to the field. It provides the first comprehensive mapping of dermatoglyphic patterns and their potential cognitive correlations in a Nigerian population. The study presents a nuanced framework for understanding how biological indicators can inform educational assessment, while also addressing critical implementation challenges.

Methodological and Practical Limitations. The research acknowledges significant limitations, including resource constraints, limited infrastructure, and underdeveloped policy frameworks. These challenges create potential equity concerns, particularly in public education and rural settings. However, the identification of variable-cost implementation models suggests feasible pathways for future applications.

Future Research Directions. Future research should focus on longitudinal studies to establish predictive validity, develop resource-appropriate implementation models, and investigate more sophisticated approaches for integrating dermatoglyphic insights with existing assessment methodologies. The study calls for continued exploration of biologically informed educational approaches that can support personalised learning.

Broader Significance. Beyond its immediate educational implications, the research contributes to a broader understanding of the complex interactions between biological indicators and learning potential. By providing a culturally contextualised approach to understanding individual cognitive differences, the study offers a valuable framework for more responsive and individualised educational practices.

The findings challenge traditional, one-size-fits-all educational assessment approaches, advocating for more nuanced, scientifically grounded methods of understanding children's learning potential. While not presenting dermatoglyphics as a definitive solution, the research illuminates a promising avenue for more personalised educational approaches that recognise the unique cognitive profile of each child.

CONCLUSIONS

Dermatoglyphic analysis emerges as a promising complementary approach to early childhood educational assessment in Nigeria, offering unprecedented insights into the intricate relationships between biological markers and cognitive potential. The research demonstrates statistically significant correlations between fingerprint patterns and learning abilities, revealing a complex biological foundation for understanding individual learning predispositions.

The study's most critical finding is the potential for dermatoglyphic insights to enhance early identification of learning characteristics, particularly for children with less typical cognitive profiles. Dermatoglyphic variables explained 18-31% of the variance in cognitive performance, providing a nuanced biological perspective that complements traditional assessment methods. Mathematical reasoning, verbal-linguistic abilities, and visual-spatial processing showed the most pronounced correlations, highlighting the potential of this innovative approach.

Despite the promising findings, the research underscores the importance of a non-deterministic interpretation. Dermatoglyphic patterns should be viewed as indicators of potential learning predispositions rather than fixed predictors of cognitive abilities. The biological insights provide a supplementary tool for understanding individual learning profiles, rather than a definitive assessment of a child's capabilities.

The significant gap between potential and current implementation presents both a challenge and an opportunity. Limited educator awareness, resource constraints, and underdeveloped policy frameworks currently constrain widespread adoption. However, the study reveals an encouraging openness among educators, with 72.4% expressing interest in exploring innovative assessment approaches after receiving information about dermatoglyphic applications.

Cultural contextualisation emerged as a critical factor in meaningful implementation. The research highlighted the importance of developing frameworks that align with Nigerian cultural perspectives, educational values, and local contextual considerations. This approach ensures that dermatoglyphic insights are applied sensitively and meaningfully within specific educational environments.

The study's recommendations provide a roadmap for responsible implementation. These include developing comprehensive policy guidelines, adopting phased implementation approaches, investing in teacher training initiatives,

and conducting further research to establish long-term predictive validity. The goal is to create an approach that enhances educational personalisation without exacerbating existing educational disparities.

From a broader perspective, this research contributes to the emerging field of biologically informed educational practices. It challenges traditional, uniform assessment approaches by offering a more nuanced understanding of individual learning potential. The findings invite educators, policymakers, and researchers to consider more holistic, scientifically grounded methods of understanding and supporting children's cognitive development.

The unique contribution of this study lies in its comprehensive, culturally contextualised approach to exploring dermatoglyphic applications in Nigerian early childhood education. By providing empirical evidence, identifying implementation challenges, and developing a framework for responsible application, the research opens new possibilities for personalised educational approaches that recognise and nurture the unique potential of every child.

Ultimately, the study represents a critical step toward more responsive, individualised educational practices. It demonstrates the potential of interdisciplinary approaches that bridge biological understanding with educational innovation, offering hope for more effective, equitable learning experiences for Nigerian children.

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