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Research Article

# Effects of Reggio-Emilia teaching approach on pupils' performance in sound energy in basic schools in Ilorin, Nigeria

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**Abstract**
Sound energy is essential in our daily lives; it helps us communicate, enjoy music and stay aware of our surroundings. This study investigated the impact of the Reggio-Emilia teaching approach on pupils' performance in Sound Energy, a physics-related concept in basic schools in Ilorin, Nigeria. The quasi-experimental design adopted a 3x2x3 factorial structure, involving three groups: pupils taught using the Reggio-Emilia Approach, those taught using both the Reggio-Emilia Approach and KwaraLearn teacher tablets, and a control group taught using only KwaraLearn tablets. A total of 120 pupils from three randomly selected public basic schools participated. Data were collected using a researcher-designed Sound Energy Performance Test (SEPT), and analysed using descriptive statistics and ANCOVA. Findings revealed that the Reggio-Emilia teaching approach significantly improved pupils' academic performance in Sound Energy compared to the control group. Pupils in both treatment groups outperformed those in the control group, with no statistically significant interaction effect of age on performance. These results highlight the effectiveness of the Reggio-Emilia approach in enhancing learners' understanding of physics-related concepts in basic science, advocating for its integration into the existing KwaraLearn initiative to promote inquiry-driven, child-centred learning. The study recommends that policymakers, educators and curriculum developers adopt and adapt the Reggio-Emilia approach for more effective science teaching at the basic school level in Nigeria.

**Keywords**: Reggio-Emilia, Teaching Approach, Basic Science, Sound Energy, Pupils' performance.

## 1. Introduction

Science is a systematic quantity of knowledge that employs a testable and verifiable approach to examine nature, aiming to establish presumed links among phenomena and to improve our comprehension of the natural world. Given the increasing challenges confronting educators and educational institutions, science is a discipline that concentrates on a systematically organised body of knowledge that elucidates the functioning of universal laws. Many countries face the challenge of transforming conventional educational methods to align with the modern knowledge-based economy, where the need for advanced skills is expected to increase substantially. This necessitates the establishment of evidence-based educational systems in which students actively engage in scientific learning, and where school administrators and educators function as a professional community endowed with the authority to act judiciously and the access to effective support systems to facilitate change implementation.

Physics as one of the fundamental science subject was perceived to play a crucial role in promoting technological progress, national wealth and health improvement, yet, students frequently exhibit lower performance in the subject due to inadequate teaching approach. In Nigeria, senior secondary school science students offer Physics, covering topics such as Motion, Mechanics, Optics, Electricity, Heat, Atomic Physics and Subatomic Particle Physics, in preparation for advanced Physics and Physics-related courses (Omosewo, 2009; Stonier, 2012; Heiney, 2022; Jeynes et al., 2023). Also, its related concepts such as motion, aerodynamics, machinery, pulleys, inclined planes, atmospheric pressure, mineral resources, force, friction, the solar system, forms of energy, sound, light, and measurement of length, among others, were taught within the realm of basic science, a fundamental element of basic science and technology at the basic level.

Basic science, often known as fundamental science, is motivated by a desire and curiosity to understand the natural world. The basic objective is to reveal essential principles and rules of the universe, without immediate practical applications in consideration (Bodrova & Leong 2024).

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Currently, basic science is taught as penultimate subject in the science and technology curriculum at the primary school level in Nigeria. Sound Energy is one of the topics taught in basic science at basic three. Sound energy is a form of energy that is produced when an object vibrates, creating waves that travel through a medium such as air, water, or solids. These vibrations cause the particles in the medium to move, allowing the sound to reach our ears. The louder the sound, the more energy it carries. Sound energy is essential in our daily lives; it helps us communicate, enjoy music and stay aware of our surroundings. It can be naturally produced, like in thunder or a bird's song, or artificially created using instruments and machines. According to Roederer & Roederer (2009). Sound energy plays a vital role in various fields, including medicine, engineering, and entertainment. Various methodologies and philosophies exist in early childhood education, encompassing diverse methods and beliefs regarding the instruction and care of young children (Mata-McMahon & Escarfuller, 2023; Walton & Darkes-Sutcliffe, 2024). Among these is the High Scope Method which encourages active, participatory learning, allowing children to actively explore their environment. The Montessori Method focuses on child-led learning, enabling children to choose their activities and progress at their own pace. Waldorf Education prioritizes creative play, consistent routines, and artistic activities while limiting technology use. Meanwhile, the Reggio Emilia Approach highlights self-expression, community engagement, and documenting children's thought processes (Maritz, 2022; Pretti-Frontczak & Brown, 2023).

The Reggio Emilia approach is a pedagogical philosophy in early childhood education. This approach, originating in Italy and with over 40 years of proficiency, give precedence to the cultivation of strong, capable, and resilient children. Reggio Emilia, a thriving region in Northern Italy, hosts one of the most innovative and high-quality municipal infant-toddler and pre-primary education systems. While the Reggio Emilia Approach to early childhood education draws inspiration from a wide range of influential theorists, it evolves beyond a simple collection of ideas to form a cohesive and dynamic educational philosophy (Taguchi, 2007; Atabey, 2020; Mercan & Kandır, 2024).

In recent years, the Reggio Emilia Approach has gained considerable attention, especially in its application to pre-primary and basic education. This teaching approach has been successfully implemented in developed regions of Europe and the United States, showcasing effectiveness in diverse global settings and receiving strong support from parents (Abdullahi, et al. 2021). The Reggio-Emilia approach posits that all children possess preparation, potential, curiosity and an inclination for social interaction, relationship-building, learning construction and engagement with their environment (Harrison, 2005; Stone, 2012; Hart & Bracey, 2023).

It is essential for young-learners to identify and rectify their own mistakes when engaging in activities. This method offers the essential opportunity to develop proficiency in creative problem-solving. Educators must possess sufficient regard for children to facilitate these processes. The youngsters are regarded as competent and the teachers neither offer solutions nor abandon the children to their own devices. The child-centered curriculum of Reggio Emilia Schools is founded on the perception of children as vibrant, empowered and self-assured rather than as beings defined by need (Rouvali & Riga, 2019; Motherway, 2022). A good number of studies have been conducted employing various teaching and learning interventions to enhance learners' learning outcomes in basic science, particularly in physics-related components; however, research on implementation and the adoption of the Reggio-Emilia teaching approach remains limited according to available reports in online databases.

As at the time of this study, no previous research has been found that explores the interactive effect of age on the influence of the Reggio-Emilia approach in teaching sound energy. While many studies have assessed the general impact of the Reggio-Emilia approach on educational outcomes, there is a lack of focused research on its effect on teaching physics-related concepts in basic science and technology. Therefore, this study investigates the impact of the Reggio-Emilia teaching approach on students' performance in sound energy in basic science and technology in Ilorin, Nigeria.

This study investigated the impact of the Reggio-Emilia teaching approach on pupils' performance in sound energy in basic schools in Ilorin, Nigeria. Other specific purposes are to:

(i) examine the effect of the "Reggio-Emilia teaching approach in teaching sound energy to pupils in basic schools;

(ii) explore the effect of the Reggio-Emilia teaching approach with the teacher tablet (KwaraLearn) in teaching sound energy to pupils in basic schools;

(iii) explore the interactive effect of age in the use of the Reggio-Emilia teaching approach in teaching sound energy to pupils in basic schools;"

The following questions guided the study:

1. What is the difference in the academic performance mean score of pupils taught sound energy using Reggio-Emilia Approach and those taught using Teacher Tablet (KwaraLearn) Approach?
2. What is the difference in the academic performance mean score of pupils taught sound energy using Reggio-Emilia Approach and Teacher Tablet combined and those taught using Teacher Tablet (KwaraLearn) Approach alone?
3. What is the difference in the academic performance mean score among the pupils taught sound energy using the Reggio-Emilia Approach and those taught using Teacher Tablet (KwaraLearn) Approach?

The following null hypotheses were formulated and tested at a 0.05 level of significance:

Ho1: There is no significant difference in the academic performance mean score of pupils taught sound energy using the Reggio-Emelia approach and the Teacher Tablet (KwaraLearn approach).

Ho2: There is no significant difference in the academic performance mean score of pupils taught sound energy using the Reggio-Emilia Approach and

Teacher Tablet combined and those taught using Teacher Tablet (KwaraLearn) Approach alone.

Ho3: There is no significant difference in the academic performance mean scores among pupils of different age taught sound energy using Reggio-Emilia Approach and those taught using Teacher Tablet (KwaraLearn) Approach.

## 2. Methodology

### 2.1. Research Design

This study employed a "quasi-experimental research design of 3x2x3 pre-test, post-test, non-equivalent control group structure. The 3x2x3 factorial design was employed to examine all possible combinations of the selected levels of three independent variables (Reggio Emilia Approach, Reggio Emilia with teacher tablet KwaraLearn and Conventional-teacher tablet alone), two levels of gender (male and female), and age classification into three categories (5-7, 8-10 and 11 & above).

### 2.2. Population and Sampling

The study's population comprises all the lower public-state owned basic school pupils in Ilorin,the target population consist of all basic three pupils. Hence, a sample of three basic schools were balloted using simple random techniques and the three schools fell among the Ilorin East, West and South, while purposive sampling technique was used to select basic three classes as the study treatments and control group respectively in the three schools balloted, because of criteria in Reggio-Emilia classrooms which has to do with age and the concept of the lesson.

### 2.3. Research Instrument

A research instrument named; Sound Energy Performance Test (SEPT) with its equivalent lesson plans 'Lesson Plan for Reggio Emilia Classroom for Sound Energy (LPRECSE) was used for the study. The test instrument was designed by the researcher to assess pupils' performance on the concept. This consists of 10 multiple-choice items with three options, requiring participants to select the correct answer. The test content was derived its unit in the Primary 3 Science textbook authored by Jessica Thompson and Rebecca Bernstein, which has been adopted by Kwara Learn. The same questions were utilised for both the pre-test and post-test, with appropriate reshuffling in the post-test administration. For the second treatment, both plans are considered, consisting of a detailed outline of the activities expected from teachers and pupils with a deliberate focus on utilising the Reggio-Emilia Classroom Approach.

#### *2.3.1 Validation of Instrument*

The content and construct validity of the performance test was established by administering the instruments to two experienced Basic Science teachers that go through the content and construct, two Physics-specialized science education lecturers of the Department of Science Education, University of Ilorin, Ilorin, Nigeria that go through the pedagogical and content, and a lecturer from the Department of Adult and Primary Education, University of Ilorin, Ilorin, Nigeria, specifically in the Primary Education unit that go through the construct. The experts aided the researcher in assessing the appropriateness of the content for its intended purpose and rectified grammatical problems in the structured items.

#### *2.3.2 Reliability of Instrument*

Following validation, the instruments underwent trial testing via the test-retest method, utilising data collected from a school excluded from the study. The items were categorised into odd and even groups, and the results were analysed using the Kuder-Richardson KR-20 to assess the reliability of the evaluations, yielding coefficient of 0.71. The instrument was deemed reliable for the study due to the results being near 1.0.

### 2.4. Procedure for Data Collection and Analyses

A letter of introduction from the Department of Science Education at the University of Ilorin, as well as an ethical letter from the University Ethical Review Committee (UERC) was obtained by the researcher. The full committee approval was granted with the UERC Approval Number: UERC/ASN/2024/2844 and Protocol Identification Code: UERC/EDU/457. The head teachers of the participating schools were presented with these letters in order to request their permission to involve their pupils and teachers in the study and to emphasise the significance of the study to the participant.

**Table 1. Procedure/Weekly activities**

| Week | Activities |
|---|---|
| First | Introduction: An introduction to the sample schools for familiarization with both the teachers and pupils of the intact classes chosen. A class three teacher in each schools was selected and they were trained on the subject matter and assigned as the research assistants |
| Second | Pre-test conducted by the research assistants in the three schools, since the researcher ascertain that the topics had been treated by the researcher assistants through the use teacher tablet KwaraLearn adopted approach |
| Third | Sound Energy was treated by research assistants in the three schools. The first experimental group was exposed to learning in Reggio-Emilia classroom, the second group were exposed to both the use of tablet and Reggio-Emilia while the control group were exposed only to the use of teacher tablet (KwaraLearn) and the post-test (SEPT) was done and retrieved immediately by the research assistants |
| Fourth | The last week, which shows the end of the programme, the researcher appreciates and commend the research assistants, the authority of the schools and the pupils in particular, this was possible in each school by organizing a short meeting during their long break |

The pupils were given copies of Informed Consent Forms that included detailed information about the research. These forms were intended to be presented to their parents as a means of indicating their consent to enable their children to participate in the study. Each of the schools that were chosen participated in the survey for a duration of seven weeks. The weekly research schedule was delineated as shown in Table 1.

All participants were guaranteed that, their information would be kept confidential. Key ethical considerations, such as anonymity and the rights of volunteers, were clearly communicated. The identities of participants were never disclosed, thereby minimizing any risk to their personal information. They benefited from acquiring Physics concepts relevant to their everyday lives." The researcher ensured that all referenced studies were properly cited, extensively paraphrased and subjected to plagiarism checks to maintain a high standard of originality in the work.

Research questions were answered using descriptive statistics of Frequency, percentages and mean scores while hypotheses were tested using Analysis of Co-Variance (ANCOVA) and t-test at 0.05 alpha level of significance.

## 3. Results

The analysis in Table 2 demonstrates the distribution of pupils sampled in the study based on their age, gender and group (two treatments and control) in Ilorin, Nigeria. The first treatment group is the Reggio Emilia alone, the second is Reggio Emilia with Kwaralearn.

**Table 2, Distribution of the pupils sampled based on group, gender and age**

| | | Group | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Variable** | | **Treatment I Freq** | **(%)** | **Treatment II Freq** | **(%)** | **Control Freq** | **(%)** | **Total** | **Percentage (%)** |
| **Age** | Age 5-7 | 9 | 19.57 | 3 | 6.67 | 0 | 0.00 | 12 | 10.00 |
| | Age 8-10 | 15 | 32.61 | 30 | 66.66 | 28 | 96.55 | 73 | 60.83 |
| | Age 11& Above | 22 | 47.83 | 12 | 26.67 | 1 | 3.45 | 35 | 29.17 |
| | **Total** | **46 (38.33)** | | **45 (37.50)** | | **29(24.17)** | | **120** | **100** |
| **Gender** | Female | 22 | 47.83 | 26 | 57.78 | 14 | 48.28 | 62 | 51.67 |
| | Male | 24 | 52.17 | 19 | 42.22 | 15 | 51.72 | 58 | 48.33 |
| | **Total** | **46** | **100** | **45** | **100** | **29** | **100** | **120** | **100** |

### 3.1. Research Question 1

*What is the difference in the academic performance mean score of pupils taught sound energy using Reggio-Emilia Approach and those taught using Teacher Tablet (KwaraLearn) Approach?*

Table 3 elucidates the influence of the Reggio-Emilia pedagogical method on students' comprehension of Sound energy in basic schools. Pupils subjected to the Reggio-Emilia approach demonstrated a higher mean score (M = 8.28, SD = 1.46) than those in the control group (M = 5.48, SD = 1.06), indicating a substantial performance disparity favouring the treatment group. To substantiate this observation, hypothesis one was established.

### 3.2. Results Hypothesis 1

*There is no significant difference in the academic performance mean score of pupils taught sound energy using the Reggio-Emelia approach and the Teacher Tablet (Kwara Learn approach).*

Table 4 displays the ANCOVA findings to evaluate the hypothesis that the Reggio-Emilia approach does not significantly influence sound instruction. The revised model demonstrates a substantial effect, evidenced by a F value of 79.182 and a p-value of .000, signifying that the model effectively predicts the result. The variable of interest, groups, exerts a significant influence, resulting in the rejection of the null hypothesis.

The Reggio-Emilia teaching method significantly influences good instruction for students in primary schools ($F_{(1, 72)}$ = 133.804, p = .000). The elevated R Squared value (.687) indicates that roughly 68.7% of the variance in students' comprehension of sound can be elucidated by the model, affirming that the Reggio-Emilia approach markedly improves students' understanding of sound in Basic Science and Technology relative to the KwaraLearn approach.

### 3.2. Research Question 2

*What is the difference in the academic performance mean score of pupils taught sound energy using Reggio-Emilia Approach and Teacher Tablet combined and those taught using Teacher Tablet (KwaraLearn) Approach alone?*

The results in Table 5 illuminate the impact of the Reggio Emilia teaching method on students' understanding of sounds in elementary schools. Students exposed to the

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**Table 3. Mean Scores and Standard Deviations of Pupils in Treatment I and Control Groups**

| Test | Ո | Mean | SD | MD |
|---|---|---|---|---|
| Treatment I | 46 | 8.28 | 1.46 | |
| Control | 29 | 5.48 | 1.06 | 2.80 |

**Table 4. ANCOVA Results for the Effect of Reggio-Emilia Teaching Approach on Understanding Sound**

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. | Decision |
|---|---|---|---|---|---|---|
| Corrected Model | 182.86[a] | 2 | 91.43 | 79.18 | .00 | |
| Intercept | 157.35 | 1 | 157.35 | 136.27 | .00 | |
| Sound_pretest | 43.43 | 1 | 43.43 | 37.61 | .00 | |
| Groups | 154.50 | 1 | 154.50 | 133.80 | .00 | Rejected |
| Error | 83.14 | 72 | 1.16 | | | |
| Total | 4154.00 | 75 | | | | |
| Corrected Total | 266.00 | 74 | | | | |

a. R Squared = .687 (Adjusted R Squared = .679)

Reggio Emilia approach. demonstrated a significantly higher mean score (M = 8.76, SD = 1.43) than those in the control group (M = 5.62, SD = 1.35), indicating a substantial performance disparity favouring treatment group II. Hypothesis two is proposed to substantiate this observation.

### 3.4. Results for Hypothesis 2

*There is no significant difference in the academic performance mean score of pupils taught sound energy using the Reggio-Emilia Approach and Teacher Tablet combined and those taught using Teacher Tablet (KwaraLearn) Approach alone.*

Table 6 shown the ANCOVA findings to evaluate the hypothesis that the Reggio-Emilia approach exerts no significant influence on sound instruction.

**Table 5. Mean Scores and Standard Deviations of Pupils in Treatment II and Control Groups**

| Test | Ո | Mean | SD | MD |
|---|---|---|---|---|
| Treatment II | 45 | 8.76 | 1.43 | |
| | | | | 3.14 |
| Control | 29 | 5.62 | 1.35 | |

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**Table 6. ANCOVA Results for the Effect of Reggio-Emilia Teaching Approach Combined on Understanding Sound**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Decision |
|---|---|---|---|---|---|---|
| Corrected Model | 182.86[a] | 2 | 91.43 | 79.18 | .00 | |
| Intercept | 157.34 | 1 | 157.35 | 136.27 | .00 | |
| Sound_pretest | 43.43 | 1 | 43.43 | 37.61 | .00 | |
| Groups | 154.50 | 1 | 154.50 | 133.80 | .00 | Rejected |
| Error | 83.14 | 71 | 1.16 | | | |
| Total | 4154.00 | 74 | | | | |
| Corrected Total | 266.00 | 73 | | | | |

a. R Squared = .687 (Adjusted R Squared = .679)

The revised model demonstrates a substantial effect, evidenced by an F value of 79.181 and a p-value of .000, signifying that the model effectively predicts the result. The variable of interest, groups, exerts a considerable influence, resulting in rejecting the null hypothesis. This indicates a substantial impact of the Reggio-Emilia teaching approach on instructing sound to students in primary schools ($F(1, 71) = 133.804$, $p = .000$). The elevated R Squared value (.687) indicates that roughly 68.7% of the variance in students' comprehension of sound is elucidated by the model, affirming that the Reggio-Emilia approach substantially improves students' understanding of sound in basic science and technology relative to the KwaraLearn methods.

### 3.5. Research Question 3

*What is the difference in the academic performance mean score among the pupils taught sound energy using the Reggio-Emilia Approach and those taught using Teacher Tablet (KwaraLearn) Approach?*

**Table 7. Mean Scores and Standard Deviations of Age Groups in Reggio-Emilia Teaching Approach Study**

| Age (in Years) | ᾗ | Mean | SD | MD | |
|---|---|---|---|---|---|
| 5 – 7 | 9 | 9.11 | 0.78 | | |
| | | | | 0.84 | |
| 8 – 10 | 15 | 8.27 | 1.22 | | 0.53 |
| | | | | 0.31 | |
| 11 & Above | 22 | 7.96 | 1.70 | | |

**Table 8. ANCOVA Results for Interactive Effect of Age in Reggio-Emilia Teaching Approach on Understanding Sound**

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. | Decision |
|---|---|---|---|---|---|---|
| Corrected Model | 193.69[a] | 5 | 38.74 | 36.96 | .00 | |
| Intercept | 94.92 | 1 | 94.92 | 90.56 | .00 | |
| Sound_pretest | 45.43 | 1 | 45.43 | 43.34 | .00 | |
| Groups | 28.36 | 1 | 28.36 | 27.06 | .00 | |
| Age | .91 | 2 | .46 | .44 | .65 | |
| groups * Age | 1.68 | 1 | 1.68 | 1.61 | .21 | Not Rejected |
| Error | 72.32 | 69 | 1.05 | | | |
| Total | 4154.00 | 75 | | | | |
| Corrected Total | 266.00 | 74 | | | | |

a. R Squared = .728 (Adjusted R Squared = .708)

Table 7 presents the average scores and standard deviations for various age groups: 5 to 7, 8 to 10 and 11 years and older. The analysis indicates differing mean scores among different age groups, with younger students exhibiting higher mean scores (M = 9.11) than their older peers (M = 7.96). Hypothesis three was established to substantiate this observation further.

### 3.6. Results for Hypothesis 3

*There is no significant difference in the academic performance mean scores among pupils of different age taught sound energy using Reggio-Emilia Approach and those taught using Teacher Tablet (KwaraLearn) Approach.*

Table 8 presents the ANCOVA results, showing no significant interaction effect between age and the teaching approach, leading to the retention of the null hypothesis. Therefore, age does not have a significant interactive effect on the influence of the Reggio Emilia method in teaching sound to primary school students ($F(1, 69) = 1.606$, $p = .209$). Although the main effect of age was not statistically significant ($p = .649$), the absence of a significant interaction effect suggests that age may not substantially impact the effectiveness of the Reggio Emilia approach in teaching sound to elementary school students.

### 3.7. Summary of Findings

1. The Reggio-Emilia teaching technique has a statistically significant impact on teaching sound energy to pupils in basic schools. $F_{(1, 72)} = 133.804$, $p < .001$
2. A statistically significant effect was observed for the Reggio-Emilia teaching approach in teaching sound energy to basic schools pupils ($F_{(1, 71)} = 133.804$, $p = .000$)
3. The Reggio Emilia teaching approach did not show a statistically significant interaction effect of age on its efficacy in teaching sound energy to basic school pupils.

## 4. Discussions

The demographic analysis of the data indicates a notable difference in the age distribution between the treatments and control groups. This disparity is believed to influence the study's findings on the effect of the Reggio Emilia approach in enhancing pupils' learning in Physics-related concept in Basic Science and Technology. Ossai and Ramsaroop (2022) carried out a study within the Nigerian education system, focusing on Nsukka in Eastern Nigeria, and found that the Reggio Emilia strategy can greatly improve students' academic performance in subjects involving physics-related concepts at that level. These findings are consistent with a four-week baseline study conducted in Minnesota by Nakaoka (2023), which demonstrated that the Reggio Emilia teaching method enhanced the social skills of four- and five-year-old children. Fox (2023) observed that the Reggio Emilia philosophy is becoming one of the most widely adopted progressive teaching approaches in early childhood education, as indicated by his study findings.

The results showed a significant impact of the Reggio Emilia teaching Approach on teaching elementary pupils about different forms of energy. In a study by Glauser-Abou et al. (2022), which used an innovative teaching approach to combine free play with basic Physics concepts for kindergarten children, it was concluded that this method, rooted in the Reggio Emilia Approach, enables children to engage with and understand physical laws in a playful way.

Fridberg et al. (2019) found that the Reggio Emilia approach successfully fosters inter-subjectivity in preschool children's learning of Chemistry and Physics. This approach allows teachers to improve their instructional methods by promoting simultaneous and reciprocal communication with students about specific content in these subjects. Ultimately, the Reggio Emilia Approach proves to be an effective pedagogical tool for introducing new concepts to preschoolers.

The findings indicated a substantial impact of the Reggio-Emilia teaching strategy utilising teacher tablets on instructing basic school students on forms of energy, sound, light and length measurement. Nakaoka's (2023) research examines the impact of the Reggio Emilia Approach to technology, namely iPad tablets and a media projector, on students' social skills inside an early learning classroom inspired by the Reggio Emilia Approach (REA). The study utilised three methods: videotaping, questionnaires and diaries with notes and further observations.

The findings suggest that the research could be advantageous for early learning centres, schools and preschools in integrating technology into their classrooms. Glauser-Abou et al. (2022) demonstrated that an innovative didactic method, which integrated kindergarten children's free play with basic Physics concepts, allowed children to experience and comprehend physical laws playfully, in accordance with the Reggio Emilia approach. Anderson et al. (2014) investigated children's conceptual understanding of plant structure and function through drawings. Data were acquired by drawing, surveys, interviews and observations. The results indicated that the youngsters possessed diverse understandings of plant structure and function.

The present study's findings revealed a significant interaction effect of age on the use of the Reggio Emilia teaching approach for teaching basic school pupils about form of energy. According to Smith (2018), where the early childhood teaching beliefs were comparatively analyzed using the Nvivoprogramme for content analysis. Research indicates that early childhood learning achieves equilibrium when educators facilitate children's communicative agency; for instance, actively encouraging peer learning among students in foundational classes can enhance children's potential and subsequently lead to child-directed learning through deliberate peer observations. Jobb (2017), in distinct research on early childhood educational environments, reached conclusions that somewhat contradict previous findings, asserting that the power of learning is a negotiated construct between young children and early childhood

educators, reflecting a traditionally enhanced power dynamic between the two parties.

The study's findings also reveals differences in the mean gain scores across the first, second, and third age groups of children taught sound energy -physics-related topics using the Reggio Emilia Approach. The data showed that the 5 to 7 age group had the highest gains, followed by the 8 to 10 age group, while the 11 and above group had the lowest. These results suggest that the Reggio Emilia Approach is more effective for younger learners. This conclusion is consistent with the research by Elui et al. (2021), which explored the impact of the Reggio Emilia approach on interest and achievement in emergent literacy skills among nursery three children, as well as the work of Mendes-da-Silva and Rocha-Lédo (2020)., which focused on prominent Italian schools and the Reggio Emilia Approach's contributions to clinical psychopedagogy. The study examined Reggio Emilia's techniques, prevalent in Italian schools and their contribution to psycho pedagogy during clinical procedures. The methodology employed was bibliographical to collect information regarding psycho pedagogy and its efficacy, particularly in relation to Reggio as a premier model of early childhood education globally. The information indicates that the listening pedagogy from Reggio fosters motivation, relationships and enhances the enjoyment of learning among students.

## 5. Conclusion

It can be concluded from the findings of this study that Reggio-Emilia teaching approach can significantly enhances pupils' understanding of Sound Energy, a physics-related concept in basic science. Pupils exposed to this method, either alone or in combination with digital tools like the KwaraLearn teacher tablets, consistently outperformed their peers taught with the conventional approach. Although the study revealed no significant interactive effect of age on pupils' performance, it confirmed that the approach is effective across different age groups, with younger learners showing slightly higher gains.

The Reggio-Emilia philosophy, which promotes child-centred, exploratory, and participatory learning, proves to be a powerful pedagogical strategy for improving conceptual understanding and engagement in science education at the basic level. These findings support the call for integrating evidence-based, developmentally appropriate methods like the Reggio-Emilia approach into the Nigerian basic education system to achieve deeper learning and improved academic outcomes in science-related subjects.

**Recommendations**:

The following recommendations are raised in tandem with the findings of the study:

- Kwara State government should integrate the Reggio-Emilia approach with the KwaraLearn initiative to achieve the holistic learning outcomes desired for early stages of learning in the state.
- Educators must undergo training and professional development aimed at comprehending and applying the ideas of the Reggio Emilia approach proficiently. This training must underscore the significance of promoting communication, cooperation and inquiry-driven learning inside the classroom.
- Curriculum developers should investigate methods for aligning current curricula with the principles of the Reggio Emilia approach, particularly in disciplines where empirical evidence indicates its efficacy, such as the sciences (physics, chemistry, biology) and mathematics, to prevent these subjects from becoming burdensome for learners at this stage and to enhance their development in the third phase of their educational journey. This may entail the development of curriculum materials that emphasise experiential learning and problem-solving activities for primary and secondary education levels.

## Abbreviations

| | |
|---|---|
| ANCOVA | Analysis of Covariance |
| REA | Reggio Emilia Approach |
| SEPT | Sound Energy Performance Test |

## Author Contributions

**A. A. Yusuf**: Conceptualization, methodology, writing-original drafts, writing and editing and everything about the paper
**A. O. Akanbi**: Supervision, Writing-Review and editing
**E. K. Ola-Alani**: Co-Supervision, Writing-Review and editing
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