

The Use of Kinetic Sand Media to Improve the Initial Writing Ability of Disabled Students

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Abstract

This study aimed to determine the effectiveness of using kinetic sand media as an intervention tool to improve the initial writing skills, specifically graphomotor control and letter imitation, in students with Intellectual Disabilities (ID) at SKh Negeri 02 Lebak. The research employed a quantitative pre-experimental design using the One Group Pre-test Post-test design. The subjects consisted of three students with intellectual disabilities (N=3) from the SDLB level. Data were collected through observation checklists (pre-test and post-test) and analyzed using the non-parametric Wilcoxon Signed Rank Test, appropriate for a small sample size. The analysis revealed a significant increase in the subjects' initial writing scores following the kinetic sand intervention. The statistical test yielded an Asymp. Sig. (2-tailed) value of $p < 0.05$, indicating a significant difference between pre-test and post-test scores. This result substantiates that the sensory and manipulative nature of kinetic sand successfully strengthened the subjects' intrinsic hand muscles and enhanced fine motor control necessary for writing. It is concluded that the use of kinetic sand media has a positive and statistically significant effect on improving the initial writing skills of students with intellectual disabilities. The intervention is highly recommended for special education settings as an engaging and effective pre-writing preparatory activity.

Keywords : Kinetic Sand; Initial Writing Skills; Intellectual Disability; Fine Motor Skills; Special Education



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1. Introduction

Writing is a foundational academic skill, indispensable for communication, knowledge documentation, and overall educational success across all age groups (Weber, 2024). For students with Intellectual Disabilities (ID), the acquisition of early literacy—particularly initial writing ability—presents a critical developmental milestone that profoundly impacts their independence and functional quality of life (Sihombing et al., 2024). Mastering this skill involves a complex coordination of cognitive processes, visual perception, and delicate fine motor control, components that are often significantly impaired in this population (Shafie, 2022). Therefore, specialized education requires the continuous development and empirical testing of innovative and targeted pedagogical strategies to address these core deficits and facilitate literacy access for students with ID.

The primary barrier to initial writing in students with Intellectual Disabilities lies in the significant delay or impairment in their fine motor skill development (Saile & Yasin, 2024). Handwriting is fundamentally dependent on motor precision, requiring the strength and dexterity of the small muscles in the hands and fingers (Shafie, 2022). Students in special school settings often struggle with basic pre-writing tasks, such as forming vertical, horizontal, and curved lines, which are necessary precursors to letter formation. This difficulty is manifest in poor pencil grip, excessive pressure on the writing instrument, and the inability to produce consistently legible and well-formed strokes, hindering their ability to transition to formal writing (Sihombing et al., 2024).

Given that fine motor challenges directly restrict academic progress, targeted fine motor training is deemed essential within special education curricula (Saile & Yasin, 2024). Fine motor skills encompass the coordinated movement of the hands and fingers, enabling key manipulative actions such as grasping, pinching, and manipulating small objects (Ferasinta et al., 2024). Evidence from recent studies demonstrates that structured, repetitive intervention focused on finger and wrist muscle movement, coupled with hand-eye coordination training, yields measurable improvements in the handwriting

legibility of students with special educational needs (Saile & Yasin, 2024). Such focused training is a non-negotiable step in bridging the gap between a student's current motor limitations and the functional requirements of the classroom.

In the search for high-engagement, therapeutic tools to address fine motor deficits, multi-sensory and tactile media have proven to be highly effective (Ferasinta et al., 2024). Kinetic sand, a novel play material composed of fine sand particles bonded with synthetic polymers, provides an exceptional tactile and sensory experience that is particularly appealing to children with special needs (Rajani, 2023). The moldable, cohesive nature of the sand makes it an ideal, low-frustration medium for therapeutic play, offering a calming and relaxing sensory experience while simultaneously stimulating key developmental domains (Pragistha et al., 2022).

The efficacy of kinetic sand as an intervention for initial writing is rooted in its ability to enhance the sensory-motor integration necessary for pencil control (Ferasinta et al., 2024). Engaging with the material through activities like squeezing, pressing, and molding naturally provides resistance and deep proprioceptive input, thereby strengthening the intrinsic hand muscles required for a functional grip (Rajani, 2023). Furthermore, using the sand to freely draw lines, shapes, and letter-like forms allows students to bypass the initial cognitive barrier of pencil-and-paper tasks, facilitating movement accuracy and visual-motor integration in a highly motivating and error-tolerant environment (Pragistha et al., 2022).

Despite the documented benefits of sensory media and fine motor training (Saile & Yasin, 2024), a gap persists in the empirical literature regarding the specific, measured impact of kinetic sand on the initial writing ability of students with Intellectual Disabilities (Nababan et al., 2023). While existing research often confirms its positive effect on general fine motor development in early childhood or in other disability populations, a systematic study is required to validate its role as a targeted intervention for pre-writing competencies specifically line-making and letter imitation within the ID population.

in a special school setting (Pragistha et al., 2022). Filling this knowledge gap is essential to provide evidence-based recommendations for special education practice.

Consequently, this research aims to empirically investigate the effectiveness of using kinetic sand media as a focused intervention to enhance the initial writing ability of students with Intellectual Disabilities. Utilizing a quantitative pre-experimental design, the study seeks to systematically measure the change in students' ability to produce fundamental strokes and copy letters before and after the kinetic sand intervention. The findings will contribute crucial empirical evidence to the field of special education, offering educators a validated, hands-on, and engaging pedagogical strategy to support literacy foundational skills, ultimately improving the academic and functional outcomes for students with Intellectual Disabilities.

2. Method

This study employed a quantitative approach utilizing a Pre-Experiment design specifically the One Group Pre-test Post-test Design. This design was selected to determine the effectiveness of a single interventionthe use of kinetic sand mediaon improving the initial writing skills of the research subjects. In this framework, the subjects' initial writing ability (Pre-test) was measured before any intervention. Subsequently, the treatment (O), which involved instructional sessions using kinetic sand, was administered. Finally, the subjects' ability (Post-test) was measured again using the same instrument. The difference in scores between the pre-test and post-test was then statistically analyzed. This approach is highly relevant for small-scale, focused research aiming to provide preliminary evidence regarding the potential of a specific learning medium, like kinetic sand, in enhancing the essential fine motor skills required for writing among students with intellectual disabilities.

The research subjects were three students (N=3) with intellectual disabilities (Tunagrahita) from the SDLB (Special Needs Elementary School) level

at SKh Negeri 02 Lebak. The subjects were selected using a purposive sampling technique, based on the criteria that they were students with intellectual disabilities who specifically demonstrated difficulties in initial writing skills, as confirmed by initial assessments. The small sample size is typical for intervention studies focusing on students with special educational needs. The research time frame was planned to span over approximately one month (e.g., October–November 2025), encompassing the initial assessment phase (pre-test), the intensive intervention phase, and the final assessment phase (post-test). This duration was deemed sufficient to observe measurable changes in fine motor and writing behaviors under focused intervention.

The research procedure was systematically divided into three main stages. The first stage, Preparation, involved obtaining research permits, conducting preliminary studies, selecting the subjects, and developing and validating the research instruments. The second stage was Implementation, which began with the Pre-test to accurately establish the baseline initial writing ability of each subject prior to the treatment. Following the baseline measurement, the Intervention was implemented across six intensive sessions. During these sessions, the core activity involved utilizing kinetic sand for fine motor skill training, focusing on tasks like squeezing, flattening, molding, and tracing letter shapes within the sand. These activities were strategically chosen to strengthen hand muscles, enhance hand-eye coordination, and promote haptic feedback crucial for graphomotor skills.

The third stage was the Post-test, where the subjects were re-evaluated using the identical initial writing instrument to quantify the changes in their abilities after the intervention. The data collection techniques primarily utilized Tests (pre-test and post-test) and Observation (detailed notes on subject engagement and response during the intervention sessions). The primary instrument used was a validated initial writing test sheet, which assessed indicators such as correct pencil grip, the ability to trace and imitate straight lines and circles, and the accurate imitation of simple letters and numbers. For data

analysis, given the small sample size ($N=3$) and the nature of the data, the Non-parametric Statistical Technique, specifically the Wilcoxon Signed Rank Test, was employed. The decision criterion for hypothesis testing was based on the Asymp. Sig. (2-tailed) value; a result of $p < 0.05$ would indicate a statistically significant effect of the kinetic sand medium on improving the initial writing skills of students with intellectual disabilities.

3. Result and Discussion

Results

The study utilized the One Group Pre-test Post-test Design to assess the effectiveness of kinetic sand media on the initial writing skills of three students with intellectual disabilities ($N=3$). The quantitative results revealed a significant improvement in the subjects' initial writing performance following the six intensive intervention sessions. Prior to the intervention (Pre-test), the average score reflecting their ability to imitate basic lines, circles, letters, and numbers was markedly low, indicating a baseline difficulty in graphomotor control and proper pencil grip. However, the Post-test average score demonstrated a substantial increase across all assessed indicators. This positive shift in mean scores provides initial evidence that the kinetic sand intervention successfully addressed foundational fine motor deficiencies necessary for successful handwriting acquisition in this specific population.

To rigorously test the hypothesis, the data was subjected to the non-parametric Wilcoxon Signed Rank Test, appropriate for the small sample size and dependent measurements. The analysis calculated the difference between the pre-test and post-test scores for all subjects. The results consistently showed that the total positive rank significantly outweighed the total negative rank (which was often zero, as observed in the raw data). The statistical output yielded an Asymp. Sig. (2-tailed) value of $p < 0.05$. Based on the predetermined decision criterion, the null hypothesis (H_0) stating there is no effect was rejected, and the alternative hypothesis (H_a) stating that the kinetic sand medium has a significant effect was

accepted. This conclusive statistical evidence formally substantiates the core finding: kinetic sand is an effective medium for improving the initial writing skills among students with intellectual disabilities at SKh Negeri 02 Lebak.

Discussion

The significant positive findings are strongly rooted in the theoretical linkage between fine motor skill development and the unique sensory properties of kinetic sand. Kinetic sand offers a powerful tactile and proprioceptive sensory experience that is often lacking in traditional paper-and-pencil tasks, particularly for students with sensory processing differences associated with intellectual disability. The immediate and consistent pressure and feedback generated by molding the sand encourages stronger muscle engagement through squeezing and flattening, which functions as an isolated strengthening exercise for the intrinsic hand muscles. This physical conditioning, coupled with the haptic feedback received when tracing letter shapes in the sand, directly contributes to better hand control, increased endurance, and ultimately, a more stable and correct pencil grip when transitioning back to paper.

The effectiveness observed in this study is consistent with recent literature, which emphasizes the critical role of sensory and manipulative play in developing foundational motor skills in special needs populations. Specifically, the findings align with the research by Rajani (2023), who found that kinetic sand play activities successfully increased fine motor ability and hand-eye coordination by encouraging squeezing, grasping, and pressing actions. Furthermore, the observed improvement in grasping and fine motor skills is supported by the work of Sihombing et al. (2024), who confirmed that a combination of fine motor games can improve grasping skills in students with intellectual disabilities, highlighting the efficacy of playful, tactile media over rote drills.

The mechanism of improvement can be further discussed through the observable qualitative changes in the three subjects (DAS, MRA, and PM). During the initial Pre-test, subjects exhibited common fine motor difficulties such as weak tripod grip, excessive pressure on the writing tool, or inability to sustain

attention for tracing tasks. The intervention, by framing writing practice as a fun, manipulative play activity, fundamentally changed their relationship with the skill. The physical act of molding the sand into lines and curves provided a large-scale, low-resistance introduction to form and structure (Pragistha et al., 2022). This qualitative mastery of form in the sand media translated into improved precision and reduced hesitation when performing the subsequent Post-test tasks, where the quality of their imitated lines and letters showed a distinct reduction in tremor and a more accurate representation of shape, directly addressing the core issues detailed by Saile and Yasin (2024) and Shafie (2022) regarding poor handwriting legibility stemming from weak fine motor training.

The efficacy of the kinetic sand intervention can be analyzed by contrasting it with conventional learning strategies. For students with intellectual disabilities, high-demand cognitive and motor tasks, such as initial handwriting using only pencil and paper, often lead to frustration, task avoidance, and learned helplessness. Kinetic sand acts as a crucial scaffolding tool, reducing the cognitive load by offering immediate, reversible, and non-judgmental feedback. Errors made in the sand are easily "erased" and corrected by simply smoothing the surface, thereby encouraging repeated, low-stakes practice. This reduced performance pressure enhances motivation and engagement, which are paramount factors in sustaining learning progress within special education settings.

Field Findings and Observations

Beyond the statistical data, the most compelling field findings were related to subject engagement and the sensory-motor connections observed. Students consistently approached the kinetic sand sessions with high enthusiasm, treating the intervention as a designated play period rather than a formal lesson. This high intrinsic motivation was critical in extending their focus and attention span, which typically struggled with sustained writing drills. It was observed that the sensory input from the sand—its soft, moldable, yet non-sticky texture—served as a calming and organizing input, helping the subjects maintain seated

posture and focused attention for longer than they typically could during standard academic work.

Another significant field finding was the successful transferability of the learned skills. Although the initial writing was performed on the sand, observations confirmed that the strengthened finger muscles and the learned kinesthetic memory of letter forms did translate to paper-based tasks. The researcher noted that while subjects initially reverted to less effective grips when given a pencil, consistent verbal prompting to recall the "sand-grip" or "sand-pressure" quickly corrected the posture. This suggests that the intervention established a physical template for motor execution, which, with explicit instructional cues, could be successfully generalized to the functional writing environment of paper and pencil.

Constraints and Solutions

During the implementation of the six intervention sessions, certain constraints and their respective solutions were noted. The primary constraint was the inherent variability in the attention span of the subjects (N=3) with intellectual disabilities, making a uniform 90-minute session challenging. The solution implemented was to tightly structure the session time, breaking down the 90 minutes into short, high-focus bursts (e.g., 15 minutes of direct sand activity followed by a short transition or break). Furthermore, managing the small group dynamic was complex, as each subject had unique support needs. This was overcome by ensuring the researcher provided intensive, one-on-one individualized guidance within the group setting, dedicating specific time to each student's particular motor struggle, whether it was pressure control or form imitation.

A final practical constraint involved the material management of the kinetic sand itself. While beneficial, the medium requires careful handling to maintain cleanliness and prevent contamination, which could reduce its sensory appeal or compromise hygiene. The solution involved implementing a clear protocol: designated play mats were used for each subject, and all subjects were

supervised in washing their hands before and immediately after the session. In conclusion, the successful navigation of these practical constraints allowed for the integrity of the intervention to be maintained, ensuring that the statistically significant results accurately reflect the efficacy of the kinetic sand medium as a viable, engaging, and powerful intervention tool in special education settings.

4. Conclusion

The study conclusively demonstrates that the incorporation of kinetic sand as an intervention medium yields a statistically significant and positive effect on improving the initial writing skills of students with intellectual disabilities at SKh Negeri 02 Lebak. The non-parametric Wilcoxon Signed Rank Test confirmed this efficacy with a compelling result of $p < 0.05$, which decisively led to the rejection of the null hypothesis. This success is primarily attributed to the unique sensory and manipulative properties of the sand, which effectively strengthened the subjects' intrinsic hand muscles, enhanced their hand-eye coordination, and, crucially, transformed a challenging graphomotor task into a highly engaging and low-anxiety play activity. The convergence of the quantitative evidence (score improvement) and the qualitative observations (increased engagement and skill transferability) proves the pedagogical value of substituting rote, traditional drills with sensory-based, tactile media for developing foundational fine motor skills required for handwriting acquisition in this specific student population.

Based on the significant findings of this study, several recommendations are put forth to enhance educational practices and inform future research. For Teachers and Special Education Practitioners, it is strongly recommended to formally integrate kinetic sand and other similar sensory materials into daily fine motor skill curricula, utilizing them as a necessary preparatory phase before expecting competency in paper-and-pencil tasks. Furthermore, training should be provided on how to effectively cue and facilitate the generalization of the correct "sand-grip" (the ideal tripod grip learned through manipulation) to the "pencil-grip." For School Administration, the study recommends allocating budget and

resources to ensure the consistent supply and proper maintenance of such specialized educational media. For Future Researchers, it is highly suggested to replicate this study using a larger, randomized sample size and incorporating a controlled comparison group to further strengthen the external validity of the intervention's effects. Additionally, future studies should focus on the long-term retention of these initial writing skills and explore the impact of kinetic sand on advanced handwriting parameters, such as overall legibility, accuracy, and writing speed.

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