



# American Journal of Arts and Human Science (AJAHS)

ISSN: 2832-451X (ONLINE)

VOLUME 4 ISSUE 1 (2025)



PUBLISHED BY  
E-PALLI PUBLISHERS, DELAWARE, USA

## Enhancing Subtraction Skills Among Kindergarten Learners: A Hands-on Approach Using Bundle of Stick

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### Article Information

**Received:** October 28, 2024**Accepted:** November 29, 2024**Published:** January 07, 2025

### Keywords

*Action Research, Bundles of Sticks, Early-Grade Mathematics, Ghana, Hands-on Learning, Kindergarten Learners, Subtraction*

### ABSTRACT

The inception of standard-based mathematics curricula has underscored the variety of students' backgrounds and learning abilities, posing noteworthy challenges for teachers, particularly in promoting foundational mathematical skills such as subtraction. This study investigates the use of practical teaching aids, specifically bundles of sticks, to improve subtraction skills in Kindergarten. Learners in Kindergarten were involved in the study. The study sought to identify students' difficulties when learning subtraction and evaluate the effectiveness of using physical teaching resources to address these challenges. Pre-test and post-test results revealed a notable improvement in student performance, with 57.9% achieving a passing score after the intervention compared to 23.7% before the intervention. Observations highlighted that the visual and tactile nature of the bundle of sticks method significantly enhanced pupils' conceptual understanding of subtraction. However, challenges such as difficulties in managing the sticks were identified, leading to recommendations for interactive learning tools in early-grade mathematics education to bridge foundational gaps in numeracy.

### INTRODUCTION

In the domain of early childhood education, developing foundational numeracy skills is paramount (Salminen *et al.*, 2021). According to Nkansah (2020), understanding basic mathematical operations such as subtraction lays the groundwork for more advanced concepts. Early childhood education research suggests that hands-on, concrete experiences significantly enhance young learners' understanding of mathematical concepts (Bernard *et al.*, 2020; Salminen *et al.*, 2021). Singh (2023) argued that traditional teaching methods may not always resonate with every child, particularly those with diverse learning styles or challenges. Therefore, exploring alternative approaches, such as the use of manipulatives like bundles of sticks, presents an opportunity to cater to different learning needs and promote inclusivity in the classroom. The mathematics curriculum in Ghana was revised in 2019 to prepare learners with mathematical skills and abilities to qualify for many desired courses (National Council for Curriculum and Assessment, 2019). This curriculum underscores the need to teach mathematics with concrete objects with the learner leading the teaching and learning. Therefore, the curriculum can be said to be rooted in constructivism. Constructivism is a theoretical framework that influenced the recent modifications in the mathematics curriculum to cater to diverse learning styles (Ministry of Education, 2019). The incorporation of constructivism as a foundational philosophy in the mathematics curriculum is rooted in the recognition of unique methods of conceptualizing reality (MoE, 2019). Several studies have shown that the most fundamental concepts of mathematics consist of two primary

arithmetic operations known as additions and subtractions (Ipek, 2018; Kwakye *et al.*, 2020; Starkey & Gelman, 2020). Ipek (2018) and Kwakye *et al.* (2020) argued that no mathematics notion can be developed without a strong basis in basic operations such as addition and subtraction. However, most research demonstrated that subtraction with fluency is a more challenging arithmetic concept compared to addition in Mathematics (e.g. Kullberg *et al.*, 2019; Nkansah, 2020; Sidik *et al.*, 2021). Kullberg *et al.* (2019) found that young children may struggle with the notion of subtraction, as it can be a challenging mathematical operation. Mastering basic subtraction is crucial in mathematics and failing to do so can hinder educational progress (Kullberg *et al.*, 2019). Subtraction is a part of our everyday lives and therefore an important concept to develop early (Byjus, 2023). Understanding subtraction is essential for engaging effectively in society, as it is utilised in various daily activities such as managing finances, cooking, traveling, and time management (Kwakye *et al.*, 2020; Nkansah, 2020). Subtraction helps children understand how to associate numbers with objects and calculate and express losses using math language (Sidik *et al.*, 2021).

To help the theoretical and practical knowledge of the subtraction problem, various researchers and professional organisations have suggested a range of interconnected teaching methods to enhance understanding of the concept of subtraction (Young, 2018). Scholars recommended using a bundle of sticks as Teaching Learning Resources (TLR) for students who lack an understanding of the concept of subtraction (Jones & Tiller, 2017; Kwakye *et al.*, 2020; Young, 2018). Kwakye

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*et al.* (2020) encouraged the significance of utilising a bundle of sticks to aid in teaching subtraction operations. Researchers like Sidik *et al.* (2021) and Young (2018) endorsed the take-away method for teaching subtraction as an evidence-based practice in mathematics for students with learning difficulties.

### Statement of the Problem

The ability to perform subtraction is a foundational mathematical skill that significantly impacts a child's overall academic success. In kindergarten settings, many learners struggle to grasp abstract mathematical concepts, leading to difficulties in basic arithmetic operations as a result of inadequate documented evidence on the use of various concrete materials for teachers to emulate. Despite the availability of various teaching methodologies, traditional methods often fail to engage young learners effectively, resulting in a lack of confidence and proficiency in subtraction. Many scholars are of the view that visual learning tools like bundles of sticks improve subtraction skills, fostering a deeper understanding of mathematical concepts, and promoting a positive attitude towards learning mathematics among young children.

### Purpose of the Study

The primary objective of this study was to assist Kindergarten pupils in a school within the Wa Municipality of Ghana in overcoming difficulties associated with subtracting one-digit numbers through the use of the bundle of sticks method.

### Research Questions

1. What difficulties do Kindergarten pupils encounter when learning subtraction skills?
2. How can the use of a bundle of sticks as a teaching resource in facilitating Kindergarten pupils' understanding of the subtraction of one-digit numbers?
3. What are the potential challenges associated with implementing the bundle of sticks method, and what strategies can be proposed to overcome these challenges effectively?

It is anticipated that the outcome of this study will go a long way to help solve the problem of the Kindergarten pupil's difficulty in subtraction of one-digit numbers, enabling them to progress steadily in their academic ladder.

The result of this study will be useful in the school and other schools by teachers, future researchers, Non-Governmental Organizations and the Ghana Education office in the Wa Municipality, and other workers in the field of education in the municipality.

Finally, in Ghana, this study will contribute to the existing body of literature, which will improve the field of mathematics in academia. Additionally, it will serve as a reference document for researchers and scholars who, at a later time, may decide to carry out a study that is either identical to or comparable to this study.

### LITERATURE REVIEW

According to Fuadi (2017), subtracting in mathematics simply refers to taking away one number or an amount from another. Simply put, subtraction involves the act of taking away one or more things from the other to decrease the size, number, amount and so on. Subtraction is one of the four fundamental operations along with addition, multiplication and division mathematics, symbolizing the process of removing objects from a collection (Samuel *et al.*, 2020). The concept of Subtraction is often introduced at the elementary level to help students understand how to determine the difference between two numbers or quantities (Fuadi, 2017). It represents the process of removing objects from a collection (Samuel *et al.*, 2020). The result of a subtraction operation is called the "difference."

Subtraction is not merely a mechanical operation but embodies a deep mathematical principle that is intertwined with the concept of difference and reduction. It represents the inverse relation to addition, where understanding one operation aids in the comprehension of the other (Samuel *et al.*, 2020). According to Benjamin (2022), subtraction is symbolized by the minus sign "-". For example, in the expression  $5 - 2 = 3$ , 5 is the minuend, 2 is the subtrahend, and 3 is the difference (Benjamin, 2022). This can be interpreted as having a group of 5 objects, removing 2 objects, and then having 3 objects left.

The literature provides a comprehensive overview of subtraction, portraying it as a fundamental mathematical operation alongside addition, multiplication, and division. Subtraction is described as the process of taking one number or amount from another to decrease the size, number, or amount. This operation is crucial in mathematics for determining the difference between two numbers or quantities. The literature further highlights that subtraction is the inverse of addition, suggesting that mastery of one operation can enhance understanding of the other. This relationship underscores the interconnectivity of mathematical operations and the foundational role of subtraction in developing numerical literacy.

The concept of one-digit numbers is foundational in mathematics education, serving as the building blocks for understanding larger numerical values, operations, and mathematical principles (Fauzi *et al.*, 2021). One-digit numbers, ranging from 0 to 9, are the simplest forms of numbers but play a crucial role in developing numeracy skills in early learners. Mathematics education focuses on enabling students to grasp these basic numerical concepts through engaging and interactive methods, thereby setting the groundwork for more complex mathematical reasoning and problem-solving skills (Ministry of Education, 2019).

In the field of mathematics education, various approaches have been utilized to enhance students' understanding of one-digit numbers and basic arithmetic operations. For

instance, Fauzi *et al.* (2021) explored learning designs for the addition and subtraction of two-digit numbers based on Realistic Mathematics Education (RME) principles, utilizing games like Snakes and Ladders to facilitate understanding. Although their study primarily focused on two-digit numbers, the foundational understanding of one-digit numbers is implicit in grasping these concepts. The study showed that employing the RME approach significantly improved students' understanding of addition and subtraction, indicating the importance of interactive and context-based learning methods in mathematics education (Fauzi *et al.*, 2021).

Moreover, research by Astuti (2014) on learning one-digit decimal numbers through measurement and game predicting length highlighted the effectiveness of Realistic Mathematics Education (RME) in promoting students' understanding of decimals. This study demonstrates the importance of hands-on learning experiences and the use of real-world contexts to facilitate the comprehension of numerical concepts, including one-digit numbers (Astuti, 2014).

The concept of using a "Bundle of Sticks" in teaching subtraction has its roots in practical, hands-on learning methods. This approach, often applied in the context of mathematics education, emphasizes the tangible representation of numbers and operations, making abstract concepts more accessible to learners (Fauzi *et al.*, 2021). The "Bundle of Sticks" method can be traced back to ancient counting tools, where physical objects were grouped to represent quantities (Kwakye *et al.*, 2020). Kwakye *et al.* added that in modern educational settings, it serves not only as a method for teaching subtraction but also for reinforcing the understanding of place value, counting, and the principles of borrowing and regrouping.

In subtraction, a bundle of sticks helps students visualize the process of taking away quantities. For instance, when a student needs to subtract 15 from 23, they can start with 23 sticks, bundled in groups of 10 where possible (Jones & Tiller, 2017). By physically removing the required number of sticks, the student can see the result directly, which aids in comprehension and retention (Jones & Tiller, 2017). This method aligns with the principles of concrete manipulatives advocated by educators and researchers who emphasize the importance of sensory experiences in learning mathematics.

Furthermore, the use of tangible objects like sticks in subtraction aligns with the constructivist approach to education, which posits that learners build knowledge through experiences (Salman *et al.*, 2019). This method provides a bridge between the concrete and the abstract, allowing students to transition from performing operations with physical objects to visualizing and solving problems mentally.

The effectiveness of such methods in mathematics education has been the subject of various studies. For instance, research has highlighted the role of tangible and interactive teaching aids in improving students'

understanding of mathematical concepts (Salman *et al.*, 2019). Similarly, initiatives like RadarMath, an intelligent tutoring system, have explored the integration of technology and interactive tools in math education, demonstrating potential benefits in personalized learning environments (Lu *et al.*, 2021).

From the literature, the "Bundle of Sticks" method offers a compelling example of how traditional tools can support learning in contemporary educational settings. It not only facilitates the teaching of subtraction but also enriches students' overall understanding of mathematical concepts through hands-on learning experiences.

Pupils encounter several learning difficulties in using subtraction operations, a fundamental aspect of mathematics education. According to Salman *et al.* (2019), one significant challenge is the transition between different representations of subtraction problems. Kara and Incikabi (2018) found that students performed better in addition operations than in subtraction, indicating specific challenges with subtraction that merit further investigation. Additionally, operational learning in subtraction, particularly at the elementary level, is hampered by the use of borrowing techniques (Kwakye *et al.*, 2020). Parwines and Noornia (2019) highlighted that many teachers apply these techniques in ways that are too abstract, failing to offer a contextual strategy that students can grasp easily.

Another aspect of learning difficulties in subtraction operations is related to technological interventions (Kullberg *et al.*, 2019). For instance, the use of augmented reality technology has been explored as a means to support students with specific learning difficulties, showing promise in making the learning process more engaging and effective (Turan & Atila, 2021).

These findings underscore the complexity of learning subtraction operations for pupils, particularly those with learning difficulties. The transition between different representations, the abstract nature of borrowing techniques, and external factors such as the shift to online learning all contribute to the challenges faced by students.

## MATERIALS AND METHODS

### Research Design

Research design is the strategic blueprint that guides researchers in addressing specific research problems. For this study, the chosen design is Action Research, a methodology that emphasizes solving immediate and localized issues. This approach is widely utilized by educators to address challenges within classrooms and schools, employing a structured scientific process that includes problem identification, data collection, analysis, and conclusion. The ultimate aim of action research is to develop actionable solutions tailored to unique contexts, making it particularly effective for addressing practical challenges in educational settings. While action research offers significant benefits, such as its direct applicability and relevance to real-world problems, it is not without limitations. The flexible nature of this design often results

in limited generalizability and challenges in replication. Furthermore, its less stringent adherence to the standards of traditional scientific research can be seen as a drawback. Nevertheless, the action research design is well-suited for this study, given its focus on practical problem-solving and contextual relevance.

### Population of the Study

The research population refers to the set of all the units, which possess a variable characteristic under study (Shukla, 2020). Shukla explained that population is a totality of all the objects, subjects or members that conform to a set of specifications. At the time of the study, the study locale had a total of 138 learners, consisting of 62 boys and 76 girls (Student's Attendance Register, 2024). Kindergarten (2) learners were involved in the study because the class was conveniently accessible to the researcher. The Kindergarten enrolment was 53 learners (Student's Attendance Register, 2024).

### Sample and Sampling Techniques

A preliminary evaluation test conducted by the researcher revealed that fifteen (15) learners out of the fifty-three (53) could subtract one-digit numbers while thirty-eight (38) learners were not able to do the subtraction. The thirty-eight (38) learners scored below 50% of the total marks. The intention here was to determine their level of understanding of the concept of subtraction of one-digit numbers as well as specific skills in which they are deficient. The thirty-eight (38) learners who could not do simple subtraction of one-digit numbers were chosen as samples for the project work.

Thus, the sample for the study was made up of 38 learners in Kindergarten (2). The learners chosen for this study were selected through a purposive sampling technique. The list of pupil participants was obtained from the learners' attendance register. Thus, the sample size for the study was 38 participants.

### Data Collection Instruments

The researcher employed both observation and tests as the primary instruments for collecting the necessary data for the study.

### Observation

Observation is a method through which the researcher gathers data on the current state of the participants by watching, listening, and recording their actions (Kwakye *et al.*, 2020). In this study, observations were conducted during mathematics lessons, where the researcher noted that many learners struggled with subtracting one-digit numbers. To address this issue, the researcher implemented the use of a bundle of sticks as a teaching aid to support the learners in overcoming their difficulties. The observation instrument served multiple purposes throughout the study. During the intervention stage, it helped the researcher identify the specific challenges the pupils faced. It also allowed the researcher to monitor

how the pupils applied the teaching aids available to them. At the post-intervention stage, the observation tool was used to assess whether the intervention had a positive impact on the learners' ability to subtract one-digit numbers, providing insights into the effectiveness of the teaching strategy.

### Tests

Tests were also used to collect data. Two main types of tests were conducted- pre-test and post-test. The pre-test was conducted during the pre-intervention stage to diagnose the level of learners' ability to subtract one-digit numbers. This was done by giving pupils written tests.

A Post-Test was conducted after the intervention, for the thirty-eight (38) learners with the aid of a bundle of sticks for solving five questions involving the subtraction of one-digit numbers within twenty-five minutes.

### Interventions

The intervention procedure was in three stages namely pre-intervention, intervention, and post-intervention. Six weeks were used to collect the data; two days within each of the weeks were used for the project. In all 12 working days were used for collecting the data. Two weeks for the pre-intervention, three weeks for the intervention and the last one week for post-intervention.

### Pre-Intervention (First and Second Weeks)

In the pre-intervention phase, the researcher utilized both observation and tests to gather data on the identified problem. Through classroom observations during mathematics lessons, it became evident that many pupils struggled significantly with one-digit subtraction problems during class exercises. To further assess the pupils' understanding of the topic, a pre-test was administered, providing a clearer picture of their existing knowledge. A sample of the pre-test results can be found in Appendix A.

### Intervention Implementation (Third, Fourth and Fifth Weeks)

In educational settings, intervention is a set of strategies or sets of activities planned and implemented to solve a specific problem or aimed at improving educational practice among students located in an immediate situation (Kwakye *et al.*, 2020). The goal is to identify areas where students are struggling and to implement targeted measures that can help them improve (Hawthorne, 2021). The primary intervention employed was the utilisation of "loose" bundles of sticks to teach the concept of subtraction in one-digit numbers.

### Third Week

#### Activity one (1)

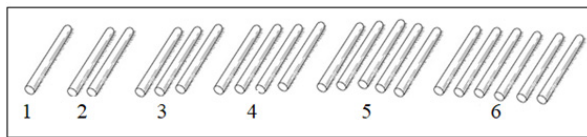
In the third week, the researcher introduced the sub-strand "Subtraction of Whole Numbers (0-9)" with a dynamic and engaging approach. To capture the learners' attention and set the tone for the lesson, she began

by leading them in singing songs and reciting rhymes connected to subtraction, such as “One, two, buckle my shoe...” These activities created a lively and interactive learning environment.

To ensure understanding, the researcher further clarified the concept of subtracting one-digit numbers by explaining it in the local Waali language. She emphasized that subtraction involves taking away or “minusing” one-digit numbers from each other to find the difference. Following the explanation, the researcher facilitated group activities, guiding the pupils in forming small groups and distributing loose bundles of sticks to each group. This hands-on method allowed the pupils to actively participate in the learning process, visually demonstrating the subtraction of one-digit numbers.

**Activity two (2)**

During this activity, the researcher guided the learners to write down whole numbers from 0 – 9. The researcher also guided the learners to represent each digit with sticks to assist them to recognise the numerals from 1 – 9 as shown below in the Figure 3.1. This activity was conducted with the learners in order to enhance their comprehension of representing integers from 1 - 9 as subtraction statements.



**Activity three (3)**

In this activity, learners were guided to subtract the following:

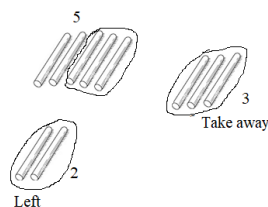
- i)  $5 - 3 = \square$     (ii)  $7 - 2 = \square$     (iii)  $9 - 5 = \square$

The researcher explains that subtraction means to take away a set of objects from a collection.

For  $5 - 3 = ?$

The researcher guided each group to count 5 sticks and put them aside to represent 5. She guided the learners to take away 3 sticks out of the 5 sticks. She further let them count the remaining sticks and write down the difference as 2 as shown in Figure 3.2.

Therefore,  $5 - 3 = 2$



**A diagram showing the subtraction of  $5 - 3 = 2$**

The researcher took learners to through similar activities to guide learners to solve (ii)  $7 - 2 = ?$

(iii)  $9 - 5 = ?$

The researcher reviews the lesson with learners by letting them sing song like: “I’m counting one, what is one.” Learners were asked to solve  $6 - 4 = ?$ .

**Fourth Week**

During the fourth week, the researcher revised with learners to review their understanding in the previous lesson. The researcher took learners to through similar activities to have learners to practice with more examples to strengthen what was taught in the third week.

**Fifth Week**

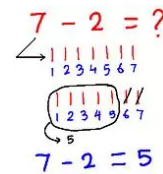
During the fifth week, the researcher revised with learners to review their understanding in the previous lesson. The researcher guide the learners to used strokes along with bundles of sticks to solve  $7 - 2$  and  $9 - 5$  by following the steps below.

**Activity I**

For  $7 - 2 = \square$

**Steps**

- (i) The researcher states that  $7 - 2$  means start and make 7 strokes.
- (ii) From the 7 strokes, she guided learners to take away 2 strokes and cancel the strokes.
- (iii) She asked the learners to count the remaining stokes and tell how many are left. Thus, 5 strokes are left.
- (iv) Therefore,  $7 - 2 = 5$ . This is shown below mathematically;



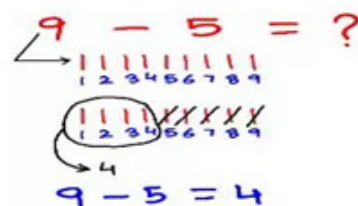
**A diagram showing subtraction of  $7 - 2 = 5$**

**Activity two (2)**

For  $9 - 5 = \square$

**Steps**

- (i) The researcher states that  $9 - 5$  means start and make 9 strokes.
- (ii) From the 9 strokes, she guided learners to take away 5 strokes by canceling the 5 strokes.
- (iii) She asked the learners to count the remaining stokes and tell how many are left. Thus, 4 strokes are left.
- (iv) Therefore,  $9 - 5 = 5$ . This is shown below mathematically;



**A diagram showing Subtraction of  $9 - 5 = 4$**

In each of the three weeks used for the intervention learners were assessed at the end of each lesson. Lesson plans were drawn for the intervention process. The

samples of the lesson plans will be shown in Appendix B.

### Post-Intervention Stage (Six Weeks)

Following the intervention, a post-test was administered to all 38 learners, challenging them to solve five subtraction problems using the bundle of sticks within the same 25-minute time frame as the pre-test. This was done to assess whether the implemented intervention had a positive impact on their performance.

The same group of pupils who took part in the pre-test were given the post-test, ensuring consistency in the evaluation process. The post-test was conducted over one week, with two days dedicated to administering the test. Afterward, the researcher collected, marked, and scored the test scripts to analyse the results.

### Data Analysis Procedures

The pre-test and post-test scores were analysed using Microsoft Excel as an analysis tool. The analysed results were presented using a frequency table, percentages and bar charts. Also, the data collected through observation were analyzed using thematic analysis.

## RESULTS AND DISCUSSIONS

### Data Analysis

The primary objective of this research was to assist Kindergarten 2 pupils in a school within the Wa Municipality of Ghana in overcoming challenges related to subtracting one-digit numbers through the use of bundle of sticks. This chapter presents a comprehensive analysis of the data collected from 38 pupils during both the pre-intervention and post-intervention tests. Additionally, it delves into the findings from the observational data, providing critical insights into the effectiveness of the intervention.

### Presentation of Pupils Pre-test Results

The pre-test results of the pupils are presented in Table 4.1.

From Table 4.1, the researcher gave out five (5) questions

to the pupils which were marked over ten (10). A total of 38 pupils participated in the pre-test, and their performance varies significantly across different mark categories. The data revealed that 4 pupils (10.5%) scored 0 marks. This indicates that a small (10.5%) but significant number of pupils struggled significantly with the pre-test. Additionally, 9(23.6%) pupils scored just 1 mark, suggesting several learners with some, but very limited understanding of the subject matter.

Also, from Table 1, 2 marks were achieved by 8 pupils, representing 21.1% of the total, indicating a slightly better grasp of the content compared to those who scored 0 or 1, but still demonstrating a considerable need for improvement. There is a noticeable drop in the number of pupils as the marks increase, with 6 pupils (15.8%) scoring 3 marks and only 2 pupils (5.3%) managing to achieve a score of 4. Interestingly, no pupils scored 5 or 8 marks.

However, there were 3 pupils (7.9%) who scored 6 marks, and another 4 pupils (10.5%) who scored 7 marks. This suggests that a small 18.4 % (7.9 + 10.5) group of the learners have a moderately good understanding of the concept of subtraction of one-digit numbers. Only 2 pupils (5.3%) achieved a score of 9, and no pupils attained the full score of 10 marks, indicating that while there are some 23.7% (5.3 + 7.9 + 10.5) learners who have a relatively strong grasp of the content, there is still room for improvement even among the higher achievers. Generally, the pre-test results demonstrate a wide range of understanding among the pupils, with a majority 76.3% (10.5 + 23.6 + 21.1 + 15.8 + 5.3) of pupils scored below the pass mark of 5. This suggests a need for focused instructional interventions to help improve the understanding and performance of the majority (76.3%) of pupils, particularly those who faced the most challenges during the pre-test.

### Presentation of Pupils Post-test Results

The post-test results of the pupils are presented in Table 2.

Source: *Field Survey, 2024*

**Table 1:** Summary of Pupils' Pre-test Results

Marks	Number of pupils	Percentage (%)
0	4	10.5
1	9	23.6
2	8	21.1
3	6	15.8
4	2	5.3
5	0	0
6	3	7.9
7	4	10.5
8	0	0
9	2	5.3
10	0	0
Total	38	100

**Table 2:** Summary of Pupils Post-test Results

Marks	Number of pupils	Percentage (%)
0	0	0.0
1	2	5.3
2	7	18.4
3	5	13.1
4	2	5.3
5	2	5.3
6	3	7.9
7	6	15.8
8	5	13.1
9	2	5.3
10	4	10.5
Total	38	100

The data from Table 2 provides a summary of the post-test results of 38 pupils. The researcher gave out five (5) questions to the pupils which were marked over ten (10). The distribution of marks ranges from 0 to 10, with the number of pupils and the corresponding percentages provided for each score.

Firstly, no pupils scored 0 marks, which suggest that all participants who sat for the post-test managed to secure at least 1 mark. The lowest scores, 1 and 4 marks were each obtained by 2 pupils, accounting for 5.3% of the total participants respectively. Similarly, the scores of 5 and 9 marks were also each achieved by 2 pupils, making up another 5.3% for each score category.

Moreover, the most common score was 2 marks, achieved by 7 pupils, which constitutes 18.4% of the total. This indicates a relatively high number of pupils at the lower end of the scoring range. The second most frequent score was 7 marks, with 6 pupils, representing 15.8%

of the participants. Scores of 3 and 8 marks were both attained by 5 pupils each, representing 13.1% for each score. Furthermore, 3 pupils scored 6 marks (7.9%), and 4 pupils achieved a perfect score of 10 marks, representing 10.5% of the total.

In conclusion, the data from Table 4.2 demonstrates a varied performance among the pupils. This indicates that while 16(42.1%) pupils have struggled with the post-test, a substantial number 22(57.9%) achieved the pass mark of 5 and above, reflecting a mixed level of understanding and proficiency within the class.

**Comparison of Pre-test and Post-test Results**

The comparison between pre-test and post-test results provides insight into the impact of the instructional intervention on the pupils’ understanding and performance. Table 4.3 and 4.4 depicts Distribution of Scores of in the pre-test and post-test.

**Table 3:** Lowest Scores (0-4 marks)

Marks	Pre-Test	Pre-Test percentage	Post-Test	Post-Test percent
0	4 pupils	10.5%	0 pupils	0.0%
1	9 pupils	23.6%	2 pupils	5.3%
2	8 pupils	21.1%	7 pupils	18.4%
3	6 pupils	15.8%	5 pupils	13.1%
4	2 pupils	5.3%	2 pupils	5.3%
Total	29 pupils	76.3%	16 pupils	42.1%

Out of 38 pupils who took both pre-test and post-test, from Table 4.3, 29(76.3%) pupils failed the pre-test whereas 16(42.1%) failed the post-test. The suggests that the number of pupils scoring between 0 – 4 marks

decreased significantly from 29 (76.3%) to 16 (42.1%), indicating a notable improvement among the lower-performing pupils in both pre-test and post-test.

**Table 4:** Highest Scores (5-10 marks)

Marks	Pre-Test	Pre-Test percentage	Post-Test	Post-Test percent
5	0 pupil	0.0%	2 pupil	5.3%
6	3 pupils	7.9%	3 pupils	7.9%
7	4 pupils	10.5%	6 pupils	15.8%
8	0 pupil	0.0%	5 pupils	13.1%
9	2 pupils	5.3%	2 pupils	5.3%
10	0 pupil	0.0%	4 pupils	10.5%
Total	9 pupils	23.7%	22 pupils	57.9%

Source: Field Survey, 2024

Out of 38 pupils who took both pre-test and post-test, from Table 4.4, 9(23.7%) pupils passed the pre-test whereas 22(57.9%) passed the post-test. This suggests that there was a significant increase in the number of pupils passing in the post-test than the pre-test, from 9(23.7%) to 22(57.9%), reflecting a considerable improvement in understanding and performance among the pupils.

Based on the analysis of pre-test and post-test results, the researcher observed a moderate decrease in the number of pupils scoring between 0-4 marks, from 76.3% in the pre-test to 42.1% in the post-test. This suggests that the instructional intervention significantly helped struggling

pupils improve their understanding and performance. Moreover, there was a notable improvement in pupil performance, with the percentage of students scoring between 5 and 10 marks rising significantly from 23.7% in the pre-test to 57.9% in the post-test. Impressively, four pupils achieved a perfect score of 10 marks. The comparison between pre-test and post-test results, particularly the increase in pupils passing with higher marks and the reduction in those failing, highlights a clear improvement. This positive shift demonstrates that the intervention was effective, as the majority of pupils, 22 out of 38 (57.9%), showed a strong understanding of the content.

In conclusion, the comparison between pre-test and post-test results reveals a significant improvement in pupils' performance. The instructional interventions effectively enhanced pupils' understanding and proficiency, especially among those who initially struggled. The distribution of scores shifted towards higher marks, reflecting overall progress in learning outcomes.

## Discussion

### Research Question 1

What difficulties do KINDERGARTEN pupils encounter when learning subtraction skills?

This research question aimed to investigate the specific difficulties encountered by Kindergarten pupils in acquiring subtraction skills in a selected school within the Wa Municipality of Ghana. The focus was to identify the nature and scope of these challenges to inform targeted interventions.

The findings from the observation with teachers indicated that Kindergarten pupils used in the study encountered three challenges when learning subtraction skills. One of the primary difficulties the pupils faced was conceptual understanding. The researcher observed during the pre-intervention that the children struggle with the idea of taking away or removing items from a set, as it requires a certain level of abstract thinking that is still developing at their age. Additionally, the researcher also observed that the concept of zero and its role in subtraction is confusing for Kindergarten pupils, leading to errors and misunderstandings which manifested in the pre-test results.

Another significant challenge is the development of numerical fluency and problem-solving skills. The researcher further observed that many 29(76.3%) of the Kindergarten pupils have very low experience with whole numbers (0 – 9) and were struggling with basic counting of objects, which is essential for performing subtraction tasks. This lack of numerical fluency led to slow and inaccurate calculations.

### Research Question 2

How can the use of bundle of sticks as a teaching resource in facilitating Kindergarten pupils' understanding of subtraction of one-digit numbers?

Based on the findings of the post-test, the study discovered that, the use of bundles of sticks as a teaching resource was significantly facilitated the Kindergarten pupils' understanding of the subtraction of one-digit numbers. This hands-on, visual approach helps make the abstract concept of subtraction more concrete and tangible for young learners.

The physical manipulation of the sticks during the intervention stage helped pupils visually see the process of taking away or removing a certain number of sticks from a set, enhancing their conceptual understanding. For example, the pupils were given  $9 - 5$  to solve. They started with a bundle of 9 sticks and they were able to physically remove 5 sticks from the 9 sticks and count the

remaining sticks to see that there were 4 left. This visual and kinesthetic method reinforces the idea of subtraction as taking away, making it easier for pupils to grasp and remember. This finding is in line with the findings of Kwakye *et al.* (2020) who discovered that pupils performed well when they used a bundle of sticks to complete the exercise given to them. The authors concluded that the bundle of stick promote the acquisition of knowledge in addition and subtraction as well as other mathematical skills and concepts.

### Research Question 3

What are the potential challenges associated with implementing the bundle of sticks method, and what strategies can be proposed to overcome these challenges effectively?

The findings from the intervention phase revealed that implementing the bundle of sticks method for teaching subtraction to Kindergarten 2 pupils in the selected school presented two significant challenges. One potential issue was that 15 out of 38 pupils found it difficult to manage and keep track of the sticks, leading to confusion and inaccuracies in their subtraction tasks. The researcher assumed that since the Kindergarten pupils are still developing their fine motor skills, handling small objects like sticks can be tricky, resulting in frustration and distraction from the learning objective. Secondly, using bundles of sticks in teaching Kindergarten pupils requires careful classroom management and organization. As noted by Agamboka, Mensah and Ador (2023), the use of physical objects in teaching young children requires more classroom management and organization, as teachers need to ensure that each pupil has an adequate supply of sticks and that they are used appropriately during lessons. This can be time-consuming and may detract from instructional time if not managed efficiently (Agamboka *et al.* 2023).

To overcome these challenges effectively, several strategies can be employed as documented in the literature. First, Samuel, Nyarko and Dwumfuo (2020) suggested that teachers can use larger, more manageable sticks that are easier for young children to handle. This can help reduce frustration and improve accuracy in subtraction tasks. Second, Benjamin (2022) advocated that teachers should demonstrate the subtraction process step-by-step and provide guided practice before allowing pupils to work independently. Additionally, incorporating group activities can foster collaboration and peer learning, as pupils could help each other manage and use the sticks effectively (Kwakye *et al.*, 2020).

### Key Findings

The study's findings revealed that 9 out of 38 pupils (23.7%) achieved a pass score of 5 marks or above in the pre-test, while 22 pupils (57.9%) achieved a pass score of 5 marks or above in the post-test. This indicates that the intervention was effective, resulting in a moderate improvement in the pupils' understanding and

performance of one-digit number subtraction.

The observation revealed that Kindergarten 2 pupils faced significant challenges in conceptualizing and performing the act of removing objects from a set, a foundational aspect of subtraction. Furthermore, the results indicated that 29 out of the 38 pupils (76.3%) demonstrated limited familiarity with whole numbers (0–9) and encountered difficulties with basic counting, a critical prerequisite for successfully executing subtraction tasks.

The study found that using bundles of sticks as a teaching resource significantly facilitated Kindergarten pupils' understanding of one-digit number subtraction. This hands-on, visual approach made the abstract concept of subtraction more concrete and tangible for young learners. The physical manipulation of the sticks during the intervention allowed pupils to visually see the process of taking away or removing a certain number of sticks from a set, enhancing their conceptual understanding.

The study revealed that implementing the bundle of sticks method for teaching subtraction to Kindergarten pupils presented notable challenges. Specifically, 15 out of the 38 pupils (39.5%) experienced difficulty in managing and keeping track of the sticks, resulting in confusion and inaccuracies during subtraction tasks. However, the findings also highlighted that utilizing larger, more manageable sticks tailored to the fine motor skills of young children significantly reduced frustration and enhanced accuracy. Additionally, breaking the subtraction process into sequential steps and providing guided practice prior to independent work were identified as effective strategies for improving pupils' comprehension and performance in subtraction.

## CONCLUSIONS

The study revealed a significant improvement in pupils' understanding and performance of one-digit number subtraction following the intervention. Initially, only 23.7% of pupils passed the pre-test, but this increased to 57.9% in the post-test, indicating the effectiveness of the instructional strategies employed. Observations showed that kindergarten pupils faced substantial difficulties with subtraction due to limited experience with whole numbers and basic counting, highlighting the need for targeted interventions to build numerical fluency. Using bundles of sticks as a teaching resource significantly facilitated pupils' understanding of subtraction, making the abstract concept more concrete. However, challenges such as managing the sticks and inaccuracies in tasks were noted. These issues were mitigated by using larger sticks and providing step-by-step demonstrations and guided practice, which enhanced pupils' understanding and performance. The study recommends that kindergartens invest in more hands-on learning resources, implement interventions to build numerical literacy, incorporate structured practice sessions, and develop effective classroom management strategies to facilitate the use of physical learning aids.

## REFERENCE

- Agamboka, A. A., Mensah, S. K., & Ador, E. (2023). Using the abacus to address challenges basic three (3) pupils with learning difficulties have with place value of numbers in experimental school in Bolgatanga Municipality, Ghana. *GPH-International Journal of Educational Research*, 6(06), 57-75. <https://doi.org/10.5281/zenodo.8167688>
- Astuti, P. (2014). Learning one-digit decimal numbers by measurement and game predicting length. *Journal on Mathematics Education*, 5(1), 35-46. <https://doi.org/10.22342/jme.5.1.1447.35-46>
- Benjamin, E. A. (2022). *Methods of teaching primary school mathematics*. Module for B. Ed Early Childhood Education Programme.
- Bernard, J., Golbert, A., & Susuoroka, G. (2020). Assisting JHS Form One Pupils to add unlike fractions using Cuisenaire rod and paper folding: A case at Chamba M/A Junior High School. *Teacher Education and Curriculum Studies*, 5(3), 53. <https://doi.org/10.11648/j.tecs.20200503.12>
- Byjus. (2023). *Addition and subtraction (definition, rules and examples)*. BYJUS. <https://byjus.com/maths/addition-and-subtraction/>
- Clark, J. S., Porath, S., Thiele, J., & Jobe, M. (2020). Action research. *NPP eBooks*. <https://newprairiepress.org/ebooks/34>
- Fauzi, I., Mauhibah, R., & Jupri, A. (2021). Learning designs for the addition and subtraction of two-digit numbers based on realistic mathematics education principles using snakes and ladders game. *Al Ibtida: Jurnal Pendidikan Guru MI*, 8(1). <https://doi.org/10.24235/al.ibtida.snj.v8i1.7741>
- Fuadi, I. (2017). Implementation of CTL approach to increase understanding of the concept of operation of addition and subtraction of integers by using learning tools. *Journal of Education and Practice*, 8(8), 81-85. <https://www.semanticscholar.org/paper/Implementation-of-CTL-Approach-to-Increase-of-the-Fuadi/849da9096562dbf46ee585c55d5b826a5b33927f>
- George, T. (2023, January 27). *What is action research?* Scribbr. <https://www.scribbr.com/methodology/action-research/>
- Hawthorne, H. (2021, July 9). *Interventions in education: Importance, types & strategies*. High Speed Training. <https://www.highspeedtraining.co.uk/hub/effective-interventions-in-education/>
- Ipek, A. S. (2018). Pre-service elementary mathematics teachers' specialized content knowledge: The case of integer addition and subtraction. *International Journal of Progressive Education*, 14(4), 70-84. <https://doi.org/10.29329/ijpe.2018.154.6>
- Jones, J., & Tiller, M. (2017). Using concrete manipulatives in mathematical instruction. *Dimensions of Early Childhood*, 45(1). <https://files.eric.ed.gov/fulltext/EJ1150546.pdf>

Kara, F., & Incikabi, L. (2018). Sixth grade students' skills of using multiple representations in addition and subtraction operations in fractions. *International Electronic Journal of Elementary Education*, 10(4), 463-474. <https://doi.org/10.26822/IEJEE.2018438137>

Kullberg, A., Björklund, C., Brkovic, I., & Runesson Kempe, U. (2020). Effects of learning addition and subtraction in preschool by making the first ten numbers and their relations visible with finger patterns. *Educational Studies in Mathematics*, 103(2), 157-172. <https://doi.org/10.1007/s10649-019-09927-1>

Kwakye, D. O., Ofosu, E. K., Karim, S., Zacharia, Y., Zakari, Z., & Emmanuel, A. (2020). Using abacus and bundles of sticks to help basic two (2) pupils to add two and three-digit numbers: An action research of Ghana National College Basic School, Cape Coast, Central Region, Ghana. *African Journal of Mathematics and Statistics Studies*, 3(5), 21-37.

Lu, Y., Pian, Y., Chen, P., Meng, Q., & Cao, Y. (2021). RadarMath: An intelligent tutoring system for math education. *AAAI Conference on Artificial Intelligence*. <https://doi.org/10.1609/aaai.v35i18.18020>

Mertler, C. A. (2021). Action research as teacher inquiry: A viable strategy for resolving problems of practice. *Practical Assessment, Research, and Evaluation*, 26(19). <https://scholarworks.umass.edu/pare/vol26/iss1/19>

Ministry of Education. (2019). Kindergarten curriculum for preschools (KG 1&2). Ministry of Education Republic of Ghana. <https://nacca.gov.gh/wp-content/uploads/2019/06/KG-Curriculum.pdf>

Mutlu, A., & Tuncay, C. (2021). An action research on improving classroom communication and interaction in social studies teaching. *Education Research International*, 2021, 1–19. <https://doi.org/10.1155/2021/9943194>

National Council for Curriculum and Assessment (NaCCA). (2019). New standards-based curriculum (2019). NaCCA. <https://nacca.gov.gh/learning-areas-subjects/new-standards-based-curriculum-2019/>

Nkansah, E. (2020). *Assisting primary six pupils of Offinso State A to overcome their difficulty in addition and subtraction of six and seven-digit numbers using abacus and place value chart*. <https://doi.org/10.13140/RG.2.2.28450.04805>

Parwines, Z., & Noornia, A. (2019). Is it required to remove borrowing techniques in clearly subtraction operations in elementary school? *Journal of Physics: Conference Series*, 1157. <https://doi.org/10.1088/1742-6596/1157/4/042076>

Salminen, J., Khanolainen, D., Koponen, T., Torppa, M., & Lerkkanen, M.-K. (2021). Development of numeracy and literacy skills in early childhood—a longitudinal study on the roles of home environment and familial risk for reading and math difficulties. *Frontiers in Education*, 6. <https://doi.org/10.3389/educ.2021.725337>

Samuel, A. G., Nyarko, J., & Dwumfuo, K. (2020). Improving the performance of basic school pupils in addition and subtraction of integers using rectangular cut-out number line: A case of a Ghanaian basic school. *IOSR Journal of Mathematics (IOSR-JM)*, 16(3), 21-28. <https://doi.org/10.9790/5728-1603042128>

Shukla, S. (2020). *Concept of population and sample*.

Sidik, G. S., Suryadi, D., & Turmudi, T. (2021). Learning obstacle on addition and subtraction of primary school students: Analysis of algebraic thinking. *Education Research International*, 2021(1), 5935179. <https://doi.org/10.1155/2021/5935179>

Singh, A. K. (2023, September 12). *Blended learning vs. traditional learning: A detailed overview of the two approaches*. ELearning Industry. <https://elearningindustry.com/blended-learning-vs-traditional-learning-a-detailed-overview-of-the-two-approaches>

Starkey, P., & Gelman, R. (2020). *The development of addition and subtraction abilities prior to formal schooling in arithmetic*.

Student's Attendance Register. (2024). *Fongo English and Arabic (E/A) Kindergarten School*.

Turan, Z., & Atila, G. (2021). Augmented reality technology in science education for students with specific learning difficulties: Its effect on students' learning and views. *Research in Science & Technological Education*, 39, 506-524. <https://doi.org/10.1080/02635143.2021.1901682>

Young, J. (2018). *Alternative strategies for solving subtraction problems generated by third grade students' proficient with the standard algorithm*. <https://core.ac.uk/download/pdf/199658437.pdf>

**APPENDIX**

Pre-test and Post-test questions on subtracting 1-digit Number

**Instruction: Answer All Questions**

1. Cross out 6 sticks, count the sticks left and find the difference.

8 – 6 =  

2. Cross out 3 sticks, count the sticks left and find the difference.

7 – 3 =  

3. Cross out 4 sticks, count the sticks left and find the difference.

6 – 4 =  

**Subtract and find the difference.**

4. 8 – 7 = \_\_\_\_\_

5. 9 – 9 = \_\_\_\_\_