Chapter One

Introduction

1.1 Background to the Study

Mathematics is a compulsory subject at both primary and post-primary level in Nigeria as a result of its importance to the scientific and technological advancement of the nation. It is also one of the crucial and strategic school subjects worldwide due to its mutual relationship with other subjects which make it a foundation subject. The importance of Mathematics can be further justified by the way it is being made a compulsory subject and course at the primary, secondary and tertiary educational level in Nigeria. In addition, Mathematics is seen as a strategic subject not only from the point of view of getting academic qualifications, but also as a subject that prepares the students for future challenges as well, irrespective of the field they eventually ventures into[1].

Furthermore, the scientific progress and technological prosperity of a country can be said to depend on the quality of Mathematics taught in its educational system, especially at the primary and secondary school level, where the foundation for subsequent educational development is laid. In order to survive in the society and improve one's quality of life, basic learning skills such as reading, writing, arithmetic and life skills, are necessary and Mathematics education was designed to nurture these skills[2]. In other words, the usefulness and benefits inherited in Mathematics is so enormous that students across all levels will always encounter it and Mathematics-related problems. Thus, the emphasis being laid on Mathematics as a core, mandatory and compulsory subject offered in primary and post primary institutions of learning in Nigeria and its recognition as part of the mandatory requirements for admission into Institutions of higher learning in the country through

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attainment of credit in external examinations are clear indications of the relevance of the subject in the Nigerian educational system[3].

In addition, most recruitment exercises and job opportunities in both private and public sectors in Nigeria are mostly based on Mathematics and current affairs related questions, thus further emphasising the strategic importance of Mathematics. All these are notable and concrete validations for the much emphasis laid on Mathematics as a field of study and subject in virtually every aspect of national development. As the world is advancing into technology-driven economies, such development and advancement will surely be based on scientific and technological knowledge both of which are highly dependent on Mathematics and other science subjects. This simply implies that, the general development of a country in terms of economic prosperity, scientific and technological advancement among others, is largely reliant on the scientific and technological education, and by extension, the Mathematics Education made available to the citizens of such country[4].

One of the common Mathematics concept/topic at the secondary school level is Algebraic word problems. The teaching of Algebraic word problems in Mathematics is premised on the idea that real life Mathematics problems goes beyond simple and common Mathematical operations as it can incorporates a combination of operations such as addition, subtraction, multiplication, square root, square, division and other operations. Thus, the incorporation of Algebraic word problems as a Mathematics topic can be justified by the need to enable Mathematics students applies Mathematics knowledge to real-life problems. A good Mathematics teacher should thus be able to expose students to necessary Mathematics skills to prepare them for everyday life and preparing them for future challenges.

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Furthermore, Algebraic word problem is a Mathematics problem where the relevant information is presented grammatically rather than by using Mathematics symbols and signs. In this case, students were expected to apply basic mathematical skills to solve real-life situations through application of Mathematics symbols, operatives and procedures. This topic is a very important as it permeates virtually all other Mathematics topics thus forming a common basis for research problems among of researchers such as psychologists and Mathematics Educators. It has been documented that most researches related to Algebraic word problems focuses mostly on the likely influences of linguistic, computational, and presentational task features such as number of words, grammatical complexity, presence of particular key words, number and nature of the required operations, nature and size of the given numbers and subject features such as age, gender, general intelligence, linguistic and mathematical ability of the problem solver among others, on learners' success rate[5].

Algebraic word problems are usually made up of sentences highlighting a scenario requiring applications of Mathematics operations such as addition, subtraction, multiplication, division, less than, greater than, equal to and others. These are usually real-life situations that people might find themselves in every day, thus requiring application of one method or the other. The rationale behind Algebraic word problems can further be justified by the fact that learning problems are important for children to understand as they make them apply their knowledge of different Mathematics concepts to problems. This can also further be justified by the fact that they understand Mathematics language and terms like difference, fewer, more, less, multiply, addition, subtract, reduced among others. It's very common to see teachers including Algebraic word problems in their Mathematics lessons a couple of times a week as the concept of Algebraic word problems permeates virtually all

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Mathematics topics. This further gives children a chance to work on the problems and let their brains process what they have learned.

As important as Mathematics and Mathematics topics like Algebraic word problems are to attainment of goals, aims and objectives of learning Mathematics, there is extremely high and consistent failure of Nigerian students in it as students continue to exhibits weaknesses in almost all topics and aspects of the subject, particularly in Nigeria[6]. This was revealed in most of the results released by external examination bodies like West African Examinations Council (WAEC) and National Examinations Council (NECO), which usually reveals a mass failure in Mathematics and English Language[7, 8]. On the basis of the above, the performance of students in other school subjects can be said to appear higher than that of Mathematics, thus making investigating poor performance in Mathematics a topical issue in educational researches in Nigeria without exception of students with hearing impairment.

This dwindling performance is likely to be caused by a myriad factors which can be student-related, government-related, home/family-related and environment/society-related Specifically, many studies and authorities presented many causes of poor performance in Mathematics among students. The government-related factors are in the majority and these includes but not limited to: shortage of well-trained Mathematics teachers, inadequate Mathematics teaching facilities, lack of fund to purchase necessary teaching and learning equipment, poor quality of Mathematics textbooks, large Mathematics classes, poorly motivated Mathematics teachers, lack of science and Mathematics laboratories and libraries, poorly coordinated supervisory activities, interference in the school system by the civil service, incessant transfers of Mathematics teachers, automatic promotions of pupils who did not pass Mathematics and inequality in access to education opportunities, all of which

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hamper the smooth acquisition of Mathematics knowledge and further contributes to the dwindling state of Mathematics achievement[9, 10, 11, 12].

However, it should be noted that the main aims of teaching and learning Mathematics topics and concepts such as Algebraic word problems can only be attained if the needs of all categories of learners in the classroom is considered as every classroom is diverse in nature. In other words, there is diversity in every classroom as a result of the varied learning needs, abilities and background of each student. Diversity can be conceptualised through understanding of each student's differences along dimensions of ethnicity, gender, socioeconomic status, age, ability/disability among others. In other words, diversity in the classroom can be said to signify variations in abilities, intelligence, status and identities. For instance, student's age, race, socioeconomic status, gender, disability, and nationality can be construed as components of diversity among students. On the basis of the above, any special need and disability displayed by a student can be categorised as a component of diversity which need to be considered by the teacher, while planning for classroom activities.

In relation to the above, Nigeria is a signatory to the Education for All (EFA) policy. Education for All (EFA), which is a global intervention started by the United Nations Educational, Scientific and Cultural Organization (UNESCO). The main aims of EFA includes provision of basic education to all people, including children, youth and adults, which is synonymous with what inclusive education signifies[13, 14]. The discriminatory attitude of educating students with special needs in alienating environments such as segregated/special schools was what prompted the introduction of inclusive education and this educational practice has been recognized as a strategy to reach the EFA goals in the Dakar Framework for Action[11]. In other words, the concept of diversity can thus be said to be

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synonymous with inclusive education as both concepts emphasises a situation whereby instructors are aware of the diversity of students and works with students to create a safe and collaborative learning environment. That way, teacher adopts multiple learning strategies to deliver instructions and provide students with an opportunity to share what they know.

Based on the above, there is the need for change in the process of teaching and learning Mathematics due to the need to fully accommodate the needs all categories of learners who are of various individual differences and intellectual capabilities. This is what inclusive education entails as creating equal access to all categories of students in the classroom is crucial to attainment of teaching objectives. This is justified in as there are varieties of students in a classroom with varying learning needs. While some are having high intelligence quotient which demand a specialised educational programme for them, others are slow learners and some might be facing certain learning difficulties due to the existence of a physical or unseen learning disability. All these variables are muchcapable of directly influencing the academic achievement of students in Mathematics and need to be considered in any educational planning and study. Such seen and unseen learning disability can range from auditory, visual, intellectual, physical and emotional challenges. However, this study focused on the category of students experiencing auditory impairment.

The World Health Organization stated that a person who is not able to hear and someone with hearing thresholds of 25 dB or better in both ears can be said to have hearing loss, while the hard of hearing refers to people with hearing loss ranging from mild to severe and capable of benefiting from usage of assistive devices such as hearing aids, cochlear implants and communicating through spoken language, lip-reading and captioning.[15] Educational challenges and obstacles related to hearing impairment, stem around

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communication. Such students are likely facing difficulties in the aspects of arithmetic, calculation, manipulation among others. This clearly implies hearing impairment is a factor capable of directly affecting secondary school students learning of Mathematics.

Hearing impairment could be viewed as one of the most complex sensory deficit in humans and can be of various forms and capable of influencing the academic achievement of students in Mathematics generally and Mathematics Algebraic word problems in particular. Hearing impairment can be congenital or adventitious. Congenital hearing loss is a hearing loss that occurs before birth and can be mostly associated with genetic factors, disease or medications[16]. This kind of hearing loss means you are born with partial or complete hearing loss and it is most often associated with genetic disorders that affect the normal development of hearing organs, although birth complications, maternal infections, and drug and alcohol use during pregnancy are sometimes to blame[17]. There are three types of hearing loss that could occur congenitally and these are conductive hearing loss which involves problems with the outer or middle ear; sensorineural hearing loss**,** which involves problems with the organs that transmit nerve signals from the ear to the brain such as the cochlea and the cochlear (acoustic) nerve of the inner ear and mixed hearing loss, which involves features of both conductive hearing loss and sensorineural hearing loss.

Hearing loss could also be adventitious (acquired) which occur after birth as a result of post-natal causes. This type of hearing loss which is the most common and occurs at a later stage during a person's life as a result of various factors ranging from diseases or infections to accidents. For an hearing loss to be considered adventitious, such a child must possess a normal auditory system which functions normally, just like any other person, until a situation arise which alter everything. Such situations can be in form of accident,

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infections, disease among others. Among the common causes are diseases like measles, mumps, flu, typhoid fever, otitis media – inflammation of the middle ear, red fever and meningitis[18]. It has also been discovered that exposure to drugs and harmful chemicals can likewise lead to hearing deficiency as certain medications can lead to bad effect on the hearing system and some of these drugs are ototoxic drugs like aminoglycoside antibiotics, diuretics and cisplatin[19].

From the above, it could be deduced that type of hearing impairment is a strong factor to be considered while carrying out any study that focuses on education of students with hearing impairment. This could be premises on the idea that students with hearing impairment are likely to experience challenges in learning Mathematics concepts such as Algebraic word problems due to the nature of Mathematics language and difficulties arising from the identification of crucial connectives which these students might find difficult to interpret and everyday words that are used in very specific ways in mMathematics and specialist words which have to be learnt so that problems can be solved[20]. There is also the need to consider other language structures such as conditionals (if and when), comparatives (greater than, the least, less than and the most), negatives (not and without), inferentials (should, could, because and since), low information pronouns (it and something), lengthy passages that relies on connectives, words that have different meanings within Mathematics than they do in general usage (such that, difference, factor, product and integral), various ways of expressing concepts, abbreviations and symbols[21].

It can be stated that Mathematics performance can be affected by language comprehension abilities as students with hearing impairment experiences delay in development of language skills and this delay affects their ability to comprehend Algebraic

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word problems, comprehends and interpret Mathematics terminologies and engage in mathematically-centred classroom discussions[22]. Research indicates that students with hearing impairments may encounter difficulties comprehending mathematical vocabulary and instructions, resulting in errors when solving problems and a diminished sense of confidence in their Mathematics skills[23]. As expected, these notable challenges are enough evidences that students with hearing impairment actually experiences difficulties in understanding crucial Mathematics concepts and topics such as Algebraic word problems [24].

Students with hearing impairment, as a result of their acoustic inadequacies, usually adopt visual and manual ways to communicate, and that further explains their reliance on a special coded manual and spatial language for interaction based on signs which makes use of body language and lip patterns. Thus, there is the need to adopt an appropriate learning strategy to make them learn at an equal pace compared to their hearing peers and that's why strategies and educational tools for teaching/learning Mathematics should be inclusive and accessible in such a way that everyone in the same classroom should be able to learn at an equal rate. Adopting inappropriate ways of learning can make them learn at a slower pace irrespective of the school setting they are placed, whether segregated or inclusive.

Given the linguistic challenges likely faced by students with hearing impairment, interpreting Algebraic word problems into mathematical statements might be a bit challenging. The way out is thus for the teacher to devise the appropriate instructional strategy capable of inculcating Mathematics growth mindset and positive learning skills in students with hearing impairment. Thus, while attempting to achieve the aims and objectives of teaching Mathematics to students with hearing impairment, there is the need to imbibe the spirit of Mathematics growth mindset through adoption of constructivist-based learning

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strategies such as collaborative learning capable of taking care of the diverse learning needs of such students in various Mathematics topics, especially in Algebraic word problems. This assertion was further reinforced by the fact that some methods used in teaching and learning of science subjects such as Mathematics are ineffective and devoid of challenging and creative activities, thus demanding for the use of an instructional strategy that could involve use of concrete activities to enhance learning among learners. Thus, Mathematics teachers need to engage the students in a collaborative learning environment which encourages social interaction among students with hearing impairment.

As Algebraic word problem is a very crucial aspect of Mathematics that exposes students to critical and logical thinking, it definitely have a significant role to play as far as teaching of science and technology is concerned. These skills can be achieved if in Algebraic word problems learning, the conceptual understanding relational knowledge is embedded in the minds of students as conceptual and relational knowledge is more needed by students with hearing impairment, not memorisation and cramming[25]. Such category of knowledge reflects the ability of students to combine, relate and connect several different learning activities and apply same to problem solving. The most often used mathematics concepts thus require deep understanding to facilitate their proper application in real-life situations.

Toward this end, students with hearing impairment in classrooms, whether segregated or inclusive, need to be given opportunity to have equal access to Mathematics learning so as to significantly reduce the learning gap between them and others. In other words, the aims of teaching Mathematics can only be achieved if all psychological impediments capable of disrupting smooth acquisition of Mathematical skills are removed. Among examples of such psychological impediments is what is termed mindset[26]. Students with hearing impairment's

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readiness to learn is dependent on their believe that they can learn or not and those with the belief that abilities can be improved with consistent practice (growth mindset) tend to show higher motivation than those who believe that abilities are unchangeable (fixed mindset)[27]. This implies that a student's readiness and ability to learn basic mathematical concepts can be hampered by the type of mindset such a student possess.

Students with fixed mindset exhibits the tendency to give up easily on challeneging tasks, whereas those with a growth mindset are of the opinion that keeping going, even when work is hard and being persistent is the ideal value to imbibe[24]. In other to eradicate fixed mindset in a Mathematics class, there is the need to imbibe the culture of growth mindset. The two mindsets are associated with different achievement pathways. It can thus be stated that having a growth mindset is paramount to positive Mathematics achievement as it motivates students to believe that their abilities can be boosted and improved upon[28]. In other words, growth mindset is the complete opposite of fixed mindset as it eradicates all manners of negative thoughts and attitudes towards learning of Mathematics. This is a very important tool to possess in a Mathematics class as the pathway toward unhindered learning need to be strengthened first.

However, apart from the need to imbibe growth mindset in learners in a Mathematics class, it can be stated that the objectives of Mathematics education can only be achieved if the needs of all categories of learners in the classroom is considered as every classroom is diverse in nature. In other words, there is diversity in every regular classroom as a result of the varied learning needs, abilities and background of each student. Diversity can be conceptualized through understanding of each student's differences along dimensions of ethnicity, gender, socioeconomic status, age, ability/disability among others. There can thus

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be said to be a close and interlinked relationship between diversity and inclusive education as both concepts create awareness about the need to consider individual needs and differences of students by creating an inclusive and collaborative classroom. That way, teacher adopts multiple learning strategies to deliver instructions and provide students with an opportunity to share what they know.

Continuously, the aims and objectives of teaching Mathematics to students with hearing impairment are attainable if appropriate learning strategies suitable for their learning needs are adopted as the success of any teaching depends on the teaching strategy adopted by the teacher. Such learning strategies, as envisaged, should have dual advantages of imbibing growth mindset in them and taking care of their diverse learning needs through constructivist approach. An example is collaborative learning strategy. This can be justified by the fact that some of the factors which lead to successful learning include 'learning by doing' and 'making sense of things[29] and collaborating.

The focus on collaborative learning strategy strategies is premised on the assumption that subject teachers who adopt constructivist approach in teaching abstract subjects like Mathematics are more effective compared to those who transmits. This can be reinforced by the idea that these strategies are constructivist in context rather than being transmissive as teachers who are constructivist in their teaching style view learning as centred in the development of skills and knowledge in the child, while those who are transmissive are focussed on the delivery of curriculum content and the efficiency of information flow to the learner[30, 31].

Also, with regards to current global trends in education, teachers are expected to teach beyond subject matter and imbibe important life and learning skills which include

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critical thinking, creativity, collaboration and communication[32, 33]. Thus, promoting a learning environment that is premised on collaboration and cooperation, which addresses the aforementioned learning skills and thus exposes students to cooperation skills after school which further prepares them for life after school which can be challenging and competitive. This further justifies the need for the adoption in inclusive teaching and learning strategies such as cooperative and collaborative learning strategies.

Thus there is the need to erase all challenges, fixed traits in students with hearing impairment and replace them with growth mindset through constructivist approaches to teaching Mathematics such as collaborative learning strategies in teaching students with hearing impairment in the classrooms. The rationale behind such learning strategies is embedded in the belief that constructivism approach is synonymous with paradigm shift from traditional and conventional learning to modern pedagogies. In other words, constructivist approach is the best in building growth mindset in learners. However, there is the need to briefly discuss what collaborative learning strategies are all about.

Collaborative learning strategy is an instructional approach premised around organizing classroom activities into academic and social learning experiences and such a educational approach encompasses a whole lot more than group work as it improves social skills through cooperation and collaboration in learning, provides learning cum social opportunities for students in a controlled environment and allows for students to be academically successful and socially active[34, 35]. The implication here is that this learning strategy is presented as a social experience that fosters interdependence and positive dependency in such a way that knowledge construction takes place through collaboration. A valid demonstration of the idea that two heads is better than one. However, collaborative

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learning needs to be structured and all students need to be involved to accomplish specific goals and acquire knowledge through information exchange, self-evaluation among the participants, all these processes facilitated by the teacher as the teacher is classified as a facilitator[31]. Collaborative learning strategies also involves work in small clusters and teams to achieve a stated goal in Mathematics, as determined and facilitated by the teacher. These methods can be used to teach any Mathematics topic to any class as it accommodates all age ranges.

The underlying context of collaborative learning strategy is premised upon reaching consensus as a team through cooperation and collaboration among team members. This is totally different from competing with each other in that each member of a group is key to resolving the main problem and there is no effort by a group to defeat another, while competition promotes the exact opposite of this. This process can be used in various learning situations, irrespective of learning needs, ability level, gender and special needs as it does not discriminate on any basis. In addition, while applying collaborative learning strategy, the team members work independently on specific tasks based on teacher's instructions, within the same group to achieve a common goal[36]. In other words, collaborative learning strategy is an instructional approach that puts the burden and responsibility on team members/students to be actively involved in cracking the main problem and resolve the logjam themselves. This kind of system enables students to benefit from each other through shared responsibilities and accountability by learning from the knowledge and strengths demonstrated by others[37].

There are some essential components of collaborative learning strategy that distinguished it from other learning strategies. These are: positive interdependence which imply that when an environment of interdependence is provided, students feel responsible

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for their own outcome and the team's success which translates to sinking or swimming together; face-to-face interaction which demonstrate how students engage in meaningful discussions, make bold eye contact with each other and provide supportive guidance; group behaviors: students can acquire various behavioral techniques like interpersonal and social skills that teach students how to successfully work together with fellow team members; and group processing which signify that students can evaluate the effectiveness of their team at the end of the given task by analyzing how well its members were able to collaborate[38].

Collaborative learning strategy can thus be said to be a process capable of actively engaging Mathematics learners to process, synthesise and apply information and ideas, unlike the traditional strategies that promotes rote memorisation of information and facts. In other words, collaborative learning strategy can be explained as a process of interaction and learning style where students are responsible for their actions, acknowledge and respect the knowledge, decisions and contributions of their peers. In other words, it depicts a situation where people come from teams to tackle a given instructional conundrum like Algebraic word problems in groups and respects and highlights other team members' decisions, judgement and contributions as this process describes a situation involving sharing of control and taking responsibility among team members for the teams' decisions[39].

There are various examples of collaborative learning strategies that can be used in teaching Mathematics to students with hearing impairment. However, it should be noted that in each of these strategies, methods and techniques, the teacher's responsibility is to guide and observe the members of each group, give direction for selecting the members of the group, choose the Mathematics topic they will learn and assists in obtaining the learning materials and allocate duties among the students so that each member's assigned

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responsibility is incorporated to achieve the predetermined aims, goals and objectives. There are several types of collaborative learning strategy but among the prominent ones are jigsaw strategy which includes jigsaw I, peer-tutoring strategy and Think-pair-share strategy among others [40]. This study focused on Jigsaw I, one-way peer-tutoring and standard think-pair-share.

Jigsaw I can be described as an instructional strategy in which students of varying abilities are categorized into home and expert groups, and each student is then asked to work on a different element of a particular selected main topic[41]. In applying a jigsaw strategy, students from home and expert groups are allocated the same topic to brainstorm on and then return to their home group to explain their findings to their home group after which the entire group then gives a presentation on what they have learned about the given umbrella topic after each student of the home group to focus on one aspect of a topic[42]. For instance, one group studies Algebraic word problems involving fractions, while the other group studies Algebraic word problems involving brackets after which they meet with members from other groups who are assigned the same topic area, to compare notes and absorb the learning material. After that, they return to the home group and teach the material to their group members. With this strategy, each student in the home group serve as a piece of the topic's puzzle and when the two groups later assemble together as a whole, they create the complete jigsaw puzzle. It has been established that students exposed to jigsaw mathematical learning strategy performs better than those taught with traditional and conventional method of rote learning[43]. Teachers were thus encouraged to get more knowledge on the use of jigsaw I strategy in teaching Mathematics.

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There is also standard think-pair-share strategy which is a collaborative learning exercise involving a process whereby the individual students collaborate with another student to answer a teacher's question[44] after which the pair of students will then present their answers to the whole class. Also, standard think-pair-share strategy as designed is aimed at guiding students to think on a given topic by formulating individual ideas and share the ideas with another student[45]. In addition, standard think-pair-share is adjudged to be a strategy capable of promoting learning by guiding children to ruminate, think and evaluate their response to a question, and then share their ideas with a partner. This strategy requires the teacher to first asks a question on the topic under discussion and then compels the students to complete the three steps in standard think-pair-share[46]. The strategy is effective in any classroom settings and can be used with primary, secondary and post-secondary school students as it is a helpful way to keep students engaged in a Mathematics topic. Students are arranged in pairs based on any suitable criteria that are beneficial to all participants.

Continuously, in standard think-pair-share, as applicable to other collaborative learning strategies, the main strategy is founded on a range of complementary theoretical perspectives as the strategy allows each of the students to construct their own understanding of a problem by thinking about it independently prior to discussing it with a classmate or partner[47]. This process further entrench constructivism approach in learning Mathematics among students. Simply put, standard think-pair-share signifies a situation whereby Mathematics students works together on a Mathematics problem within a structured period of time as there is tendency for students to get off topic if the allocated time is not structured.

Another prominent example of collaborative learning strategy is one-way peer-tutoring. One-way peer-tutoring is a refers to an instructional strategy in which learners

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works together in a modified teacher-student arrangement where one of them who acts as peer teacher conveys knowledge and skills that he/she has mastered to the other who is classified as peer learner. In this situation, the real teacher acts as a facilitator or supervisor. In other words, one-way peer tutoring can be described as an interactive approach between two or more students in which one of them, usually the more knowledgeable one, acts as the teacher, while the remaining student(s) are the learner. It has been revealed that peer-delivered instructional strategy such as peer-tutoring is very effective in teaching academic skills to students with varying needs across grade and ability levels[48, 49].

It can thus be justified from the above that collaborative learning strategy gives students with hearing impairment a chance to share their own unique ideas and learn from each other. In other words, one of the best ways to get students with hearing impairment to learn actively in a Mathematics class is to use the collaborative learning approach as a way of teaching where such students work together in small groups to reach a shared goal. That way, students will be made to be responsible for both their own learning and the learning of others and share the burden to succeed.

However, due to the nature of the problem under investigation and the nature of Algebraic word problems, this study focused on jigsaw I, one-way peer-tutoring and standard think-pair-share strategies. Based on the need to fully integrate all categories of students in the classroom, specifically the students with hearing impairment, into Mathematics learning and the benefits inherent in adopting collaborative and cooperative learning strategies, there is the need to determine the possible effects of the selected learning strategies on the academic performance of students with hearing impairment, especially in areas like words

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problems which is directly affected by the delayed or impaired language development among students with hearing impairment. Thus, this research work thus proceeded in that direction.

1.2 Statement of the Problem

Students with hearing impairment are known to experience difficulties in Mathematics generally and particularly, Algebraic word problems. The issue with Algebraic word problems can be linked to their inability to decode spoken words and terminologies which are crucial to solving Algebraic word problems related questions. There is thus the need for Mathematics teachers to find a solution to this anomaly by adopting appropriate learning strategies. Consideration can be given to learning strategies that promotes social learning and positive interdependence such as cooperative and collaborative learning strategies. Focus was therefore on selected collaborative learning strategies such as jigsaw I, standard think-pair-share and one-way peer-tutoring.

In addition, the influences of certain variables capable of affecting the achievement of students with hearing impairment in Algebraic word problems such as mindset and type of hearing impairment need to be considered. The study was thus carried out on the basis of mindset and type of hearing impairment of students of the students. Thus, mindset and type of hearing impairment served as moderator variables of the study. The study is thus necessary as there is a dearth of available literature on the topic. This research work thus made efforts to bridge this gap.

1.3 Aim and Objectives of the Study

The aim of this study was to determine the effects of collaborative learning strategies on academic achievement of senior secondary school students with hearing impairment in

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Algebraic word problems in inclusive classrooms. Specifically, the objectives of the study are to:

i. examine the main effect of treatment on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.
ii. examine the main effect of type of hearing impairment on academic achievement of senior secondary school students with Hearing Impairment in Algebraic word problems.
iii. examine the main effect of mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.
iv. examine the interaction effect of treatment and hearing impairment on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.
v. examine the interaction effect of treatment and mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.
vi. examine the interaction effect of hearing impairment and mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.
vii. examine the interaction effect of treatment, hearing impairment and mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

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1.4 Hypotheses

Ho1: There will be no significant main effect of treatment on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Ho2: There will be no significant main effect of type of hearing impairment on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Ho3: There will be no significant main effect of mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Ho4: There will be no significant interaction effect of treatment and hearing impairment on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Ho5: There will be no significant interaction effect of treatment and mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Ho6: There will be no significant interaction effect of hearing impairment and mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Ho7: There will be no significant interaction effect of treatment, hearing impairment and mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

1.5 Significance of the Study

The study is significant in the sense that it would be beneficial to teachers in inclusive settings on how best to handle the learning needs of students with learning difficulties in

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general and those with hearing impairment in general. Also, learners with hearing impairment would be able to identify ways of maximally benefiting from an collaborative learning settings. Mathematics teachers in inclusive settings would also be able to identify strategies for boosting the best mindset and academic performance of students with hearing impairment.

1.6 Scope of the study

The variable scope of the study covered selected collaborative learning strategies of jigsaw I, think-pair-share, peer-tutoring and conventional learning strategy which served as the control group. The effect of these selected strategies on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems in Oyo State was examined. The scope of the study also involved only three aspects of Algebraic word problems which covered word problems involving fractions, word problems involving brackets and word problems involving both fractions and brackets.

The senior secondary school students with hearing impairment were those with any form of hearing impairment which could be congenital, that is, occurred before or not long after birth or adventitious which refers to an hearing loss that occurred after birth as a result of accident, environmental factors, disease, infections and any other factor. They were also categorised on the basis of the mindset they possess. The type of hearing impairment and mindset possessed thus served as moderator variables used in categorising the students. The study thus determined the effects of the selected collaborative learning strategies on academic achievement of students with hearing impairment on the basis of type mindset they displays or possess which can be fixed or growth.The study thus determined the effects of the selected collaborative learning strategies on academic achievement of students with hearing

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impairment on the basis of type mindset they displays or possess which could be fixed or growth.

The geographical scope of the study was limited to selected secondary schools for students with hearing impairment in Oyo State. However, due to high concentration of special schools in Ibadan zone and scarcity of such schools in some zones like Ibarapa and Oke-ogun, two schools were selected from Ibadan zone alone with one school from Oyo zone and another one from Ogbomoso zone. Thus, Ijokodo High School, Ijokodo and Methodist Grammar School Bodija were selected from Ibadan zone, while Ogbomoso Grammar School, Paku was selected from Ogbomoso zone and Durbar Grammar School, Oyo was selected from Oyo zone.

1.7 Limitation of the study

The study faced some challenges and limitations. First of all, securing permission from the relevant authorities to use all the selected schools for the research was cumbersome as the schools were on session, with examinations fast approaching and anything capable of causing distraction was frowned at. Also, accessing vital documents such as the case files of the students which contains their medical history from which the type of hearing impairment was extracted was also not released on time due to the confidentiality of the contents. There was also the challenge of communication involving the recently-deafened students who are not yet versed in sign language which is the adopted channel of teaching students with hearing impairment. These students were taught using a mix of total communication involving gesturing, simple sign languages, writing on the board among others. Another major constraint experienced in the course of the study is the challenge of getting the

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commitments of the research assistants in each school as they were not keen at first due to their tight schedule.

1.8 Operational Definition of Terms

Mathematics Academic Achievement in Algebraic **Word problems:** These are scores of the senior secondary school students with hearing impairment in the pretest and posttest tests on Students Achievement Test on Mathematics Words problems.

Algebraic **Word problems:** A significant Mathematics topic where background information on the problem is provided to Students with Hearing Impairment in ordinary language rather than in Mathematical notation.

Hearing Impairment: Loss in hearing ability by a Mathematics student which can be congenital or adventitious

Congenital Hearing Loss: A type of hearing loss that occurred during or not long after birth and which can be conductive, sensorineural or acoustic.

Adventitous Hearing Loss: A type of hearing loss that occurred after birth.

Mindset: A collection of thoughts and beliefs that shapes one's thoughts habits of students with hearing impairment in Mathematics class and which affects how they thinks, feels and reacts to issues which can be growth or fixed.

Growth Mindset: Ability of students with hearing impairment to believe that they can learn anything and that their intelligence can grow as far as Mathematics is concerned.

Fixed Mindset: A situation whereby students with hearing impairment believe that traits like intelligence and talent are inborn, fixed and unchangeable as far as Mathematics is concerned.

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Collaborative Learning: A supervised and informal educational approach for students with hearing impairment which aims to organize Mathematics classroom activities into academic and social learning experiences such as jigsaw, peer-tutoring and think-pair-share

Jigsaw I: An aspect of collaborative learning strategy in which students with hearing impairment are broken up into home and expert groups, and then each student is asked to research a different element of an umbrella topic in Mathematics.

Peer-tutoring: A type of collaborative learning strategy in which a participant with hearing impairment (peer tutor/teacher) conveys Mathematics knowledge and skills that he/she has mastered to other students with hearing impairment (peer learner) under the supervision of the teacher

Think-pair-share: A kind of collaborative learning strategy in which students with hearing impairment think on a given Mathematics topic by enabling them to formulate individual ideas and share the ideas with another student(s).

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Chapter Two

Literature Review

This section is about the review of related works already done on the topic and other related topics. This was done on the basis of conceptual review, theoretical review and empirical review. Also included were conceptual framework and summary of reviewed literature.

2.1 Conceptual Review

2.1.1 Collaborative learning strategy

2.1.2 Jigsaw I strategy

2.1.3 Peer-tutoring strategy

2.1.4 Think-Pair-Share strategy

2.1.5 Algebraic Word problems

2.1.6 Academic Achievement

2.1.7 Types of Hearing Impairment

2.1.8 Mindset

2.2 Theoretical Review

2.2.1 Vgotsky's Theory of Constructivist Learning

2.2.2 Deutch's Theory of Social Interdependence

2.2.3 Vygotsky's Theory of Social Learning and Development

2.3 Review of Empirical Studies

2.3.1 Hearing Impairment and Academic Achievement in Algebraic Word problems

2.3.2 Jigsaw strategy and Academic Achievement in Algebraic Word problems

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2.3.3 Peer-tutoring strategy and Academic Achievement in Algebraic Word problems

2.3.4 Think-pair-share strategy and Academic Achievement in Algebraic Word problems

2.3.5 Mindset and Academic Achievement in Algebraic Word problems

2.4 Conceptual Framework

2.5 Summary of Reviewed Literature

2.1 Conceptual Review

2.1.1 Collaborative Learning Strategy

Collaboration in general can be described as a joint effort between parties to solve a problem or reach a conclusion through face-to-face interaction through an all-inclusive participation among each other in such a way that there is a collective decision by each of the participants and the outcome should be to every member satisfaction such that total learning is promoted through collaboration and speaking with one voice[1]. Cooperation and collaboration in the classroom emphasise group work which further makes learning to be more conducive and productive. Thus, collaborative learning strategy is an offshoot of constructivism[2], the practice of constructing new knowledge upon the foundation of previously acquired ones. It is premised on the idea that the best learning takes place when students of varied levels of ability actively got engaged in the knowledge acquisition process and work in collaboration with other students to achieve a common goal[3]. In addition, the learning strategies involved in collaborative learning all emphasised that learning is more of a social act in which the learners discusses among themselves and it is through the discussion that learning occurs[4]. In other words, collaborative learning strategies can be interpreted as educational approaches to teaching and learning that involves groups of students working

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together to solve a problem, complete a task, or create a product. It can thus be deducted that the main goal of collaborative learning strategies is to ensure a paradigm shift from teacher-centred learning strategy to child/student-centred learning strategy and entrenchment of knowledge-building skills among learners.

Furthermore, in the field of science, collaborative learning is one of the innovative practices usually deployed as it can be described as an instructional strategy that deploys motivational techniques to ensure learning is more interesting and relevant. This is in addition to increasing students' motivation, self-esteem, learning skills, reasoning and thinking ability, achievement and active learning. This avails the students the opportunity to develop interpersonal skills[5].

The concept of collaborative learning incorporates five basic elements which are: positive interdependence which indicate the task/goal assigned to each group so that each member of the group knows that they are to sink or swim together; individual and group accountability which indicate that each member of the group must make contribution as no one can predate on the work of others; interpersonal and small group skills to develop effective leadership skills among members, make important decisions, entrench trust, communicate and manage conflicts; face-to-face interaction by helping, supporting, encouraging each other and sharing resources; and finally group processing through maintaining of effective working relationship[6]. In other words, the process involves building classes around small groups that cooperates and collaborates in such a way that each group member's success is dependent on the group's success[7].

Continuously, collaborative learning is a student-centred cum instructor-facilitated instructional strategy in which a small cluster of students are jointly responsible for their own

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knowledge acquisition and that of all team members. In other words, the collaborative learning strategy holds each of the team members accountable for their outcomes and that of the entire team. To achieve this, a team must possess several essential characteristics to be called collaborative. Even though the instructor plans the majority of the activities, it is the whole team and each of its members who are responsible for their learning by demonstrating interdependence, be supportive of one another's learning, be accountable to each other for the team's success and outcomes and exhibit acceptable interpersonal skills and possess team spirit[8]. In one word, collaborative learning is an educational approach that promotes interaction among students and shared responsibility for academic achievement.

It can thus be stated that, while comparing collaborative learning strategies with traditional and conventional classroom instructional methods using the same set of teachers, curriculum and assessments, students who are exposed to collaborative learning strategies learn significantly more, exhibits better retention and demonstrates superior critical-thinking skills compared to their counterparts exposed to traditional and conventional techniques[9]. In addition, Mathematics students are likely to enjoy cooperative learning better than traditional methods. Thus, they are more likely to attend classes, participate and cooperate fully. In cases whereby students are planning to engage in assignments that involve teamwork, collaborative learning strategies guide students in developing the necessary skills required to work on difficult assignments that are complex for only one person to accomplish in a reasonable amount of time[10]. The implication of this is that collaborative learning emphasises on learners working together in small groups to accomplish specific shared goals or accomplish team tasks. Such a learning strategy has the tendency to promote socialisation

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and social learning among students irrespective of educational stage and across different subjects and curriculum areas[11].

There are many approaches to collaborative learning strategies as some set of assumptions defines these strategies and these needs to be pointed out. For instance, in collaborative learning strategies, learning is an active process involving assimilation of information by students and subsequently relating this new knowledge to a body of already acquired prior knowledge; learning is precipitated by a challenge that exposes the learner to actively take on his/her peers, and subsequently constructs, process and assimilate information instead of simply memorising and cramming details; exposing learners to diverse range of opinions from people with diverse backgrounds which can be very beneficial to them in the long run; learning is promoted in a social environment where fruitful discussion between learners takes place thus enabling each learner to construct a new knowledge from their own perspective during the discourse[12].

Another aspect of collaborative learning that can be deduced from the above is that, in an environment that promotes collaborative learning, learners are socially and emotionally challenged by listening to multiple perspectives, expanding their knowledge reservoir thus enabling them to articulate and defend their ideas. As a result of this, learners develop their own personal meanings to the topic under discussion instead of relying on crammed, memorized or regurgitated meanings. All these developments are made possible due to the opportunities to discuss with peers, state and defend personal ideas, engage in exchange of diverse opinions, question others opinions, and be actively involved in the learning process[12].

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There are five key elements of collaborative learning strategy that differentiate it from simply putting students into groups to learn and these are: positive interdependence, individual accountability, face-to-face interaction, interpersonal and small group social skills and group processing[13]. There is positive interdependence as the usual rationale and motivation behind grouping students to work in teams in the first place is to find solution to a given task that is difficult for student to accomplish individually within a reasonable period which further promotes the spirit of sink or swim together among students when perceive that they are not alone in resolving the given task. This can easily be achieved through setting of mutual and achievable goals, engaging in division of labor, dividing materials and allocating roles and by ensuring that each student's scores is dependent on the performance of the whole group. That way, all the group members will be of the opinion that individual effort is beneficial to the entire group, not only to one person. Thus positive interdependence can be achieved by ways of output goal interdependence in which a single outcome is produced by the group; acquiring knowledge on goal interdependence whereby every member can understand, defend and explain the group's outcome; resource interdependence whereby members have access to parts of the given assignment or relevant information or the group is only provided one copy of the assignment; and role interdependence in which members are given distinct roles that are key to the functioning of the group.

There is also individual accountability in collaborative learning. The essence of individual accountability in collaborative learning is students learn together, but perform alone. That way, no one can hitch-hike on the work of others. A lesson's goals must be clear enough that students are able to measure whether (a) the group is successful in achieving them, and (b) individual members are successful in achieving them as well. Individual

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accountability can be achieved through Individual grades whereby individuals can be given quizzes and examinations. Likewise, parts of group projects can be done independently or randomly drawn students can provide oral/written reports on group results. Another way to discourage students from letting others do their share of group work is to have students (anonymously) rate their group mates and include the average rating from all of a student's group mates as part of his or her grade.

Collaborative learning also promotes face-to-face interaction as relevant cognitive activities and interpersonal dynamics only occur when students promote each other's learning. This includes oral explanations of how to solve problems, discussing the nature of the concepts being learned, and connecting present learning with past knowledge. It is through face-to-face, promotive interaction that members become personally committed to each other and to their mutual goals. Face-to-face interaction can be achieved by encouraging students to interface with multiple parts of the project by assigning roles that require interaction with the rest of the group as they work, such as checking data, keeping the group on task, or keeping records.

There is also promotion of interpersonal and small group social skills in collaborative learning. In a typical collaborative learning group, students are exposed to academic subject matter (taskwork) and also cooperative and small team skills (teamworks). Such a team must be able to provide effective leadership, possess decision-making skills, develop trust-building, possesses good communication skills and exhibit conflict management skills. Given the difficulties associated with development of these skills, teachers can use collaborative learning strategies to motivate students to attain perform better. As students develop these skills, subsequent group works will likely be easier to resolve efficiently than previous ones

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based on experiences already acquired. It is thus very important and helpful for the teacher/facilitator to explain to students the reasons for working together and how they can promote learning among themselves. Also, teachers should give students time to adapt to working together before expecting positive results from adoption of collaborative learning strategy. For instance, by assigning students to groups early in the term and enable them carries out a series of assignments or projects together, they are likely to familiarize themselves with each other's area of strengths, thus learning to interdepend on each other by asking questions and working together as a team.

There is also group processing. For instance, upon completion of their assigned task, it is imperative that students be given enough time and procedures for discussing how well their learning groups are progressing and how well their social skills are being put into practice. Group processing covers both taskwork and teamwork, with the expectation that there will be improvement in the next project. This can be done through writing of individual observations on their learning after completion of the project, indicating their experiences during the project.

There are common techniques that can be used to promote the above mentioned elements of effective collaborative learning. Some of the well-known types of collaborative learning strategies are[14]: think-pair-share, jigsaw, guided design, simulations, peer-tutoring, small group discussion, peer editing, fishbowl debate, roundrobin, the three-step interview, STAD (Student Teams Achievement Division), TGT (Teams Games Tournaments), GI (Group Investigation) among others.

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2.1.2 Jigsaw I strategy

The jigsaw learning strategy is a research based collaborative learning technique innovated and developed in the early 1970s by Elliot Aaronson and the most commonly used one is jigsaw I. The technique emphasises on collaboration during classroom activities in such a way that students are interdependent on each with the aim of successfully resolving a given task. This is achieved through classification of students into groups and breaking tasks into pieces with the groups expected to assemble to complete the entire task[15]. In a jigsaw I strategy, each of the students' contribution is essential for resolving and full understanding of the final outcome. In other words, just as each part of the task or assignment is essential, each student is essential as well and that is precisely the main reason that makes this collaborative strategy so effective.

Furthermore, jigsaw I is a collaborative learning strategy that enables each student of a home group to specialize in one aspect of a topic(for instance, one group studies Algebraic word problems involving brackets, while another group studies Algebraic word problems involving fractions). Students are required to brainstorm with members from other groups who are given the same area of the topic and after grasping a good understanding of the material, return to the home group and explain the material to other group members. Through this method, each member of the home group serves as a piece of the task's puzzle and when they come together as a whole, they resolve the complete jigsaw puzzle[16]. Certain unique traits associated with jigsaw learning strategy which distinguishes it from other learning strategies are: ability to reduce racial or discriminatory profile by bringing students from different background together to achieve a common learning goal, granting students

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opportunities to listen to perspectives of other students, increasing students sense of belonging and encouraging students to take responsibility for their own work.

The process of using jigsaw I are: introduce the task and material to be studied; assign each of the student to a home group of 3-5 students who are of a range of Mathematics abilities; select a set of activities under a particular Mathematics topic and delegate one activity to each of the students; create expert groups of students selected from home groups who will execute the same activities; assign to all students a framework for effectively managing their time on the various parts of the given jigsaw task; provide important questions capable of guiding the expert groups in gathering information in their allocated area; provide needed materials and resources required for all students to understand their topics better and become experts; explain the rules for regrouping into home groups and provides necessary guidelines as each expert give reports of the knowledge acquired; guide each home group in preparing a brief summary chart or graphic organizer for organizing the experts knowledge report among others[17].

2.1.3 Peer-tutoring strategy

Collaborative learning can also occur in the form of peer-to-peer pairings. A peer group can be said to consist of individuals with the similar status who usually interacts with one another and the influence of peer groups is typically strong during adolescence. Thus, peer tutoring/peer teaching/peer instruction signifies activities related to isolating, brainstorming and studying one's own and others academic inadequacies in a collaborative attempt to improve learning[18]. This definition is somehow related to the supportive learning situations whereby professionals functions as one another's mentors. Thus, peer-tutoring, or peer instruction can be described as a type of collaborative learning that describes students

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working in pairs or small groups to brainstorms on concepts or find solutions to academic problems. Based on the common saying that two or more heads are better than one, educational researchers have postulated that through peer tutoring, students tutors each other by addressing difficult aspects and clarifying ambiguities[19]. This form of collaborative learning strategy usually occurs between a person who possesses a specific experience and a person who is deficient that experience. An example is an experienced and more knowledgeable student being a peer tutor to an academically inferior student, classified as the peer mentee, in a given subject like Mathematics.

Peer tutoring can also be viewed as one of the best ways to grasp a good understanding of a particular subject. It is an instructional method whereby a more knowledgeable student instructs another student who is deficient in similar area, wherein the former is classified as an expert and the latter a learner. This method enables the learner-student to acquire knowledge without depending on the subject teacher, and the tutor-student to revise on the topic again. Given the direct interaction that occurs between students, peer tutoring impact active learning and participation among students as student-teachers enhance their own knowledge depth of the topic by tutoring others[20].

In addition, Peer tutoring is not really a novel concept, as it has been in existence right from the time when the system of Gurukula education, a personalized system which emphasises on guru-shishya (teacher-student relationship), was in practice in our society[21]. And now, peer tutoring is a quite popular practice among students of all varieties as the process essentially involves students learning from each other as contemporaries without any form of superiority feeling, as Students learn a great deal by explaining their ideas to others and by participating in activities in which they can learn from their peers[22].

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There are some of the main advantages of peer tutoring[23]. It improves the student's level of creativity in expressing their own ideas and in assimilating new ideas, as the student become bolder in expressing their mind during discussions. This is capable of uplifting his knowledge level and thus improves his understanding to a greater level. By feeling comfortable with a peer tutor, a student is able to concentrate better on the given tasks, which may boost his achievements in the future. After being exposed to peer-tutoring strategy, the student will start clearing his own doubts, and thus develops the ability to resolve issues himself, thus further improving his critical thinking skills. In addition, peer tutoring emphasises interaction between the tutor-student and the tutee-student which further promotes active learning and entrenches interpersonal skills, which further reduces dependent on real teachers for clarity of lessons. Peer tutoring also has the capacity to further ease the teacher's burden because the process enables sharing of duties with students which is beneficial to both sides. Alternatively, it will further increase the teacher's role in monitoring the students.

There are some common types of peer-tutoring strategies and these needs to be discussed.

One-way peer-tutoring

This way of peer tutoring involves a process whereby only the trained student-tutor teaches, while the student with some kind of academic inferiority will remain observant and passive. This method is more useful in teaching students with severe learning disabilities like autism, deafness, visual impairment, intellectual retardation or cerebral palsy. One of the main merits of this technique is that the tutor, and the tutee, will be well aware of their roles, while practising this method[23].

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Duplex or Reciprocal peer-tutoring

Students are paired on heterogeneous basis, with each student acting simultaneously as teacher and learner to ensure a successful learning[24]. For instance, students read out a Mathematics task from the textbook and another student, acting as the teacher, asks questions about the task to the other participant, who must think the question. The pair then discusses the question and reverses roles for question asking. Once the selected question have been read and discussed, both participants review the observations they compiled for further learning. This method is useful in bringing out the activeness in students with moderate learning difficulties as every individual will get a chance to act as the tutor and the student simultaneously[24].

Class-wide peer-tutoring

In this category of peer tutoring, the whole class is engaged simultaneously as students work in pairs to apply skills or concepts they have already been exposed to[25]. This is done by asking each member of each team to take turn in acting as the tutor and tutee. The student acting as the tutor asks questions already prepared by the teacher and observes the correctness of their partner's responses. Correct answers can be made to earn two points, while partially correct or incorrect answers earn one point. Then the roles are switched and vice-versa. Another practical example of this method is by grouping the entire class into pairs and students mentoring each other by asking questions, constructively discussing tasks, correcting errors and giving guidance. That way, no student is singled-out and every student has the potential to participate regardless of their ability level.

Cross-age peer-tutoring

Another type of peer tutoring strategy is crisscross or cross-age peer tutoring. This is a style of tutoring where students of varied age groups and ability levels are paired together to work for a task and the eldest in the group or the most knowledgeable will be assigned as the peer-tutor, while the others will be the tutee thus helping the students to improve their interpersonal skills[26]. Another dimension is for the eldest of the students to be paired with younger ones to impacts contents that are age appropriate for the tutee. This is done by explaining the topic, concept or skill and thereafter asking questions to inprove the younger student's critical thinking.

Apart from the above, there are other categories of peer tutoring and these are:

Same-age peer-tutoring

In applying same-age peer-tutoring strategy, higher-achieving and lower-achieving classmate are paired together to learn content the lower-achieving student is yet understand[27]. The arrangement is not necessarily done as a whole-class model and can be practised as a small-groups arrangement, while unpaired or unengaged students rely on the teacher or work independently.

Teach-back

In teach-back peer-tutoring strategy, students are assigned a skill or concept that has been previously taught and develop a short lesson to teach it back to a peer[28]. These lessons can be recorded or enacted in real time. As one example, students were assigned a range of mathematical tasks to demonstrate how fractions are represented in different ways. Students developed charts to explain the representation they chose (e.g., groups of

objects, a number line, shapes in a tangram) then used their chart as a display to teach a partner.

There are also other versions of peer-tutoring such as,

Uni-directional peer-tutoring

In unidirectional peer-tutoring strategy, the trained peer tutor teaches the entire time, and the child with a learning disability remains the student in the pair[29]. This method is effective when working with children with more severe disabilities such as severe autism, intellectual disability, visual impairment, or cerebral palsy. The benefits of this option are that the tutor and student always know their roles, and the peer tutor carries the responsibility throughout the entire program.

Bi-directional peer-tutoring

In bi-directional peer-tutoring strategy, a student with and a student without a learning disability form a pair by taking turns at acting as the tutor, while the other students acts as the tutee[30]. The teacher can ask these students switch roles for each session. This method is very effective with students with mild learning challenges. Another benefit of this technique is that each student has an opportunity to be the tutor and experience leadership skills.

2.1.4 Think-pair-share strategy

Think-Pair-Share is a kind of collaborative learning strategy first propounded by Frank Lyman in 1981[31]. Although there are various versions of think-pair-share, the standard think-pair-share strategy is the mostly used one. It is a collaborative learning strategy where students works together to find solution to a problem or perform a given task and the name think-pair-share was derived from the three stages involved in the process which emphasises

what students are to do at each of the stages[32]. The process involves students thinking individually about a given Mathematics topic or provides answer to a given question and shares their opinions with their colleagues. By discussing their findings with a partner, students improve their participation skills and engage in activities capable of enhancing their understanding of topics or problems under discussion. The process of think-pair-share also emphasises on giving students time to think about answers to questions and further helping each other to resolve the issue with their individual and collective capabilities.

Furthermore, think-pair-share is a type of collaborative learning involving pairs of students and give enough rooms for students to ruminate on a problem, respond to questions and to assists each other[33]. That way, the technique possess the great advantages of improving students' information recalling ability and ability to learn from other students by conveying each other's ideas for discussion before concluding on the given task. The idea of think-pair-share promotes active learning among students and is considered suitable for arousing students' interest in Mathematics and making students more active in the class through socializing and collaboration among students, while discussing the topic or problem under consideration, further improving student learning outcomes[34].

The procedures and steps involved in applying think-pair-share strategy are as follows[35]:

Think*:* The teacher activates students' thinking ability through a previously planned question and students take a few minutes or seconds to think about the question.

Pair*:* Using assigned partners or a desk mate, students pair up with each other to talk about their individual solutions they came up with and compare their observations before identifying the answers they think are most suitable, convincing or unique.

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Share*:* After students works together in pairs for a few minutes, the teacher calls for each pairs to share their findings with the rest of the class. This can be done by going round the class, calling on each pair to share their findings with the class or take answers from each pairs randomly as they are called out. It is very important that the teacher or a designated student such as the class captain record these responses as they are being shared

2.1.5 Algebraic Word Problems

Mathematics is simply regarded as the study of numbers, shapes and patterns. In other words, the concept of Mathematics incorporates how things can be counted (numbers), how things are organized (algebra), where things are and their arrangement (geometry), and how things become different (analysis). Mathematics can be applied in solving real life problems. One of the aspects of Mathematics is Algebraic word problems. Algebraic Word problem is a significant Mathematics exercise where key information on the problem is presented grammatically rather than in mathematical notation[36]. In other words, Algebraic word problems can be defined as verbal or grammatical descriptions of Mathematics problem situations, presented within a scholastic setting, incorporating one or more problems to be resolved through application of mathematical operations[37].

Furthermore, Algebraic word problems can be described as a Mathematics exercise where key information on the problem is presented using ordinary language rather than mathematical expressions. To solve such problems, students are expected to apply basic and complex mathematical concepts to real-life situations using algebraic identities and other necessary applications. In addition, Algebraic word problems usually consist of sentences describing a situation that needs to be solved through application of Mathematical notations and functions. These scenarios are usually real-life ones, situations that people might find

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themselves in every day. For example, it could be the division of pizza between party members or working out how long a train might take from one place to another.

Previously, research on Algebraic word problems focused mainly on the effects of various kinds of linguistic, computational, and/or presentational task features (for example, number of words, grammatical complexity, presence of particular key words, number and nature of the required operations, nature and size of the given numbers) and subject features (for example, age, gender, general intelligence, linguistic and mathematical ability of the problem solver) on learners' success rates. For most Mathematics students, Algebraic word problems might resemble a jumble of words and numbers but this wrong opinion can be eradicated by identifying the usual problems and adopting appropriate teaching strategy. This implies that Algebraic word problems is a unique avenue for developing conceptual knowledge, strategic thinking, and adaptive reasoning which are crucial for effective Mathematics learning[38].

2.1.6 Academic Achievement

Students' academic achievement is considered one of the important aspects of teaching and learning that educational systems seek to improve thus making high academic achievement a significant indicator of a successful educational system[39]. Academic is explained as academic work or school work. The term academic work refers to the results obtained by students after passing through successive learning experiences, while school work can be described as the learning tasks planned by the school which is usually implemented in stages. Achievement can thus be described as the level attained after a series of learning experiences, exposures or training, while performance is described as the scores or results obtained in an examination in a particular subject or a whole course[40]. Also, the

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term Achievement can be described as success, establishment; cultivation or the result of a career. Achievement can also be defined as the result obtained through study and academic outcomes that reveal the extent to which a student has achieved expected learning goals and objectives or the extent to which a student has achieved educational goals in short or long term and this is usually measured through periodic examinations or continuous assessments and can be evaluated through students' grade point average[41]. In other words, academic achievement indicates performance outcomes that reveal the extent to which a student has accomplished specific learning aims, goals or objectives that were the main focus of activities in experienced in schools, college, polytechnics and university[42].

Achievement is the feeling of getting things done as we wish or achieving things that we expected to achieve. It can as well be described as the process of accomplishing or achieving something successfully as desired, especially by means of practice, determination, exertion, skill or endurance[43]. It goes beyond reaching greater heights but also succeeding in achieving something after much efforts and struggle. Academic achievement can as well be described as the extent to which a student, teacher or school achieved their expected short or long-term educational goals. Meanwhile, academic achievement is determined by the level of accomplishment of a given task evaluated by the teacher through achievement tests and assignments. in summary, academic achievement van be described as the academic or educational standing of a student at a particular moment which signifies individual intellectual abilities. Achievement in Mathematics can therefore be said to identifies how good or poor students have accomplished a given Mathematics task or test.

As the concept of academic achievement is very wide and encompasses a broad range of educational outcomes, the definition of academic achievement can be said to depend on

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the indicators used to assess it. Among such common criteria of measuring academic achievement are reliable and tested indicators such as procedural and declarative skills and knowledge acquired after exposure to an educational system, curricular-based methods such as grades or performance in a periodic achievement test and certifications such as educational degrees, diplomas and certificates[42, 43]. All these criteria reveal the intellectual ability level of an individual.

In most advanced societies, academic achievement plays an important role in critical decisions in people's life. For instance, academic achievement as indicated by the GPA (grade point average) or by assessments tests usually used for selection purpose such as the SAT (Scholastic Assessment Test) can be used in determining whether a student is guaranteed to secure admission into higher institutions, further his or her education among others[44].

2.1.7 Hearing Impairment

Hearing impairment is described as a permanent or fluctuating impairment of the hearing capable of adversely affecting a child's total development and educational performance[45]. Most practitioners consider an hearing loss of below 90db as an impairment. People experiencing hearing impairment are also referred to as the deaf because they face restriction in communication which differentiates them from other people[46]. In other words, students with hearing impairment do not have a gift of smooth and direct verbal communication shared by the hearing people. It should however be noted that students with hearing impairment usually have either a partial or full hearing loss in one or both ears which make degrees of hearing impairment to differs. The communication traits exhibited by the students with hearing impairment depends on certain factors such as the degree of hearing

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loss, causes of the hearing loss, age at the onset of the hearing loss and the period of onset of the hearing loss[47]. Usually, the earlier the hearing loss occurs itself in a child, the more difficulties he or she will experience in developing spoken language[48].

Furthermore, hearing impairment or deafness involves not only the loss or fluctuations of hearing, but also the loss or ineffectiveness in the ability to develop language and speech naturally or spontaneously[49]. By implication of this impairment in speech development, the abnormal, ineffective and impaired development of language has serious effects on the child's total development. While hearing impairment can be moderate, severe, mild or profound, the characteristics of a child experiencing mild hearing loss are strikingly different from that a hearing child's own[50]. It has also been reported that the existence of hearing impairment causes a number of other additional challenges that are linked to the inability to acoustically receive or verbally express messages and thoughts[51]. For the purpose of this study, hearing impairment will be categorised into congenital and adventitious.

Adventitous hearing impairment, also known as acquired hearing impairment is the type of hearing loss that occurs at a later stage during a person's life[52]. In this type of situation, the auditory system functions for language development and spoken communication until a situation arise which alter everything. Such situations can be in form of accident, infections, disease among others. One of the common causes of adventitous hearing loss is post-natal contamination[53]. For example, diseases like measles, mumps, flu, typhoid fever, otitis media – inflammation of the middle ear, red fever and meningitis are considered as common causes of extreme hearing misfortune in children and most of these mostly occurs in children under five-years.

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Also capable of causing adventitious hearing impairment are environmental factors such as loud noise, explosions, physical abuse of the cranial area and accidents[54]. It has been established that expectant mothers should be informed that repeated exposure to loud noise is one of the major cause of hearing loss in individuals irrespective of their age[52]. The common addiction to usage of headphones has also exposed many unsuspecting adolescents to damaging noise levels. It is believed spreading the knowledge of the causes and effects of hearing loss among expectant mothers and the general public, especially the female populace, will lead to its reduction to the barest minimum[55].

Similarly, it has also been discovered that exposure to drugs and harmful chemicals can likewise lead to hearing deficiency as certain medications can lead to bad effect on the hearing system and some of these drugs are ototoxic drugs like aminoglycoside antibiotics, diuretics and cisplatin[56]. Apart from these, adventitious hearing impairment can also be caused by viral, bacterial or parasitic contaminations as ear contaminations are found to be capable of leading to hearing deficiencies among children, hence the need for mothers to possess adequate knowledge to prevent it [57]. Untreated serious infections during childhood are also capable of leading to adventitious hearing impairment. It has also been discovered that other notable factors such as poor individual cleanliness and poverty leads to numerous children in developing nations like Nigeria to end up being hard of hearing or almost deaf after minor or serious sickness, contracting of viral diseases like meningitis, measles, viral encephalitis, chicken pox, flu, mumps and other viral contaminations[58].

Other notable factors capable of leading to adventitious hearing loss are: head damage, minor and serious acoustic injury and ear tumors of any size leading to a lasting acquired hearing impairment[59]. Apart from the above, cases of loss of external and internal

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hair cells which are harmful to the organ of Corti, cases of ischemia in the ear and expanded metabolic action leading to exorbitant responsive oxygen species (ROS) and lipid peroxidation[60]. Ototoxic prescriptions also may cause harm to the ear such as those drugs used in treating genuine contaminations, tumor and coronary diseases[61].

Congenital hearing impairment, on the other hand, is a kind of hearing impairment that occurs before the birth of a child, when the baby is still in the womb[62]. This kind of hearing impairment is commonly associated with genetic causes or drugs usage and due to the infection of the mother with certain diseases such as rubella, measles, smallpox, meningitis among others[63]. In other words, it is the type of hearing loss that is mostly occurs before birth when the auditory system is not yet programmed for language and communication.

While tracing the common causes of congenital hearing impairment, pre-natal disease or infection are also known to be capable of leading to congenital hearing loss thus leading to impairment in the hearing system[64]. These diseases or infections are known to occur before birth or around the time of birth. A notable example is German measles, also known as Rubella which caused an outbreak and epidemic in the mid-1960s, leading to cases of serious hearing loss among newly born infants[65]. Nowadays, the evolution of efficient rubella vaccines has helped to drastically eradicate the incidence of the disease. In addition to rubella, other common prenatal infections such as cytomegalovirus (CMV), hepatitis B virus, and syphilis are strongly linked to incidences of hearing loss among unborn children[66]. CMV is a kind of viral disease/infection that is spread through close contact with someone who is infected and contraction can also take place through blood transfusion, and through an

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infected mother infecting her new born child and this highly dangerous disease can be characterized by other complications like hearing loss and jaundice[66].

Other factors such as maternal Rh-factor and ototoxic drugs used during pregnancy can also lead to complications and negative effect on the hearing system of an unborn child[64, 67]. Although, the issue of Rh-factor is no longer considered a threat since the evolution of anti-Rh gamma globulin (RhoGAM) in the late 60s, it still remain a notable contributor to hearing impairment in unborn and newly born children as incompatible Rh factor is still capable of causing problems such hearing impairment and other complications in children.

It has also been confirmed that acquired hereditary imbalances are active contributors to existence of congenital hearing impairment in children and this is responsible for about 60% of hearing loss cases among new borns[68]. This further requires that expectant mothers should be equipped with knowledge about relationship between hereditary factors and hearing loss as genes are more like a road map in human beings which are responsible for the establishment of almost every features and aspect of the human body such as our eyes, hair, skin colour, ears, nose, hearts as well our behaviours, intelligence level among others as most children inherit a significant percentage of their parent's gene. The existence of a defective gene from any of the parents can thus lead to any kind of health disorder such as hearing loss and this can take place through the following four ways: autosomal overwhelming legacy; autosomal latent legacy; x-connected legacy; and mitochondrial legacy[69].

In addition, new infants might be born with inherent hearing loss due to the fact that the mother experienced a contamination during pregnancy, leading to serious viral infections such as rubella or cytomegalovirus[70]. Expectant mothers are thus expected to be aware of all these implications so as to limit the likely negative consequences on their unborn babies. In

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the same vein, medications used for treatment of neonatal infections, prevention and control of normal sicknesses during pregnancy such as fever and other common diseases and exposure to loud noise such as a blast and loud music during pregnancy can lead to lasting hearing impairment.

2.1.8 Mindset

Mindset is a set of beliefs that shape how you make sense of the world and yourself. It influences how you think, feel, and behave in any given situation. It simply mean that what you believe about yourself impacts your success or failure[71]. Mindset can be described as the pattern or way of thinking, a set of one's own beliefs, behaviours, and way of thinking that determine our opinion and response to our immediate environment[72]. In other words, mindset is a collection of thoughts and beliefs that shapes one's thoughts and habits. Such thoughts and habits affects how one thinks, feels and reacts to issues. In other words, mindset impact and affects how one makes sense of the world. In the classroom, mindset simply refer to one's belief about intelligence and talent as either fixed or changeable traits[73].

The mindset of a person is defined as their perceptions and beliefs about their capacities, intelligence and potential for success[74]. There are two main types of mindset and these are fixed mindset and growth mindset. The ability to developed intellectual ability is what is referred to as growth mindset. A fixed mindset simply indicate that intelligence and talent are fixed traits that cannot be effectively adjusted by a person. In other words, a fixed mindset is a sign that traits like intelligence, ability and talent are natural, inborn, fixed and unchangeable[75]. They may avoid challenges out of fear of failing since they think their intellectual aptitude is predetermined. In turn, this can cause pupils with fixed mindsets to develop talent tags, which lowers their motivation and performance. Continuously, it can be

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safely postulated that a fixed mindset is characterized by attributes such as a belief that natural talent and intelligence are innate and can't be developed; being risk-averse; threatened by others' success; views feedback as an attack; and refusal to admit flaws[76].

`The concept of growth mindset can be traced to the outcomes of works carried out by Carol Dweck which stated that people are of personal opinions about their potentials. In other words, some people are of the opinion that their intelligence is somehow fixed and in Mathematics, it is either that you know it or you don't[77]. A growth mindset on the other hand advocates strong believe in one's ability and highly motivated learning techniques as means of enhancing academic performance and intellectual abilities. Also, people with a growth mindset encounter difficulties and view failure as an opportunity for development[78]. Such people believe that, these characteristics and abilities can be grown and boosted by ways of focus and hard work. It can thus be stated that our mindset plays a crucial role in how we cope with academic challenges such as in the classroom and understanding given school works, where a growth mindset can lead to greater academic attainment and high motivation[79]. Such a mindset have the tendency to promote high passion for learning as well a high desire to be more committed academically and discover new things. It is thus strongly believed that students who imbibed the spirit of growth mindset will have a greater motivation and resilience in academic efforts[80].

2.2 Theoretical Review

There is the need to review some theories that relates with, collaborates and supports the main areas to be considered in this research work. These are:

i) Vygotsky's Theory of Constructivist Learning

ii) Deutch's Theory of Social Interdependence

iii) Vygotsky's Theory of Social Learning and Development

2.2.1 Vygotsky's Theory of Constructivist Learning

The constructivist theory of learning, a theory which emphasises observation and scientific study as tool for learning also postulated that individuals construct their knowledge of the world through experiences[81]. In other words, new knowledge has to be related with previous knowledge and experiences which are capable of affecting our intellectual development. Students must be inquisitive, exploratory and able to evaluate their knowledge to obtain new skill and ideas, thus engaging in active creation of new knowledge themselves. Thus, by getting exposed to modern learning strategies such as collaborative learning strategies, students with hearing impairment will be able to develop growth mindset about Mathematics as a subject and Algebraic word problems as a topic, and improve their academic achievement in Mathematics.

According to Vygotsky, this theory argues that information is co-built and that individuals learns from each other. The whole theory of social constructivist is premised on the hypothesis that learning occurs with the involvement of others, and this idea further reinforces the social part of the theory[82]. By applying Vygotsky's theory in teaching of Mathematics, there is encouragement of communication and learning between a facilitator and a small group of students which further enhance knowledge acquisition and construction[83]. The implication of Vygotsky's theory is that facilitators/teachers should adopt interactive methods and approaches involving hands-on and group activities in teaching crucial Mathematics concepts such as Algebraic word problems among others. Again, teachers must present learners with application questions to enhance their problem-solving abilities as collaborative learning approaches are premised on this. The theory also

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emphasises that the appropriate approach to accelerate learning is through exposure to engaging activities and learners must be motivated to connect with themselves and their teacher constructively through positive interdependence, a crucial feature of collaborative learning[84]. On the basis of this, Mathematics teachers are expected to fully inculcate collaborative learning strategy in their teaching activities to enhance students understanding and performance of Mathematics concepts, such as Algebraic word problems among students with hearing impairment. The above discussions showcase collaboration, cooperation and interdependence as some notable features or tenets of the theory of as postulated by Lev Vygotsky.

The implication of the theory for this study is that in every study group there must be a more knowledgeable learner than others who will can impacts knowledge on others. In a words problems classroom, this idea can be applied in teaching students with hearing impairment Algebraic words problems using the selected collaborative learning strategies by grouping the students using various criteria that promotes positive interdependence as the theory tends to move learning from the teacher to the students. That way, a classroom is never again a spot where the teacher delivers information into passive learners, who appeared raw, crude, blank-headed and requires indoctrination and instructions to become active. This is because the theory emphasised that students construct knowledge better when they socially interacts within groups[85]. Vygotsky's social constructivism can thus be conceptualized to put into application, the common features of collaborative learning strategies which involve promotion of interactivity among learners in a Mathematics classroom, thus proving very crucial to this study.

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2.2.2 Deutch's Theory of Social Interdependence

This is one of the major theories upon which collaborative learning is premised. Social interdependence in learning is a situation whereby learners share common goals, and each individual's success is influenced by the steps taken by other members of the group/class[86]. This is necessary in collaborative learning as the presence of social interdependence is one of the main pivots of the whole process. By jettisoning social interdependence aspect of the collaborative learning, this might likely results in individualistic efforts and outcomes[86].

The idea of social interdependence in learning began in the early 1900s when a proponent of the Gestalt School of Psychology, Kurt Koffka postulated that groups can be described as dynamic wholes which promote interdependence among members for the main purpose of knowledge acquisition[87]. This notion was further reinforced and refined by Kurt Lewin in the 1920s and 1930s, while stating that the main rationale behind creation of a group in the classroom for learning activities is the interdependence among members, which lead to a dynamic whole, which further imply that the actions and contributions of each member of the group is correlated the achievement of the desired common goal of the group[88]. The process of interdependence involves at least two individuals that are capable of influencing each other in such a way that a variation in the composition or ability of a group member is capable of leading to change in the state of the others[89].

Lewin's work was further adjusted by Morton Deutsch in the late 1940s when he formulated a theory of cooperation and competition by postulating some specific types of social interdependence which are: positive, negative, and none[90]. This classification can be

premised on the idea that the direction of interdependence as it occured in a situation is correlated with how group members interact with each other and subsequently determines the final outcomes[91]. While positive interdependence leads to promotive interaction, it was stated that negative interdependence among learners tends to lead to oppositional interaction and no interdependence lead to an absence of any form of interaction, which is a negation of what the interdependence theory is all about.

This theory is very crucial to this study in the sense that it promotes positive interdependence among learners and teachers/facilitators. In collaborative learning strategies, the aim is to build knowledge through collaboration among the learners by grouping them or pairing them. This further promotes social development and social learning. Students with hearing impairment area socially compact group which make interaction easier and learning more predictable. However, the process needs strict monitoring.

2.2.3 Vygotsky's Sociocultural Theory

Lev Vygotsky's sociocultural theory is premised on the roles of social relationship in learning and cognitive development by emphasising on the importance of the community as an important variable in the process of constructing meaning and knowledge[92]. Vygotsky's theory view learning as a sociocultural process and stated that intellectual development in individuals is strongly related and linked to social and cultural experiences [92]. This simply imply that he postulated that speech is a vital ingredient in human intellectual development as engaging in conversations with more individuals of superior knowledge enriches level of understanding and cognition.

One of the vital aspects of Vygotsky's social learning theory is the Zone of Proximal Development which highlight what a person is capable and incapable of doing as zones and in-between these two zones is a third zone known as the zone of proximal development which signify what a person is capable of learning but needs guidance to achieve[93]. Simply put, this zone of proximal development signifies new skills obtained in the process of learning and development. By having access to other more knowledgeable individuals who are capable of impacting new knowledge on them, Mathematics students with hearing impairment will be able to acquire the skills found in their zone of proximal development. This idea is very crucial to the application of collaborative learning as all collaborative learning strategies are premised on learning from each other through positive interdependence and sharing of knowledge. Students with hearing impairment will thus learn from those more knowledgeable through group work and thus improves their knowledge of crucial Mathematics topics such as Algebraic word problems.

Strongly linked to the above, as postulated by Vygotsky is the the concept of the More Knowledgeable Others which is very crucial to learning words problems by students with hearing impairment. In other words, the concept of more knowledgeable others refers to a person who already possess superior knowledge or experience of the topic such as parents, teachers, older adults or just a peer[94]. In other words, it is through such beneficial interactions and collaborative dialogue with such a person that a learner with hearing impairment can have access to desired behaviours (knowledge of Algebraic word problems) and receive important information. For instance, the learner with hearing impairment seeks knowledge on Mathematics words problems and further assimilates the information provided by the More Knowledgeable Other, then uses that information in their own problem solving process. The

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more Knowledgeable others thus allow the learners with hearing impairment to operate within the Zone of Proximal Development.

2.3 Review of Empirical Studies

2.3.1 Hearing Impairment and Academic Achievement in Algebraic Word Problems

The existence of hearing impairment of any type or degree in a child is capable of affecting his educational development due to the fact that communication, which is the main vehicle for learning, has been derailed. This view can be linked to the idea that educational challenges and obstacles related to hearing impairment stem around communication and such students are likely facing difficulties in the aspects of arithmetic, calculation, manipulation, English language skills, notes taking, dialogue during classroom discussion, interpreting educational videos without captions, understanding oral reports among others[95, 96].

There is a common agreement that congenitally hearing-impaired students' achievement in Mathematics is dwindling compared to that of their hearing colleagues which can be interpreted as lagging behind in 2 to 4 school years[97]. Previous findings also revealed that students with hearing impairment typically sees questions related to Algebraic word problems as the usual Mathematics numbers and procedures identifying the crucial semantic relations in such problems. That way, instead of applying their acquired previous knowledge to solve the problems, they resort to counting and other basic problem-solving skills[98].

The reasons for likely difficulties faced by students with hearing impairment in Algebraic word problems includes the nature of Mathematical language, difficulties in interpreting crucial connectives such as if, because, more, difference, factor, product, quotient, sum, average, square among others[98]. This is highly linked to the issue of access to

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Mathematical concepts by students with hearing impairment as it can be stated that since sign language is a visual and spatial-based language it should serve as a highly reliable medium for teaching crucial Mathematics concepts and relationships[98]. It is therefore necessary to consider whether congenitally hearing impaired students are accessing the Mathematics curriculum in the most appropriate way or not. In other words, it is very important to examine the extent to which the medium of teaching responds to individual learning abilities as the process of solving Algebraic word problems activities requires general thinking and reading comprehension skills[99]. An appropriate illustration of this is the application of story-related problems in Mathematics to guide and develop problem-solving skills related to learning of mathematical concepts as story problems allow Mathematics students to use their previously acquired knowledge and experience to make relate with and solve the new information (the Mathematics problem)[100]. This further implies that word-problem solving are not necessarily presented as a part of the problems to be resolved but rather as a way to show what has been previously learnt.

This relationship between students with hearing impairments' word-problem solving skills and instructional method was investigated and the outcome revealed that these students shows lack of endurance and motivation in working through difficult challenges on word-problems and difficulties in linking a learned skill to another as it was revealed that the students only responds well on one-dimensional tasks unlike when exposed to two or more dimensional problems[101]. This further requires that students with hearing impairment should be sufficiently engaged in challenging word-problem situations.

Mathematics performance can also be said to be affected by language proficiency and understanding levels among students as expected due to their limitations in mastering

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language proficiency and application occasioned by their hearing loss and ability[102]. While examining comprehension level and conceptual learning ability among students with hearing impairment in Algebraic word problems through a self-report questionnaire, the outcome revealed that hearing students performs higher than their hearing-impaired counterparts, likely as result of deprivation of auditory processing of information and other challenges[102]. It can thus be concluded that specific English language competency and reading ability level, are correlates of performance in Mathematics Word-problems[103].

Given the linguistic challenges likely faced by students with hearing impairment, interpreting Algebraic word problems into mathematical statements might be a bit challenging. The way out is thus for the teacher to devise the appropriate instructional strategy. The most debilitating aspect of hearing loss is the subsequent language impairment occasioned by weakened auditory ability as the main rationale behind educating children with hearing impairment is the need to strengthen their language acquisition skills because such learners usually exhibits reading and writing skills considered below inferior, while compared to that of learners with normal hearing level [104, 105] and this deficiency in reading and writing abilities among them can be attributed to the difficulties they face in language acquisition[106].

In comparison with their hearing peers, while language is the base for acquiring most of the needed Mathematics skills, students with hearing impairment are likely to miss out on various concepts and vocabulary that hearing children pick up incidentally. For learning Mathematics, there is the need for mastering of crucial problem-solving, communication, logical thinking and reasoning skills, all of which can be hampered by loss in hearing. The challenges that students with hearing impairment encounter when learning Mathematics

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word-problems are likely to be many and needed to be addressed as word problem-solving is particularly knotty for students with hearing impairment due to the pre-requisite behaviour to convert observations into mathematical expressions and apply necessary tools. The absence of these language skills is capable of making students with hearing impairment become isolated in a Mathematics learning environment and unable to fully participate in mathematical group discussions.

It has also been established that students with adventitious hearing impairment are academically inferior to students with normal hearing in Mathematics achievement as they lags behind by roughly three years in attainment and ability level[107]. This point is noteworthy as it reveals that students with hearing impairment need to be exposed to crucial Mathematics skills and knowledge and Mathematics word-problems skills, just like their hearing counterparts and they need all it requires to succeed in it as their future intellectual development depends on it. This can be achieved by exposing them to skill on numbers and number operations like addition, subtraction, multiplication and division which are parts of our everyday life activities.

While hearing impairment can be sustained prior to the acquisition of speech and language, these abilities can be developed and later lost due to various causative factors ranging from genetic, accidental and medical to environmental[108]. With regard to the time of occurrence, hearing impairment as a condition can be dichotomized into congenital and adventitious. Thus, such learners have different dispositions, potential and opportunities to learn and react to issues. For instance, it was stated that learners with adventitious hearing impairment have better opportunities to excel in science subjects compared to those with congenital hearing impairment as a great deal of academic instruction is done orally rather

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than manually through sign language[109]. However, adventitiously hearing impairment can be challenging as an individual who was previously hearing and able to respond to verbal stimuli will be faced with the challenge of adjusting to the new reality of losing such opportunity and being tagged as being adventitiously hearing impaired. At this point, unlike the case with congenital hearing impairment, such individuals may express challenging psychological and social adjustment stages and greater level of isolation.

In the same vein, it can be deduced from the above that that the stage of onset of the hearing loss, either congenital or adventitious, is a powerful predictor of academic performance and an important determinant of learning outcomes among students with hearing impairment in the classroom. In addition, research has shown that learners with adventitious hearing impairment lag behind in Mathematics achievement compared to their peers with normal hearing within the same grade levels as it has already been well-established that students with adventitious hearing impairment, specifically cochlear implant users and those with severe hearing loss, have decreased level of ability to perform academically in Mathematics and other subjects[110]. The same scenario occurred in cases of reading and communication skills among students with hearing impairment where decreased level and ability in auditory communication can significantly influence Mathematics learning skills. Indeed, studies have revealed that even infinitesimal level of hearing loss in children can result in decreased communication ability, low self-esteem, weak social support and poor academic performance[110]. It was also revealed that in the last few decades, new approaches in education of students with hearing impairment such as inclusion and cochlear implantation have significantly resulted in significant changes in the educational achievement and

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subsequently, the Mathematics achievement of students with adventitious hearing impairment[111].

2.3.2 Jigsaw I and Academic Achievement in Algebraic Word Problems

As the world is changing from teacher-centred learning to student-centred learning methods, there is the need to further promotes learning techniques that inculcates self-learning and collaborative learning through teamwork. This further implies the need to focus on collaborative learning strategies such as jigsaw learning as learning management is one factor in learners' academic success[112]. The learners are thus expected to study in an almost-independent atmosphere, assist each other interdependently and interact in class to solve a given problem, thus further opening opportunities for self-discovery and constructive learning. This can be achieved through continuous practice until they achieve the expected outcome and grasp the main contents of the lesson. In addition, jigsaw is capable of exposing them to sustained retention of acquired knowledge, development of social and emotional skill for successful living in the society[113].

Jigsaw is one of the collaborative learning models capable of increasing students' sense of responsibility towards their learning and others as they will depend on each other and need to cooperatively collaborate to achieve the learning objectives[114]. It is also one of the strategies of collaborative learning as it promotes the ability to work in teams by the students thus ensuring they reach a favourable outcome[1]. Thus, learning through a jigsaw can improve learning achievement and students' understanding as students who learn with the jigsaw admit that more cooperation and information are shared between students.

Studies that examined the effects of jigsaw strategy of collaborative learning on students' Mathematics achievement found that the strategy boosts students' performance and

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learning retention in Mathematics[112]. In an investigation on the effects of jigsaw strategy using a pretest and posttest design, results from the research revealed that students in the jigsaw strategy group performed higher in the achievement test and also exhibits greater long-term achievement compared to those in the traditional lecture-based learning group[112]. This further affirms the idea that jigsaw-based collaborative learning approach improves learning outcomes for strategic learning, while applying experimental research design as the results showed that the jigsaw strategy of collaborative Learning is capable of improving students' learning performance in Mathematics and improved the efficiency of learning.

Furthermore, the application of the jigsaw strategy is capable of resulting in improved performance in Mathematics as the jigsaw strategy provides avenues for the students to express themselves confidently and process crucial information, which can uplifts their learning abilities and outcomes[115] as Algebraic word problems are not only integral to Mathematics education but also play a crucial role in developing creativity, retention, problem-solving abilities, critical thinking ability and solving real-life mathematical problems by applying acquired problem-solving skills[116]. As conventional teaching strategy sometimes become tedious exercises in plugging numbers into formulas, leaving students disenchanted and disconnected from the beauty of Mathematics, the way out is for students to work in groups, using collaborative learning strategy like jigsaw to solve Algebraic word problems together. This will allow them to discuss their ideas and work collaboratively, which can help them better understand the problem and come up with creative solutions.

Jigsaw strategy improves cognitive and psychic achievement and also inculcates self-learning skills as students are boosted by teachers guidance and availability of learning

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materials and also get constructive and supportive help from fellow group members[113]. This is an appropriate approach for learning of Mathematics by students with hearing impairment as they are most situated for self-learning approach given their deficiency in access to information through auditory channel. In addition, it has been discovered that the utilisation of the jigsaw teaching strategy is capable of leading to an enhanced performance in Mathematics[115] as it provide students with opportunities to confidently express themselves and process critical information, which can lead to an improvement in both their academic abilities and achievement. This is considered an important ingredient in the education of students with learning difficulties such as those with hearing impairment. The ability to express themselves and showcase their abilities will guide the teachers in identifying their learning needs and further enhance their access to knowledge.

As jigsaw Technique bring together students with different abilities in a group by successfully working together to gain knowledge gained from discussions from experts among them, groups members are likely to be motivated to go higher academically, develop an improved learning attitude and develops social skills that prepare them for challenges in the real world[113]. This approach will surely influence the achievement of students as the success of each group member and the entire group depends on interdependence and collaboration, so each member must help other members for mutual benefit thus resulting in greater efforts to achieve higher learning achievement[117]. In addition, it has been discovered that jigsaw strategy also contributes to the psychological, social and intellectual development of learners as it has the ability to provide learners with cognitive, affective, and psychomotor skills and knowledge when they have access to opportunity to collaborate with others in their group to achieve predetermined common goals[118]. The strong relationship between jigsaw

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approach and achievement in Mathematics was further established by findings that stated that collaborative learning model has various benefits such as improved academic achievement, high self-esteem, and a more positive perception of self[119].

Research findings have also shown that students exposed to jigsaw instructional strategy exhibits some positive traits such as increased level of self-esteem, high achievement in school, high level of motivation in school, punctuality and cooperation with students of the same class and group, compared to students in the same class exposed to conventional teaching strategies as revealed by the outcome of a study carried out on the likely impacts of jigsaw strategy and traditional strategy on laboratory material recognition and usage skills of students in science subjects such as Mathematics[120]. This further reinforced the strong belief that jigsaw is considered a strong correlate in learning science subjects such as Mathematics.

Another study that examined the effect of jigsaw strategy on Mathematics achievement revealed a significant difference between the control and experimental groups which tilted in favour of the experimental group thus further reinforcing the idea that jigsaw influences students' achievement in Algebraic word problems[121]. This finding is similar to that of another study which analysed the influence of jigsaw collaborative learning on academic performance on female students by teaching them an education course applying jigsaw strategy, while the control group was exposed to the same course through the traditional lecture strategy and the results revealed that the jigsaw strategy had a better understanding of the content compared to the students who were taught using traditional lecture strategy[122]. This is similar to the study on the effect of jigsaw strategy on the academic achievement of middle school students in Bandar Abbas city exposed to students' academic achievement test in Mathematics and their result analysed using Analysis of Co-

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variance (ANCOVA) and finally revealed that the jigsaw learning strategy has significant effect on students' achievement in Mathematics[123].

The veracity of jigsaw method as a reliable students-centred Mathematics learning approach has been examined in previous studies and confirmed as being effective in assisting students in obtaining practical Mathematics learning skills, effective communication skills and proficiency in conceptual understanding knowledge as it promotes Mathematics students critical thinking skills [124]. As a teaching strategy that inculcates various activities in students to improve their understanding of core subjects like Mathematics through a well-structured approach involving a series of steps requiring learners to create, analyze and apply concepts, jigsaw can be viewed as a radical tool for increasing motivation and passion in learning and doing Mathematics[124]. The innovation of jigsaw strategy goes beyond a mere teaching strategy as it is viewed as a method capable of providing and promoting access to new skills and knowledge, encouraging sharing of tasks among team members with each member assigned their individual duties, with individual successes determining the success or otherwise of the group[125].

2.3.3 Peer-tutoring and Academic Achievement in Algebraic Word Problems

Peer tutoring as an instructional strategy is capable of minimizing stresses experienced by teachers who are expected to cover large groups of ability-diverse Mathematics learners[126] and there are several strategies that can be employed in setting up a peer-tutoring program in a classroom with a varied student population, age and ability level so as to meet the learning needs of such diverse groups. One of such strategies is peer-tutoring, which is a teaching strategy involving organizing a class into pairs of two or more students that are of different abilities to act as tutor and tutee in learning a particular skill or

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solving a problem through benefitting sharing of knowledge among each other[126]. A crucial and important aspect of peer tutoring is the absence of student-instructor power dynamic as tutors relates with students at a level that make the teaching and learning experience more comfortable thus facilitating smooth among students[127].

Additionally, peer teaching is a process by which a student learns from a more knowledgeable and experienced student or peer[128]. It can also be viewed as communication between a more brilliant student who is doing far better or who recently achieved the learning objectives successfully and another student who is unable to achieved the expected learning objectives in the same subject, topic or concept[129]. On the basis of this, peer teaching should be considered as an effective strategy in the teaching and learning of Mathematics as it combines both the social and academic aspect of learning by creating a interdependence, cooperative, collaborative and social environment for learning.

Researches revealed that peer tutoring is a useful approach and very beneficial for students with hearing impairment and teachers. It has been reported that peer teaching is helpful to both fast and slow learners as it assists fast learners to master the concepts related to the subject and confidently express their ideas, while slow learners learns at their own pace to relieve them of pressure to learn at the same rate as the more knowledgeable ones[130]. In addition, slow learners are more likely to upgrade their level of understanding and performance and get a better understanding of the terms of the lessons. It thus suffice to state that peer tutoring helps both fast learners and slow learners in acquiring important values such as knowledge-sharing, boosting of self-esteem and self-discipline. Other studies revealed that students with hearing impairment working in peers exhibits better performance in examinations questions involving reasoning and critical thinking skills[131].

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There are several key advantages in adopting peer tutoring for teaching and learning of Mathematics and these include: encouragement of student-to-student interaction as when students acts as Mathematics tutors to their peers, they are likely to break down abstract ideas into simpler terms, constructing their own knowledge in the process as interaction promotes a deeper understanding of mathematical knowledge through engagement in beneficial discussions, asking of questions, and clarification of doubts, creation of a dynamic learning environment, creation of a free environment where freedom of expression is encouraged and Mathematics anxiety significantly reduce[132]. Continuously, apart from the above, peer tutoring boosts the confidence level of both the tutor and the tutee to confidently and successfully convey mathematical knowledge to their peers, nurtures participants language and communication skills, expose students to clarity in expression of their thoughts, creates beneficial avenues for tutors and tutees through relatable expressions which can often be more penetrating and knowledgeable than conventional teaching strategy [133, 134].

There are other benefits accruing from adoption of peer tutoring in Mathematics learning and teaching such as: enabling students to become co-creators of knowledge[135], collaborative exploration and solving of mathematical problems thus exposing students to alternative approaches to solutions and improving students' level of understanding of Mathematics and instilling a sense of satisfaction in their learning achievement[136, 137]. Peer tutoring also have the capacity to sharpen interpersonal skills and behaviours of participants such as empathy for others and patience with slow learners as tutors learn to identify and flows with the limitations of their peers, adjusting their explanations to covers different learning abilities[138]. This enables tutees to develop patience as they work through challenges, understanding that both teaching and learning are gradual processes that takes time and can

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be challenging for those involved. These are characteristics required to navigate difficult life terrains involving both academics and social development.

It has been previously discussed that peer tutoring is very beneficial to Mathematics students, especially the slow learners[139]. Thus, peer tutoring can be said to be capable of helping all categories of learners, the hearing impaired ones inclusive, in developing important social values such as knowledge-sharing, strong and positive self-esteem, and self-discipline[131]. It was also reported that students working in peer tutoring groups perform better in aspects of Algebraic word problems that involve reasoning and critical thinking skills as peer teaching is a reliable strategy capable of helping learners achieve the educational goals[140]. This further indicated that peer tutoring strategy not only boosts students' level of comprehension of Mathematics topic, but also improves various other developmental skills in students. Overall, it can be assumed that the strategy of peer tutoring when adopted by the tutor is capable of bringing positive behavioural, social, cognitive, and academic impacts and being a beneficial strategy to use when teaching Mathematics[141]. It was further agreed that peer tutoring is an effective strategy to adopt when teaching Mathematics but can be even more effective when combined with other suitable methods or strategies as it is highly likely that students would have prefer asking their colleagues for help rather than approaching the teacher[142].

Thus, by being exposed to peer tutoring, students can positively interacts with peers to get assistance which improves social development and their mathematical skills as peer tutoring creates an highly educative environment that guarantees active participation and immediate feedback which further improves student's achievement in Mathematics. This have the tendency to further promotes positive social, behavioural, cognitive, and academic

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impacts for students. It has also been found that when peer tutoring is combined with other suitable methods such as explicit teaching strategies, students engage in purposeful learning which further improves their achievement in Mathematics because it is generally believed that when peer tutoring is paired with an additional and appropriate teaching strategy, its' effectiveness improves[143].

As peer tutoring is a type of collaborative learning that often happens spontaneously among students, including those with hearing impairment, it have been discovered through teaching experience and research that this innovation is an effective approach in assisting all categories of learners toward achieving expected educational goals as the process is seen as a very appropriate strategy that can be adopted in attempts to enhance academic achievement of all categories of students in Mathematics as it is considered gender friendly[144, 145]. It was therefore suggested that peer tutoring strategy should be used in the teaching and learning of crucial Mathematics topics to students with hearing impairment for better results. This can be premised on the idea that limitations in language abilities and exhibition of low abstraction abilities among students with hearing impairment often slows down their ability to absorbs information and this leads to challenges in learning and communicating difficulties and subsequently a causative factor in social and emotional problems[2, 146]. Thus, such challenges as arising from lack of self-esteem among students with hearing impairment and will likely influence their academic achievements and self-actualisation[147]. This challenge can be addressed by exposing them to a learning strategy such as peer tutoring[148].

2.3.4 Think-pair-share and Academic Achievement in Algebraic Word Problems

Problem-solving ability is one of the skills that students with hearing impairment need to have and is the main focus in learning Mathematics. This calls for adoption of a

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suitable learning strategy such as think-pair-share strategy. As the think-pair-share -Share model is a model that has the character to solve problems being a model developed from constructivism theory which involves students in the learning process, it can be said to be a very suitable strategy for learning various topics by mathematically challenged students such as those with hearing impairment[149]. That way, the students can be more active in the learning process by studying in groups, and having the opportunity to convey the results of their discussions to other students. In other words and based on the above, the think-pair-share model can also train students with hearing impairment to think about solving problems.

Also, it is a learning strategy that is suitable for training students to improve their communication and thinking skills during teaching and learning processes[150] which can be said to be a useful tool in learning Mathematics, especially Algebraic word problems solving skills by students with hearing impairment. The whole process involves pairing a student with another group partner to be able to convey ideas to other think-pair-share pairs in the class, thus aiding in developing students' mathematical communication skills. Accordingly, it can be stated that the adoption of think-pair-share strategy has a positive influence on the achievement of students in Mathematics[151]. For instance, usage of think-pair-share r-Share naturally will increased the wait time after learners are given a query or work, this approves extra time for school learners to think, and has been shown to get extra learners worried in the dialogue and improve the level of learner replies[152]. Think-Pair-Share is also very beneficial to Mathematics educators due to the fact that it can be used as structure of formative assessment. In order for meaningful learning to occur, school students must understand, relate, and include new information with learners'

existing information and experience. Learners must actively manner records in order to inspect preparation and teachers to learners' interactions do no longer continually enable school learners these opportunities.

In a study that investigated the likely effect of think-pair-share strategy on student achievement in secondary school Mathematics, it was discovered that there is a main and significant effect of think-pair-share strategy on the student's achievement in Mathematics. This finding further reinforces the need for the adoption of the think-pair-share model in teaching Mathematics to secondary school students by incorporating it into the Mathematics learning and teaching processes in Senior Secondary Schools nationwide[152]. Continuously, think-pair-share strategy has been found to be capable of influencing academic performance in Mathematics as think-pair-share integration of problem solving learning model can boosts students' mathematical ability, communication and problem-solving skills[150]. This further reveals the extent to which think-pair-share is capable of improving students' academic achievement in Mathematics, especially in interpretation-related topics like Algebraic word problems. If is highly believed that students with hearing impairment are capable of benefiting from such teaching and learning strategies if properly implemented.

Furthermore, the above depicts think-pair-share strategy as one effort that can be used to improve student learning outcomes is to use a collaborative learning model type Think Pair Share as all collaborative models using Think Pair Share has been found to be capable of improving students with hearing impairments' mathematical problem solving and mathematical communication skills[153, 154]. There are many good learning techniques that can be adopted in collaborative manner to maximize the benefits of think-pair-share. One of such is Class Action Research (CAR) which involves the use of interactive media such as Mouse

Mischief, a tool to foster communication between students and teachers, thus promoting access by students to prompt feedback[155]. Thus, the process of think-pair-share collaborative learning strategy requires students to interact with their partners by sharing personal ideas and opinions in solutions after a specific period of individual thinking time, with the aim to differentiate and personalize instructions through adequate thinking time to ruminates on a given assignment[156], thus giving rooms for reviews of individual ideas and sharing of such ideas with their partners.

Additionally, think-pair-share is a three-dimensional process. The first step involve the thinking stage in which the teacher asks questions or identify problems related to learning and prompts the students to measure or determine possible solutions. The next stage is pairing up in which teachers guides students to pair up with their partner to share their thoughts about the first stage and activities at this stage involves exchange of ideas on decisions made. The third and final stage requires the teacher to guide the participants in sharing their decisions and findings with the whole class by taking turns[157].

As earlier observed, think-pair-share is a model of collaborative learning involving pairings and enable students to have access to enough time to think, discuss, respond and help each other. In other words, think-pair-share strategy is a useful technique with great benefits as it can boost students' retention and recall abilities and also enable students to learn from each other interdependently by exchanging and conveying crucial ideas to each other for discussion before submission[109]. The strategy involves encouraging students to help each other in resolving given problems using individual capabilities.

In a previous research, it was concluded that think-pair-share enhance the problem solving abilities and Mathematics achievements of students with hearing impairment promoting active engagement, collaborative learning, and deeper understanding of concepts and it was stated that an increase in student achievement is achieved by implementing collaborative learning model think-pair-share[158]. This teaching and learning model creates an active learning environment for Mathematics students and provides access to beneficial learning in the classroom, thus serving as a fantastic model that is capable of arousing student interest in Mathematics and promotes active participation of students through socialisation[159].

One of the positive parts of think-pair-share is that it gives understudies time to consider the problem or the question, which is critical for Mathematics and of an extraordinary impact[160.]. That way, learners feel progressively great if they are given sufficient opportunity to think and plan their thoughts and ideas before they begin the problem. The additional time they consider it, the less error they make since they already concocts thoughts and share them at that point concede to one answer after they talked about it. It doesn't just help the students just yet it likewise offers the educator the chance to check learners' understanding and perception. Thus, there is the need to explore how common Mathematics problems and Mathematics problem-solving skills can be improved using think-pair-share and other collaborative strategies. Thus, using think-pair-share as learning strategy it is important since all learners participate in the learning. The learners learn from each other by sharing ideas and make some connections, it is important since the level of learners' understanding of the subject will increase. Think-pair-share help learners develop ownership of the subject matter and they also develop communication and skills.

Also, learners are additionally skilled to have accountability for the group's success and extreme studying results. Through team learning, it can motivate every participant to be active in teaching and learning practice[161]. It was also stated that each student in the think-pair-share pairings is given the opportunity to consider the problems individually with the aim of finding answers to these questions or issues, then exchange about the effects of their thoughts with their pair to get one reply that can characterize the answers to the two team members[162]. After that, the teacher request for each pair to explain or describe the outcomes of the answers they have agreed to their classmates. It can thus be concluded that team learning encourages all learners to participate in the learning thus further reinforcing the benefits and importance inherent in using think-pair-share strategy, as learners are given an opportunity to share ideas and conclude from their ideas.

2.3.5 Mindset and Academic Achievement in Algebraic Word Problems

Mindset is simply described as our views of what we are and a clear opinion of what our views about our abilities, capabilities, potentials and strengths are[163]. There are two main ways in which we usually view ourselves and our abilities. These are fixed mindset and growth mindset. Fixed mindset is sometimes refers to as an entity theory of ability and it simply refers to a situation whereby individuals consider their unique characteristics features to be natural and not liable to change[164]. Growth mindset on the other hand is also commonly refers to as the incremental theory of ability which depicts a situation whereby individuals are of the opinion that their individual characteristics features and traits can boosted through consisted efforts and dints of hardwork[165]. Furthermore, it can be stated that growth mindset promotes intrinsic motivation by focusing on construction of knowledge, strengthening their abilities and boosting intelligence. This is considered the main characteristics features of an

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academically sound Mathematics student capable of churning out great performances through dints of hard works, motivation and positive self-determination. The above is contrary to individuals with fixed mindset who mainly focus on getting a grade, reaching cut-off mark, prevent ridicule, being extrinsically motivated and getting rewards.

Although, biologically, it is strongly believed that individuals possess a unique genetic makeup inherited from our parents[166], this is not the main factor shaping our attainment and progress. Rather, there is the need for constant efforts to determine how far we can go through a consistent process of give and take as previous works has revealed that reinforcement can influence students' mindset and motivation, self-efficacy[167] and subsequently, academic achievement as those praised for their efforts are likely to be motivated to take on more difficult challenges with the aim of achieving mastery[2].

It has been revealed that deaf and hard of hearing students with growth mindset are more likely to secure higher scores in Mathematics achievement tests[168], while others believe that growth mindset has no association with grades as it was discovered that academic achievement is not directly related to growth mindset and there is almost no correlation between achievement and student mindset[169]. Furthermore, reports of a survey involving selected teachers who expressed their views on mindset revealed that nearly all the participants reported that adoption of growth mindset strategies in the classroom give them the expectations that there will be an improvement in student performance in the classroom and the quality of classroom instruction[170].

Growth mindset is capable of influencing a students' motivation, which in turn can affect academic capability, performance, achievement, motivation, total intellectual

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development and subjective wellbeing of the student, thus reducing the level of psychopathology in students[171]. Additionally, previous researches has revealed that the existence of growth mindset i.e the belief that one's ability and expertise can be developed, rather than being unchangeable, is capable of stimulating lifelong learning[172]. In terms of behavioural outcomes, growth mindset activates persistence behaviours in the face of challenges and problems-seeking behaviours and thus positively influencing academic performance of students[173]. Specifically, it can be safely deduced that the presence of growth mindset in Mathematics students is positively related to academic performance in Mathematics and triggers higher achievement compared to fixed mindset.

Furthermore, a positive correlation exists between the mindset of students with hearing impairment and the appraisal of students who demonstrate high achievement in Mathematics as students who are exhibits a growth mindset are much more successful in conquering the negative effects of low self-esteem on their academic achievement than those who demonstrated a fixed mindset[174]. As mindset can influence student academic achievement, there is a very high probability that it specifically influences science and Mathematics achievement. The outcome of a study which examined students with hearing impairment's mindsets and their mathematics grades recorded in the seventh and eighth grade showed that the results of the students with fixed and growth mindset varies, with students exhibiting growth mindset demonstrating higher scores more whereas those with fixed mindset students remained stagnant[175]. Thus, it can be concluded that students exhibiting a growth mindset are likely to outshine their peers with fixed mindset.

It has also been shown that existence of growth mindset in students can boosts the academic achievement of lower-achieving students with hearing impairment and increase overall interest and passion in mathematics topics among secondary schools students[176]. This further shows the extent to which growth mindset can influence the academic achievement of students in general and that of secondary school students in particular.

Students with the fixed mindset believed that making effort is only necessary for those who lacked ability and are more likely to be ineffective in Mathematics[177]. This is in contrast to those with growth mindset who usually show more expertise-oriented responses to shortcomings, likely to be sure of their ability and likely to employ positive strategies, such as being motivated to put in more efforts and new methods, instead of involving in negative ideas such as giving up and cheating. Thus, it can be stated that students' opinions about their abilities is a key factor in how they performs in Mathematics[178] and other subjects because when students are of the opinion that their knowledge and performance can be improved through persistence efforts, they inclines toward achieving same by laying much emphasis on knowledge searching and acquisition and being persistence in the face of challenges.

Another noteworthy point is that students with a fixed mindset are of the opinion that brilliance and individual attributes are unchangeable and high achievement comes from individual characteristic features, whereas people with a growth mindset believe these traits are negotiable and can improve through hard work and commitments[179, 180]. Furthermore, mindsets can be termed as adjustable and can improve or retrogress with age and how students react to challenges in the classroom as children are not naturally endowed with the belief that they are good or bad at Mathematics and their mindsets can be influenced by other variables in their lives in their lives[181].

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2.4 Conceptual Model

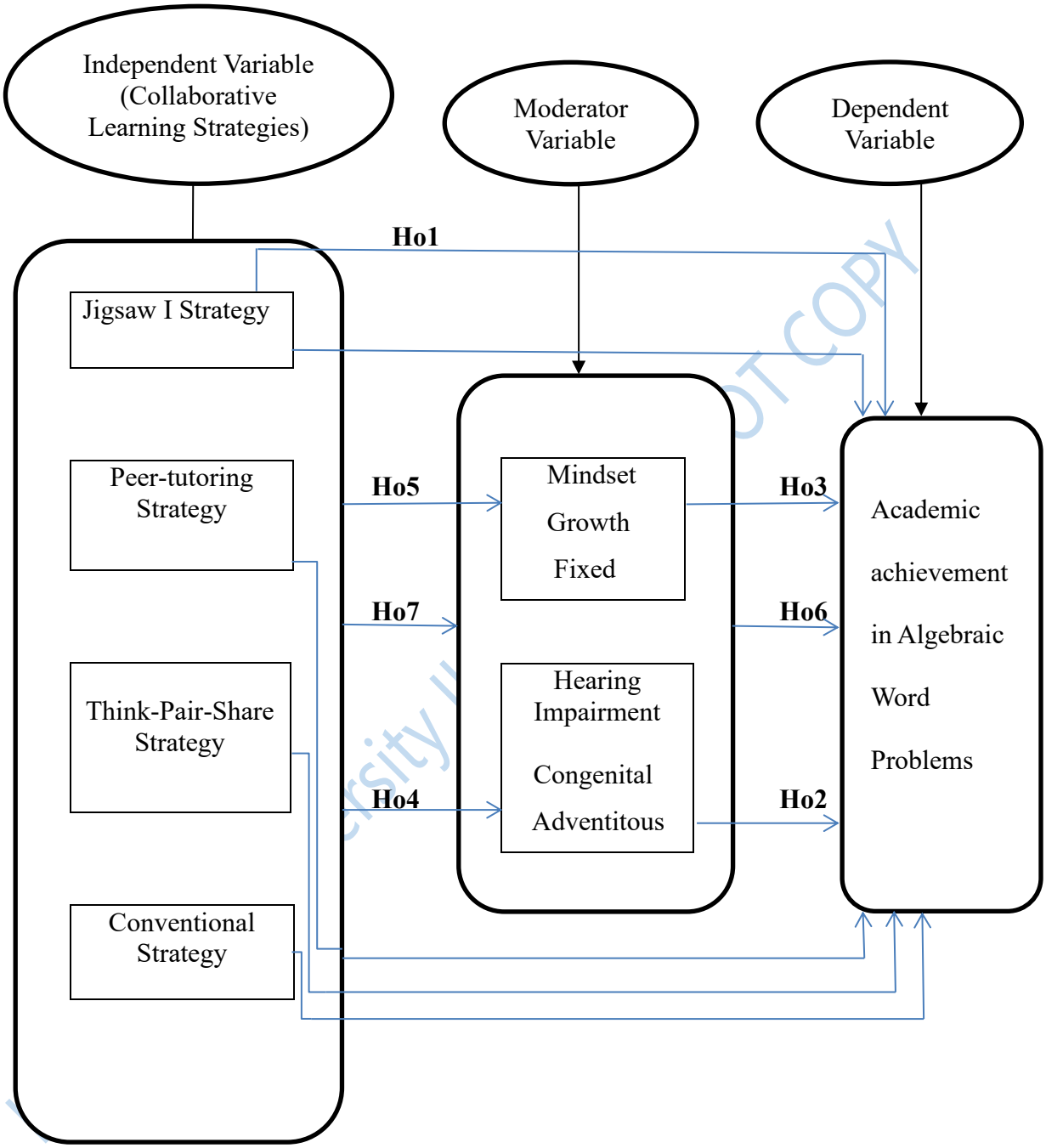


Figure 1: Conceptual model of Collaborative Strategies on Academic Achievement in Algebraic Word problems

Source: Fieldwork, 2025

2.5 Summary of Gaps in Reviewed Literature

The literature reviewed in this study was based on conceptual, theoretical and empirical review. While the conceptual review examined and discussed the meanings of all the dependent, independent and intervening variables used in the study, the theoretical review was based on theories that relates to the study. The independent variables examined are jigsaw, peer tutoring, think-pair-share and the conventional strategy of problem-based learning. The intervening variables are mindset (growth and fixed) and type of hearing loss (congenital and adventitious. In addition, the empirical studies reviewed in this study so far based their findings on the effects of selected collaborative learning strategies of jigsaw, peer tutoring and think-pair-share on the academic achievement of students with hearing impairment in Algebraic word problems. A lot of researches have been done in relation to the effectiveness of using collaborative strategies such as jigsaw, peer tutoring and think-pair-share in teaching Mathematics topics such as Algebraic word problems. The findings revealed that this strategy boosts students' academic performance. The majority of the findings are specific in their emphasis on the influences of these selected strategies on students' academic achievement in Mathematics irrespective of any differences. However, there is the need to confirm the authenticity and validity of these findings as relates to its effects on academic achievement of students with hearing impairment in Mathematics, specifically, Algebraic word problems. As students with hearing impairment are unique given the varied educational background that differs from other students without hearing loss, coupled with their declining academic achievement in Mathematics, there is the need to examine the possible effects of these selected collaborative strategies on academic achievement of students with hearing impairment in Algebraic word problems. The

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researcher is of the opinion that exposing students with hearing impairment to treatments of jigsaw, peer tutoring and think-pair-share will influence their academic achievement in Algebraic word problems.

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Chapter Three

Methodology

This section deals with the methodology employed in carrying out the research work. This included the research design, population, sample, sample technique, validity of research instrument, reliability of research instruments, procedure for data collection and analysis method.

3.1 Research Design

The research adopted the pretest-posttest control group quasi-experimental design as it aimed at determining possible effects of collaborative learning strategies on academic achievement of students with hearing impairment in Algebraic word problems. The study made use of three experimental groups and one control group. The experimental groups were exposed to the treatment in jigsaw 1, peer-tutoring and think-pair-share strategies, while the control group were exposed to the conventional strategy.

The research design was schematically illustrated as:

P_1 X_1 Q_1 (Pretest, Treatment and Posttest for experimental group on jigsaw I)

P_2 X_2 Q_2 (Pretest, Treatment and Posttest for experimental group on peer-tutoring)

P_3 X_3 Q_3 (Pretest, Treatment and Posttest for experimental group on think-pair-share)

P_4 X_4 Q_4 (Pretest, Treatment and Posttest for control group)

Key:

P_1, P_2, P_3, P_4 are prestests for jigsaw I, peer-tutoring, think-pair-share and conventional strategy respectively,

X_1, X_2, X_3, X_4 are treatment groups for jigsaw I, peer-tutoring, think-pair-share and conventional strategy respectively and

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Q_1, Q_2, Q_3, Q_4 are posttests for jigsaw I, peer-tutoring, think-pair-share and conventional strategy respectively

Factorial Matrix of the Design

The design employed the 4x2x2 factorial matrix as structurally presented in Table 3.1

Table 3.1 4 x 2 x 2 Factorial Matrix of the Design

Treatment	Mindset	Type of Hearing Impairment	
A (Jigsaw I)	Growth	Congenital	Adventitious
	Fixed		
B (Peer-tutoring)	Growth	Congenital	Adventitious
	Fixed		
C (Think-pair-share)	Growth	Congenital	Adventitious
	Fixed		
D (Control)	Growth	Congenital	Adventitious
	Fixed		

Figure 2: Factorial matrix design for the study

Source: Researcher's Fieldwork, 2025

3.2 Population of the study

The population for this study consisted of 295 Senior Secondary School students with hearing impairment in Ijokodo High School, Ibadan; Methodist Grammar School Bodija, Ogbomoso Grammar School, Paku and Durbar Grammar School, Oyo. These are Students with Hearing Impairment attending public secondary schools selected from Oyo State.

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Table 3.2 Distribution of Population of the Study

Name of School	Population
Methodist Grammar School, Bodija, Ibadan	95
Ijokodo High School, Ijokodo, Ibadan	79
Ogbomoso Grammar School, Paku, Ogbomoso	70
Durbar Grammar School, Oyo	51
Total	**295**

Table 3.2 Population distribution of the respondents

Source: Researcher's Fieldwork, 2025

3.3 Sample and Sampling Technique

The sample for this research was made up of all the students with hearing impairment in SS2 in the selected schools. The sampling technique used intact sampling technique which is a pre-formed sampling technique whereby participants were selected from an already existing group rather than being randomly selected. Thus, all the SS2 students with hearing impairment in the selected schools were used for the research. A total of 102 students with hearing impairment in these schools formed the sample for this study. 32 from Methodist Grammar School Bodija, 28 from Ijokodo High School, Ijokodo, 22 from Ogbomoso Grammar School,Paku, Ogbomoso and 20 are from Durbar Grammar School.

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While Methodist Grammar School, Bodija was used for Experimental group A, Ijokodo High School for Experimental group B, Ogbomoso Grammar School, Paku was used for Experimental group C and Durbar Grammar School, Oyo was used for control group (Group D). The total sample comprised of 102 students with hearing impairment.

3.4 Research Instruments

Three instruments were used for this research work. These are Algebraic word problems Lesson Plan, Algebraic word problems Lesson Notes and Student Achievement Test on Algebraic Word problems.

i) Algebraic Word Problems Lesson Plan: The instrument was designed by the researcher to guide in the teaching and learning of Algebraic Word Problems during the study. The lesson plan comprised all the sub-topics under MWP which the researcher covered during the study. These are: (a) Algebraic word problems involving Brackets (b) Algebraic word problems involving fractions; and (c) Algebraic word problems involving both brackets and fractions. These topics were taught on a weekly basis during the course of the study.

ii) Algebraic Word Problems Lesson Notes: This was adapted from the Algebraic word problems lesson plan. This was separated from Algebraic word problems lesson notes for each of the topics selected under Algebraic word problems lesson plan. This served as a guide during the course of the teaching. There were three lesson notes with each addressing each of the sub-topics under Algebraic word problems lesson plan.

iii) Student Achievement Test on Algebraic Word Problems: Thirty (30) test items were drawn from the three sub-topics under MWP with those items selected in

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conjunction with the General Mathematics Curriculum for Senior Secondary Schools. There were four options in the students' achievement test on Algebraic word problems which are A, B, C and D. These questions were prepared on the basis of the three levels of knowledge which are knowledge, comprehension and application. In other words, the 10 items on each of the three topics under MWP tested the students with hearing impairment's knowledge on MWP, their comprehension of the knowledge and application of the acquired knowledge. 20% of the items on each topic were based on knowledge, 30% on comprehension and 50% on application. The instrument were graded manually with each question carrying two marks, making a total of sixty (60) marks.

iv) Measure of Mindset scale developed by psychologists Jack A. Naglieri and Kathleen M. Kryza. It is a 20-item scale to measure how students feel and think about themselves. Each item was answered using Never, Sometimes, Often and Always.

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Table 3.3: Table of Specification for Student Achievement Test on Algebraic **Word Problems**

Topic		**Level of Cognition**			
S/N	**Word Problems**	**Knowledge**	**Comprehension**	**Application**	**Total**
		20%	40%	40%	100%
1.	Algebraic word problems involving brackets	2 (1, 8)	4 (2, 3, 9, 13)	4 (4, 15, 19, 28)	10
2.	Algebraic word problems involving fractions	2 (5, 7)	4 (18, 24, 26, 29)	4 (10, 11, 14, 23)	10
3.	Algebraic word Problems involving brackets and fractions	2 (6, 20)	4 (12, 21, 25, 27)	4 (16, 17, 22, 30)	10
	Total	**6**	**12**	**12**	**30**

Figure 3.2: Table of Specification for Student Achievement Test on Algebraic Word problems.

Source: Researcher's Fieldwork, 2025.

3.5 Validity of Research Instrument

To ensure the content, construct and face validity of each of the instruments, they were adopted by giving them to experts in the field, including the researcher's supervisor. Specifically, the instruments were given to lecturers and experts in measurement and evaluation in the Department of Science Education and the Department of Guidance and Counselling, Lead City University, Ibadan, for their observation, contribution and approval. This is necessary to ensure the content, construct and face validity of the instrument. The Measure of Mindset scale was given to psychologists in the Department of Guidance and

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Counselling, Lead City University, Ibadan for their observations and inputs. The Algebraic word problems lesson plan was checked for its' conformity with Mathematics curriculum and syllabus of senior secondary schools, while Algebraic word problems lesson plan was checked to confirm that it aligns with the Algebraic word problems lesson plan. The students achievement test on Algebraic word problems was checked for its' conformity with both the SSS Mathematics curriculum and Algebraic word problems lesson plan.

3.6 Reliability of Research Instrument

Reliability of the survey instrument students achievement test on Algebraic word problems was determined using Kuder-Richardson Formular 20 (KR-20). This was done by giving the instrument to a selected group of 20 students with hearing impairment from Andrew Foster Memorial College, Onireke, Ibadan which did form part of the study's sample. A value of 0.82 was obtained thus confirming the instrument for high reliability.

3.7 Data Collection

Data was collected using the following procedural steps:

i) Selection and training of research assistants (RAs).

ii) Administration of the pretest

iii) Treatment

iv) Administration of the posttest

Selection and training of Research Assistants	1 week
Administration of the pretest	2 weeks
Treatment	3 weeks
Administration of the posttest	2 weeks
Total	8 weeks

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Selection and Training of Research Assistants

The researcher visited the selected schools to meet the school authorities and teachers to explain his mission. After that, capable hands were selected as research assistants. The Algebraic word problems lesson plan and Algebraic word problems lesson notes were given to the research assistants to study. After this, the researcher trained the research assistants for two weeks, initiating them into duties expected of them. During this period, the research assistants were briefed on how to teach Algebraic word problems using the selected collaborative learning strategies of jigsaw, peer-tutoring and think-pair-share. The training also involved pairing students with hearing impairment for jigsaw, selecting peers and tutors for peer-tutoring, pairing and arranging students with hearing impairment on think-pair-share, introducing and explaining other aspects of the research to the research assistants. The research assistants were also trained on how to conduct pretest on each of the selected topics, carry out treatment on the experimental groups and evaluate the students through posttest.

After the training, the researcher then prepared the Algebraic word problems lesson notes from the already prepared Algebraic word problems lesson plan. This was followed by pretest stage which involved teaching of the students on the selected topics. This was done on the basis of one topic per week, making a total of three weeks. During the process, the research assistants were at hand assisting in organising the classes and make the whole process successful. Students were allowed to ask questions and express their feelings and opinions.

The students were then exposed to an evaluation to ascertain their achievement in Algebraic word problems. This was carried out with the assistance of the research assistants and graded using an evaluation sheet already prepared by the researcher. The pass mark was

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fixed at 50% and those that got 50% and above were adjudged to have a good achievement in the research proper.

Administration of the pretest

The administration of pretest of students achievement test on Algebraic word problems was conducted on both the experimental and control group within two weeks in the selected schools.

Treatment

The treatment procedure involved the experimental group who were taught using the three selected strategies of jigsaw, peer-tutoring and think-pair-share strategies. The control group on the other hand, were exposed to the conventional teaching strategy. A double period of 80 minutes was allocated to each of the topics. The research assistants carried out this process, while the researcher visited these schools on a regular basis to monitor and ascertain that things were done properly. The whole process covered eight weeks. The treatment was carried out using the prepared Algebraic word problems lesson notes. The detailed processes involved in carrying out the treatment for each group is as follow:

Procedure for Jigsaw I Strategy

Step 1: the teacher organised the class by dividing the class into home groups of 6 students with each group being diverse in terms of ability, gender, and background if possible.

Step 2: the teacher divided the lesson/topic by breaking the lesson or material into subtopics with one subtopic for each member of the home group. The three main subtopics covered under Algebraic word problems were Algebraic word problems involving fractions, Algebraic word problems involving brackets and Algebraic word problems involving both

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brackets and fractions. Thus, each member of the home group was given materials on one of the three subtopics.

Step 3: teacher formed expert groups. All students assigned the same subtopic from different home groups come together to form an expert group. Those assigned Algebraic word problems involving fractions came together to discuss it. The process was carried out with other expert groups. These expert groups study, discuss, and master their subtopic thoroughly.

Step 4: each expert group discussed and mastered their given subtopics. This was done by reading the assigned materials, discussing important points, clarifying doubts and preparing how to teach their subtopic to others later.

Step 5: each member of the expert groups then returned to their original home group and teaches their subtopic to the others in their home group using what was learnt and mastered in the expert group.

Step 6: the next step was integration and discussion in which each home group discuss all the subtopics together, members ask questions and help each other understand the full topic.

Step 7: the final stage involved assessment and evaluation in which the teacher assessed the students understanding through quizzes or short tests, group presentations, observation of participation, provision of feedback and clarification of any misconceptions.

Procedure for Peer-tutoring Strategy

Step 1: teacher identified the learning objectives. The learning objectives are to solve word prblems involving fractions, brackets and those involving both fractions and brackets.

Step 2: The teacher selected and paired students based on ability, interest, or personality. This was done on the basis of cross-ability pairing in which an higher-achieving student

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tutors a lower-achieving one, same-ability pairing in which students of similar ability help each other. Thus, after pairing and grouping, each pair had a tutor and a tutee (or rotating roles).

Step 3: the teacher then trained the tutors on how to explain concepts clearly, give encouragement and feedback, ask guiding questions rather than giving answers, manage time and stay focused. This was done through short practice sessions and role plays.

Step 4: The teacher then provided study materials, worksheets, or guides for use during tutoring, set clear rules and regulations guiding the sessions.

Step 5: the students then met in pairs or small groups during class or designated study time. During these sessions, the tutor explained, demonstrated helped solve problems, while the tutee listened, asked questions and practiced. During these sessions, the teacher supervised, moved around and provided support when needed.

Step 6: the teacher observed interactions to ensure accuracy, fairness, and cooperation among the pairs and also offered assistance or correction when necessary. The teacher encouraged rotation so that all students experienced both tutor and tutee roles.

Step 7: finally, evaluation and giving of feedback was attained by assessing both academic progress and interpersonal skills through short quizzes, observation checklists, peer and self-evaluation forms among others.

Procedure for Standard Think-pair-share Strategy

Step1: The teacher posed a prepared question on Algebraic word problems to the whole class and students were given a short time (1–3 minutes) to think independently about their answers, ideas, or solutions. This was to allow each participant to reflect and organize their thoughts before discussion.

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Step 2 (Pair): Pairing stage was carried out by ensuring that students pair up with a classmate. Each student then shared their thoughts and listened to their partner's ideas, compared answers, discussed differences and refined their understanding together. This phase lasted 3–5 minutes.

Step 3 (Share): Each pair (or selected pairs) shared their conclusions or best ideas with the whole class. The teacher implemented this by inviting volunteers or randomly selected pairs to present. The class discussed the shared ideas collectively, allowing for feedback and clarification.

Administration of the posttest

The administration of posttest of students achievement test on Algebraic word problems was conducted on both the experimental and control group after two weeks of treatment/exposure to the selected collaborative strategies of jigsaw, peer-tutoring and think-pair-share and the conventional strategies in the selected schools.

3.8 Data Analysis

The gathered data was analysed using inferential statistics of Analysis of Co-variance (ANCOVA). This is based on the nature of the hypotheses tested at 0.05 level of significance.

3.9 Ethical Approval

In ensuring that this study follows accepted moral, professional and ethical standards, official permission and approval was sought and obtained from the approved authorities of the Department of Science Education, Faculty of Education and the Postgraduate College, Lead City University, Ibadan before proceeding to carry out this research. This is necessary to ensure that the rights, safety and privacy of the participants is maintained.

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This was done by submitting details of the study such as methodology to be adopted, the purpose and objectives of the study, how data were obtained, used and analysed, procedure for convincing the participants and research assistants to participate in the study by orientating them about their roles and why they were getting involved in the study, guaranteeing their confidentiality and treating them fairly.

Also carried out was development and submission of ethical documents like participants information sheet, research instruments which consisted of Algebraic word problems lesson plan, Algebraic word problems lesson notes, students' achievement test on Algebraic word problems and measure of mindset scales and data protection plan detailing how the researcher kept the researcher's information confidential and limited to the study only.

All these were submitted to the approving authorities in Department of Science Education, Faculty of Education and the Postgraduate College, Lead City University, Ibadan. They made some adjustments to the request before it was finally approved.

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Endnotes

1.M. F Macrae, A. O Kalejaiye, Z.I Chima, G.U Garba, M. O Ademosu, J. B Chanon, A. McLeish-Smith & H. C Head, *New General Mathematics for Senior Secondary Schools, Book 1,* 2023, Pearson Educational Limited: Edinburgh Gate

2. M. F Macrae, A. O Kalejaiye, Z.I Chima, G.U Garba, M. O Ademosu, J. B Chanon, A. McLeish-Smith & H. C Head. *New General Mathematics for Senior Secondary Schools, Book 2.* 2023, Pearson Educational Limited: Edinburgh Gate

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Chapter Four

Results and Discussion of Findings

This chapter presents the results of the study. The results were presented in the order of the null hypotheses generated for the study.

4.1 Presentation of Demographic Analysis of Respondents

Table 4.1 Distribution of the participants by Treatment, Mindset and type of Hearing Impairment

Variables	Frequency	Percentage
Treatment Groups		
Jigsaw I Strategy	32	31
Peer Tutoring Strategy	28	27
Think-Pair-Share Strategy	22	22
Conventional Strategy	20	20
Total	102	100
Mindset		
Growth	39	38
Fixed	63	62
Total	102	100
Type of Hearing Impairment		
Congenital	47	46
Adventitious	65	64
Total	102	100

Source: Researcher's Fieldwork, 2025.

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4.2: Testing of Hypotheses

Ho1: There will be no significant main effect of treatment on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Table 4.2: Analysis of Covariance (ANCOVA) of Post-Achievement by Treatment, Mindset and Type of Hearing Impairment

Source	Type III Sum of Squares	Df	Mean Squares	F	Sig.	Partial Eta Squared
Corrected Model	3.301a	16	0.206	0.808	0.673	0.132
Intercept	50.976	1	50.976	199.506	0.000	0.701
Pretest	0.041	1	0.041	0.161	0.690	0.002
Treatment	1.429	3	0.476	1.865	0.142	0.062
Hearing Impairment	0.547	1	0.547	2.141	0.147	0.025
Mindset	0.881	1	0.881	3.446	0.067	0.039
Treatment * HI	0.237	3	0.079	0.309	0.818	0.011
Treatment * Mindset	0.213	3	0.071	0.277	0.842	0.010
HI * Mindset	0.001	1	0.001	0.002	0.963	0.000
Treatment * HI * Mindset	0.367	3	0.122	0.478	0.698	0.017
Error	21.718	85	0.256			
Total	628.000	102				
Corrected Total	25.020	101				

R Squared = 0.132 (Adjusted R Squared = -0.031) $p > 0.05$

Source: Researcher's Fieldwork, 2025.

Table 4.2 revealed that there was no significant main effect of treatment on students with hearing impairment's academic achievement in Algebraic word problems ($F_{(3,99)=}$ 1.885; $p > 0.05$; partial $\eta^2 = 0.063$). Table 4.2 indicated the effect size of 6%. Therefore, null hypothesis 1 was not rejected. In order to explore the magnitude of the insignificant main effect across treatment groups, the estimated marginal means of the treatment group was carried out and the result was presented in Table 3.

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Table 4.3: Estimated Marginal Means for the Post-Achievement by Treatment and Control Group

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Jigsaw I Strategy	2.53	0.091	2.35	2.71
Peer-Tutoring Strategy	2.44	0.101	2.41	2.64
Think-Pair-Share Strategy	2.20	0.112	1.98	2.42
Conventional Strategy	2.36	0.128	2.10	2.61

Source: Researcher's Fieldwork, 2025.

Table 4.3 revealed that students in the jigsaw I strategy treatment group had the highest adjusted mean score in their post-achievement in Algebraic word problems (2.53), followed by peer-tutoring strategy group (2.44) and the conventional strategy group (2.36), while the think-pair-share treatment group had the least mean score of 2.20. This order is represented as jigsaw I strategy > peer tutoring strategy > control group > think-pair-share strategy.

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Ho2: There will be no significant main effect of type of hearing impairment on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Table 4.2 showed that there was no significant main effect of type of hearing impairment on students with hearing impairment's academic achievement in Algebraic word problems ($F_{(1,101)=}$ 2.141; p > 0.05; partial η^2 = 0.025). Based on this finding, hypothesis 2 is hereby not rejected and it can be concluded that type of hearing impairment had no effect on academic achievement of students with hearing impairment in Algebraic word problems.

Table 4.4: Estimated Marginal Mean for Post-Achievement by Type of Hearing Impairment

			95% Confidence Interval	
Type of Hearing Impairment	Mean	Std. Error	Lower Bound	Upper Bound
Congenital	2.30	0.082	2.138	2.465
Adventitous	2.46	0.071	2.319	2.603

Source: Researcher's Fieldwork, 2025.

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Ho3: There will be no significant main effect of Mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Table 4.2 showed that there was no significant main effect of mindset on students with hearing impairment's academic achievement in Algebraic word problems ($F_{(1,101)=}$ 3.446; p > 0.05; partial η^2 = 0.039). Based on this finding, hypothesis 3 was hereby not rejected and it can be concluded that mindset had no effect on academic achievement of students with hearing impairment in Algebraic word problems.

Table 4.5: Estimated Marginal Mean for Post-Achievement by Mindset

			95% Confidence Interval	
Mindset	Mean	Std. Error	Lower Bound	Upper Bound
Growth	2.28	0.087	2.108	2.453
Fixed	2.48	0.066	2.352	2.614

Source: Researcher's Fieldwork, 2025.

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Ho4: There will be no significant interaction effect of treatment and type of hearing Impairment on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Table 4.2 revealed that there was no significant interaction effect of treatment and type of hearing impairment on students with hearing impairment's academic achievement in Algebraic word problems ($F_{(3,99)=}$ 0.309; p > 0.05; partial η^2 = 0.011). Therefore, null hypothesis 4 was not rejected and it can be concluded that there was no significant interaction effect of treatment and type of hearing impairment on students with hearing impairment's academic achievement in Algebraic word problems.

Ho5: There will be no significant interaction effect of treatment and mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Table 4.2 revealed that there was no significant interaction effect of mindset and type of hearing impairment on students with hearing impairment's academic achievement in Algebraic word problems ($F_{(3,99)=}$ 0.277; p > 0.05; partial η^2 = 0.010). Therefore, null hypothesis 5 was not rejected.

Ho6: There will be no significant interaction effect of hearing impairment and mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Table 4.2 revealed that there was no significant interaction effect of mindset and type of hearing impairment on students with hearing impairment's academic achievement in Algebraic word problems ($F_{(1,101)=}$ 0.002; p > 0.05; partial η^2 = 0.000). Therefore, null hypothesis 6 was not rejected.

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Ho7: There will be no significant interaction effect of treatment, type of hearing impairment and mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.

Table 4.2 revealed that there was no significant interaction effect of mindset, type of hearing impairment and mindset on students with hearing impairment's academic achievement in Algebraic word problems ($F_{(3,99)=}$ 0.478; p > 0.05; partial η^2 = 0.017). Therefore, null hypothesis 7 was not rejected.

4.3 Discussion of Findings

The findings of the study revealed that there is no significant effect of treatment on students with hearing impairment's academic achievement in Algebraic word problems. The result also revealed that jigsaw strategy treatment group was the most effective in contributing to the academic achievement of students with hearing impairment, while think-pair-share strategy was the least which was in agreement with the findings that stated that students exposed to jigsaw mathematical learning strategy performs better than those taught with traditional and conventional strategy of learning[1, 2, 3]. Jigsaw promotes ability to reduce racial or discriminatory profile by bringing students from different background together to achieve a common learning goal, granting students opportunities to listen to perspectives of other students, increasing students sense of belonging and encouraging students to take responsibility for their own work.

The findings also further solidified the idea that jigsaw is one of the collaborative learning models capable of increasing students' sense of responsibility towards their learning and others as students scored higher while exposed to jigsaw compared to other strategies. This implies they needed to depend on each other and need to cooperatively collaborate to

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achieve the learning objectives. This aspect of collaborative learning strategy is very crucial as it promotes teamwork and subsequently reaching a favourable outcome[4].

The outcome of the study however contradicted the idea that collaborative learning strategies and models are capable of increasing students' sense of responsibility towards their learning and others as they will depend on each other and need to cooperatively collaborate to achieve the learning objectives, it is also considered as one of the strategies of collaborative learning as it promotes the ability to work in teams by the students thus ensuring they reach a favourable outcome[5]. Thus, the idea that learning through collaborative strategies can improve learning achievement and students' understanding as students who learn with such strategies admit that more cooperation and information are shared between students was further contradicted.

The finding was also in disagreement with studies that examined the effects of collaborative learning strategies on students' Mathematics achievement which found that the strategy boosts students' performance and learning retention in Mathematics[6, 7]. Among such was a previous investigation on the effects of jigsaw strategy using a pretest and posttest design, results from the research revealed that students in the jigsaw strategy group performed higher in the achievement test and also exhibits greater long-term achievement compared to those in the traditional lecture-based learning group[8]. This further affirms the idea that collaborative learning approach alone is not capable of improving learning outcomes in Algebraic word problems, while applying experimental research design as the results showed that the jigsaw strategy of collaborative learning is capable of improving students' learning performance in Mathematics and improved the efficiency of learning was contradicted by the findings of this study.

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Furthermore, the findings of the study failed to corroborate the finding which stated that application of the collaborative strategies such as jigsaw, peer-tutoring and think-pair-share is capable of improving performance in Mathematics as the jigsaw strategy provides avenues for the students to express themselves confidently and process crucial information, which can uplifts their learning abilities and outcomes[9, 10] as Algebraic word problems are not only integral to Mathematics education but also play a crucial role in developing creativity, retention, problem-solving abilities, critical thinking ability and solving real-life mathematical problems by applying acquired problem-solving skills[11]. As conventional teaching strategy sometimes become tedious exercises in plugging numbers into formulas, leaving students disenchanted and disconnected from the beauty of Mathematics, the way out is for students to work in groups, using collaborative learning strategy like jigsaw, peer-tutoring and think-pair-share to solve Algebraic word problems together need to be considered. This will allow them to discuss their ideas and work collaboratively, which can help them better understand the problem and come up with creative solutions.

As collaborative learning strategy bring together students with different abilities in a group by successfully working together to gain knowledge gained from discussions from experts among them and groups members are likely to be motivated to go higher academically by developing an improved learning attitude and develops social skills that prepare them for challenges in the real world[12], the findings of this study did not align with this opinion. Thus, this approach cannot be said to influenced the achievement of students as the success of each group member and the entire group depends on interdependence and

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collaboration, so each member must help other members for mutual benefit thus resulting in greater efforts to achieve higher learning achievement[13].

The research findings also contradicted the idea that students exposed to collaborative instructional strategy exhibits some positive traits such as increased level of self-esteem, high achievement in school, high level of motivation in school, punctuality and cooperation with students of the same class and group, compared to students in the same class exposed to conventional teaching strategies as revealed by the outcome of a study carried out on the effects of various collaborative techniques and traditional strategy on mathematics laboratory material recognition and Mathematics usage skills of students in science subjects such as Mathematics[14]. This further discarded the strong belief that collaborative strategies such as jigsaw, peer-tutoring and think-pair-share are considered strong correlates in learning science subjects such as Mathematics.

The findings of the study refuted the veracity of collaborative strategy as a reliable students-centred Mathematics learning approach which had earlier been confirmed as being effective in assisting students in obtaining practical Mathematics learning skills, effective communication skills and proficiency in conceptual understanding knowledge as it promotes Mathematics students critical thinking skills[15, 16]. As a teaching strategy that inculcates various activities in students to improve their understanding of core subjects like Mathematics through a well-structured approach involving a series of steps requiring learners to create, analyze and apply concepts, collaborative strategy should be viewed as a radical tool for increasing motivation and passion in learning and doing Mathematics[17, 18] but the findings of the study refuted this.

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The finding of this study revealed that there is no significant main effect of type of Hearing Impairment on academic achievement of senior secondary school students with hearing impairment in Algebraic Word problems. This simply means that type of hearing impairment had no effect on academic achievement of students with hearing impairment in Algebraic word problems. This was in contrast to the idea that the existence of hearing impairment of any type or degree in a child is capable of affecting his educational development due to the fact that communication, which is the main vehicle for learning, has been derailed which was linked to the idea that educational challenges and obstacles related to hearing impairment stem around communication and such students are likely facing difficulties in the aspects of arithmetic, calculation, manipulation, English language skills, notes taking, dialogue during classroom discussion, interpreting educational videos without captions, understanding oral reports among others[19, 20].

However, the findings was in tandem with the common agreement that hearing-impaired students' achievement in Mathematics is dwindling compared to that of their hearing colleagues which can be interpreted as lagging behind in 2 to 4 school years[21, 22]. It also aligned with previous findings which revealed that students with hearing impairment typically sees questions related to Algebraic word problems as the usual Mathematics numbers and procedures identifying the crucial semantic relations in such problems. That way, instead of applying their acquired previous knowledge to solve the problems, they resort to counting and other basic problem-solving skills[23].

The outcome of the study was also in tune with the idea that the reasons for likely difficulties faced by students with hearing impairment in Algebraic word problems includes the nature of Mathematical language, difficulties in interpreting crucial connectives such as

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if, because, more, difference, factor, product, quotient, sum, average, square among others, which further pointed to low achievement in Mathematics among students with hearing impairment[21]. This was highly linked to the issue of access to Mathematical concepts by students with hearing impairment as it can be stated that since sign language is a visual and spatial-based language it should serve as a highly reliable medium for teaching crucial Mathematics concepts and relationships[24, 25].

The finding was in sync with previous findings which investigated the relationship between students with hearing impairments' word-problem solving skills and instructional method and the outcome revealed low achievement by stating that these students shows lack of endurance and motivation in working through difficult challenges on word-problems and difficulties in linking a learned skill to another as it was revealed that the students only responds well on one-dimensional tasks unlike when exposed to two or more dimensional problems[26, 27]. This further requires that students with hearing impairment should be sufficiently engaged in challenging word-problem situations.

The findings aligned with the idea that Mathematics performance can be affected by language proficiency and understanding levels among students as expected due to their limitations in mastering language proficiency and application occasioned by their hearing loss and ability[28, 29]. It was in harmony with finding which stated that while examining comprehension level and conceptual learning ability among students with hearing impairment in Algebraic word problems through a self-report questionnaire, the outcome revealed that hearing students performs higher than their hearing-impaired counterparts, likely as result of deprivation of auditory processing of information and other challenges[30]. It can thus be concluded that specific English language competency and reading ability level,

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are correlates of performance in Mathematics Word-problems among students with hearing impairment[31].

In comparison with their hearing peers, the low achievement in Algebraic word problems among students with hearing impairment can be defended on the premises that, while language is the base for acquiring most of the needed Mathematics skills, students with hearing impairment are likely to miss out on various concepts and vocabulary that hearing children pick up incidentally. Thus, in order for them to excel in learning Algebraic word problems, there is the need for mastering of problem-solving, communication, logical thinking and reasoning skills, all of which can be hampered by loss in hearing. Furthermore, the challenges which students with hearing impairment encounters when learning Algebraic word problems are likely to be many and needed to be addressed as Algebraic word problem-solving is particularly difficult for students with hearing impairment due to the pre-requisite behaviour to convert observations into mathematical expressions and apply necessary tools. The absence of these language skills is capable of making students with hearing impairment become isolated in a Mathematics learning environment and unable to fully participate in mathematical group discussions.

The findings of the study was in harmony with previous findings which established that students with hearing impairment are academically inferior to students with normal hearing in Mathematics achievement as they lags behind by roughly three years in attainment and ability level[32, 33]**.** This point is noteworthy as it reveals that students with hearing impairment need to be exposed to crucial Mathematics skills and knowledge and Mathematics word-problems skills, just like their hearing counterparts and they need all it requires to succeed in it as their future intellectual development depends on it. This can be

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achieved by exposing them to skill on numbers and number operations like addition, subtraction, multiplication, division among others which are parts of our everyday life activities[34].

In the same vein, it can be deduced from the above that that the stage of onset of the hearing loss, either congenital or adventitious, is a potent predictor of academic performance as well as an important determinant of learning outcomes among students with hearing impairment in the classroom. In addition, research has shown that learners with adventitious hearing impairment lag behind in Mathematics achievement compared to their peers with normal hearing within the same grade levels as it has already been well-established that students with adventitious hearing impairment, specifically cochlear implant users and those with severe hearing loss, have decreased level of ability to perform academically in Mathematics and other subjects[35, 36]. The same scenario occurred in cases of reading and communication skills among students with hearing impairment where decreased level and ability in auditory communication can significantly influence mathematics learning skills. Indeed, studies have revealed that even infinitesimal level of hearing loss in children can result in decreased communication ability, low self-esteem, weak social support and poor academic performance[37, 38]. It was also revealed that in the last few decades, new approaches in education of students with hearing impairment such as inclusion and cochlear implantation have significantly resulted in significant changes in the educational achievement and subsequently, the Mathematics achievement of students with adventitious hearing impairment[39, 40].

Table 4.2 showed that there was no significant main effect of Mindset on students with hearing impairment's academic achievement in Algebraic word problems. It can thus be

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stated that mindset had no effect on academic achievement of students with hearing impairment in Algebraic word problems. This is thus contrary to the belief that mindset promotes intrinsic motivation by focusing on construction of knowledge, strengthening their abilities and boosting intelligence and thus enhancing academic achievement in Mathematics[41, 42]. This is considered the main characteristics features of an academically sound Mathematics student capable of churning out great performances through dints of hard works, motivation and positive self-determination. The above is contrary to individuals with fixed mindset who mainly focus on getting a grade, reaching cut-off mark, prevent ridicule, being extrinsically motivated and getting rewards.

Although, biologically, it is strongly believed that individuals possess a unique genetic makeup inherited from our parents[43, 44], this is not the main factor shaping our attainment and progress. Rather, there is the need for constant efforts to determine how far we can go through a consistent process of give and take as previous works has revealed that reinforcement can influence students' mindset and motivation, self-efficacy[45, 46] and subsequently, academic achievement as those praised for their efforts are likely to be motivated to take on more difficult challenges with the aim of achieving mastery[2]. The finding also contradicted previous findings which revealed that deaf and hard of hearing students with growth mindset are more likely to secure higher scores in Mathematics achievement tests[47].

The finding however, was in agreement with the idea that, growth mindset has no association with grades as it was discovered that academic achievement is not directly related to growth mindset and there is almost no correlation between achievement and student mindset[41]. Furthermore, the finding contradicted the reports of a survey involving selected

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teachers who expressed their views on mindset revealed that nearly all the participants reported that adoption of growth mindset strategies in the classroom give them the expectations that there will be an improvement in student performance in the classroom and the quality of classroom instruction[48, 49].

There was also a contrast between the findings and that which stated that growth mindset is capable of influencing a students' motivation, which in turn can affect academic capability, performance, achievement, motivation, total intellectual development and subjective wellbeing of the student, thus reducing the level of psychopathology in students[50, 51]. Additionally, the results contradicted that which stated that previous researches has revealed that the existence of growth mindset i.e the belief that one's ability and expertise can be developed, rather than being unchangeable, is capable of stimulating lifelong learning[52]. In terms of behavioural outcomes, growth mindset cannot thus be said to be capable of activating persistence behaviours in the face of challenges and problems-seeking behaviours and thus positively influencing academic performance of students[53, 54]. Specifically, it can be safely deduced that the presence of growth mindset in Mathematics students is not positively related to academic performance in Mathematics and triggers higher achievement compared to fixed mindset.

Furthermore, the finding did not aligns with that which stated that a positive correlation exists between the mindset of students with hearing impairment and the appraisal of students who demonstrate high achievement in Mathematics as students who are exhibits a growth mindset are much more successful in conquering the negative effects of low self-esteem on their academic achievement than those who demonstrated a fixed mindset[55, 56]. The findings also failed to reinforces the outcome of a study which examined students with

hearing impairment's mindsets and their Mathematics grades recorded in the seventh and eighth grade and discovered that the results of the students with fixed and growth mindset varies, with students exhibiting growth mindset demonstrating higher scores more whereas those with fixed mindset students remained stagnant[57]. Thus, it can be concluded that students exhibiting a growth mindset are not likely to outshine their peers with fixed mindset.

It has also been shown that existence of growth mindset in students cannot boost the academic achievement of lower-achieving students with hearing impairment and increase overall interest and passion in mathematics topics among secondary schools students[48]. This further shows the extent to which growth mindset can influence the academic achievement of students in general and that of secondary school students in particular.Thus, it can be stated that the idea that students' opinions about their abilities is a key factor in how they performs in Mathematics[58] is not in tandem with the findings of this work and other subjects because when students are of the opinion that their knowledge and performance can be improved through persistence efforts, they inclines toward achieving same by laying much emphasis on knowledge searching and acquisition and being persistence in the face of challenges[59].

The findings of the study revealed that there is no significant interaction effect of treatment and hearing impairment on achievement of senior secondary school students with hearing impairment in Algebraic word problems which is not in tandem with the general belief that the existence of hearing impairment of any type or degree in a child is capable of affecting his academic achievement and that collaborative learning strategies are capable of leading to high achievement in Mathematics among students with hearing impairment. This finding contradicted that which investigated relationship between students with hearing impairments' word-problem solving skills and instructional method and revealed that these

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students shows lack of endurance and motivation in working through difficult challenges on word-problems and difficulties in linking a learned skill to another as it was revealed that the students only responds well on one-dimensional tasks unlike when exposed to two or more dimensional problems[60, 61, 62]. This further exposed the fact that students with hearing impairment should are not only influenced by hearing impairment and instructional strategies but there is the need to investigate further, what are the main factors determining the achievement of these students in Algebraic word problems. The reasons for this can be linked to the idea that while language is the base for acquiring most of the needed Mathematics skills, students with hearing impairment are likely to miss out on this due to their inability to acquires various concepts and vocabulary that hearing children pick up incidentally.

Table 4.2 further showed that there was no significant interaction effect of Treatment and Mindset on students with hearing impairment's academic achievement in Algebraic word problems. In other words, it can thus be stated that treatment and mindset had no effect on academic achievement of students with hearing impairment in Algebraic word problems. This finding is in contradiction with the one that stated that academic achievement can be influenced by mindset, achievement and motivation of students as those rewarded for their effort, which points to a growth mindset approach, tend to be willing to attempts more difficult challenges and leans toward attaining mastery, whereas those students praised for their intelligence, indicating a fixed mindset approach, are more likely to be more fixated on grades obtained and the alluring prospect of being smart instead of acquiring knowledge, skills and learning[64, 65, 66]. This is especially true for most brilliant students, who are more likely to be hesitant in attempting more difficult activities due to fear of failure and losing the brillant tag. This fact is very critical for parents, teachers, students and counselors others

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tasked with guiding students in improving their academic achievement. As there are two main ways in which we usually view ourselves and our abilities and these are fixed mindset and growth mindset. While fixed mindset is sometimes refers to as an theory of ability and it simply refers to a situation whereby individuals consider their unique characteristics features to be natural and not liable to change, growth mindset on the other hand is also commonly refers to as the incremental theory of ability which depicts a situation whereby individuals are of the opinion that their individual characteristics features and traits can boosted through consisted efforts and dints of hardwork[67, 68].

This is thus in contrast to the idea that growth mindset promotes intrinsic motivation by focusing on construction of knowledge, strengthening their abilities and boosting intelligence and thus enhancing academic achievement in Mathematics which is considered the main characteristics features of an academically sound Mathematics student capable of churning out great performances through dints of hard works, motivation and positive self-determination. The above is contrary to individuals with fixed mindset who mainly focus on getting a grade, reaching cut-off mark, prevent ridicule, being extrinsically motivated and getting rewards[69, 70].

The finding also contradicted that which revealed that deaf and hard of hearing students with growth mindset are more likely to secure higher scores in Mathematics achievement tests[71, 72], while it aligns with that which stated that growth mindset has no association with grades as it was discovered that academic achievement is not directly related to growth mindset and there is almost no correlation between achievement and student mindset[73].

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Table 4.2 showed that there was no significant interaction effect of Hearing Impairment and Mindset on students with hearing impairment's academic achievement in Algebraic word problems. It can thus be stated that hearing impairment and mindset had no effect on academic achievement of students with hearing impairment in Algebraic word problems. The result of this work contradicts the idea that the existence of hearing impairment of any type or degree and possession of growth or fixed mindset in a student with hearing impairment is capable of affecting his educational development due to the fact that communication, which is the main vehicle for learning, has been derailed and mindset is a strong correlate of achievement in Mathematics[74, 75, 76].

The findings also tallied with that which stated that the dwindling performance of students with hearing impairment in Mathematics is likely to be caused by a myriad of factors which can be student-related, government-related, home/family-related and environment/society-related, implying others factors apart from mindset and hearing impairment are strongly linked to poor achievement in Mathematics among students with hearing impairment[77, 78, 79]. Specifically, the result of the study was in tandem with many studies and authorities which presented many causes of poor performance in Mathematics among students and cited several factors such as shortage of well-trained Mathematics teachers, inadequate Mathematics teaching facilities, lack of fund to purchase necessary teaching and learning equipment, poor quality of Mathematics textbooks, large Mathematics classes, poorly motivated Mathematics teachers, lack of science and Mathematics laboratories and libraries, poorly coordinated supervisory activities, interference in the school system by the civil service, incessant transfers of Mathematics teachers, automatic promotions of pupils who did not pass Mathematics and inequality in access to education

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opportunities, all of which hamper the smooth acquisition of Mathematics knowledge and further contributes to the dwindling state of Mathematics achievement[80, 81, 82].

Table 4.2 showed that there was no significant interaction effect of Treatment, Hearing impairment and Mindset on students with hearing impairment's academic achievement in Algebraic word problems. It can thus be stated that the combination of treatment, hearing impairment and mindset had no effect on academic achievement of students with hearing impairment in Algebraic word problems. This finding is in contradiction with previous works which highlighted that collaborative strategies, mindset and type of hearing impairment are capable of influencing academic achievement in Algebraic word problems among students with hearing impairment[83, 84, 85].

The findings also contradicted that which stated that Mathematics performance can be said to be affected by hearing impairment through lack of language proficiency and understanding levels among students, type of mindset displayed and exposure to collaborative learning strategy due to their limitations in mastering language proficiency and application occasioned by their hearing loss and ability[86]. While examining comprehension level and conceptual learning ability among students with hearing impairment in Algebraic word problems through a self-report questionnaire, the outcome revealed that hearing students performs higher than their hearing-impaired counterparts, likely as result of deprivation of auditory processing of information and other challenges[87, 88]. It can thus be concluded that specific English language competency and reading ability level, are correlates of performance in Mathematics Word-problems[89, 90, 91].

The result further contrasted that which revealed that deaf and hard of hearing students exposed to jigsaw, peer-tutoring and think-pair-share, and those with growth mindset are

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more likely to secure higher scores in Mathematics achievement tests[92, 93]. Furthermore, reports of a survey involving selected teachers who expressed their views on mindset, adoption of collaborative strategies and effect of hearing impairment on Mathematics achievement revealed that nearly all the participants failed to prove that their knowledge of collaborative strategies, possession of growth mindset and type of hearing impairment give them the expectations that there will be an improvement in student performance in the classroom and the quality of classroom instruction[94, 95].

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Chapter Five

Conclusion

This chapter presents the summary of findings, the conclusion and recommendations.

5.1 Summary of Findings

The findings of the study revealed the following:

There was no significant main effect of treatment on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems. However, the mean score shows that jigsaw I and peer-tutoring strategies were more effective in teaching Algebraic word problems to senior secondary school students compared to think-pair-share and conventional strategy.

There was no significant main effect of type of hearing impairment on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems. This simply mean that hearing impairment did not have any effect on academic achievement of senior secondary school students with hearing impairment on Algebraic word problems.

There was no significant main effect of mindset on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems. This simply mean that mindset did not have any effect on academic achievement of senior secondary school students with hearing impairment on Algebraic word problems.

There was no significant interaction effect of treatment and type of Hearing Impairment on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems. In other words, treatment and types of hearing

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impairment cannot influence academic achievement of students with hearing impairment in Algebraic word problems.

There was no significant interaction effect of mindset and type of hearing impairment on students with hearing impairment's academic achievement in Algebraic word problems. This signifies that treatment and types of hearing impairment cannot influence academic achievement of students with hearing impairment in Algebraic word problems.

There was no significant interaction effect of treatment, mindset and type of hearing impairment on students with hearing impairment's academic achievement in Algebraic word problems. This signifies that treatment and types of hearing impairment cannot influence academic achievement of students with hearing impairment in Algebraic word problems.

5.2 Conclusion

This study determined the effects of selected collaborative learning strategies of jigsaw, peer-tutoring and think-pair-share on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems. It was discovered that none of the strategies had significant effects on the academic achievement of students with hearing impairment in Algebraic word problems. However, it was deducted from the findings that adoption of jigsaw and peer-tutoring enhanced the academic achievement of students with hearing impairment in Algebraic word problems compared to think-pair-share and conventional strategies. In other words, if senior secondary school students with hearing impairment are exposed to jigsaw and peer-tutoring strategies, it will improve their academic achievement in Algebraic word problems.

5.3 Recommendations

The following recommendations are hereby made based on the findings

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1. In order to boost the academic achievement in Algebraic word problems, teachers should adopt appropriate instructional strategy.
2. There is the need for training of Mathematics teachers on usage of constructivist approaches in teaching and learning of Mathematics.
3. Mathematics teachers should always explores other collaborative strategies not covered by this study so as to determine the best approaches to teaching Algebraic word problems to senior secondary school students with hearing impairment.
4. Mathematics teachers should always provide practical and revision sessions to aid senior secondary school students with hearing impairments' academic achievement in Algebraic word problems.

5.4 Contributions to Knowledge

This study contributed to knowledge in the following ways:

The study has established the fact that there are certainly other cultural factors peculiar to Nigeria that are determining academic achievement of senior secondary school students with hearing impairments' academic achievement in Algebraic word problems apart from collaborative strategies, mindset and type of hearing impairment which need to be investigated. Although these factors were found not to have significant effect on the academic achievement of senior secondary school students with hearing impairments' academic achievement in Algebraic word problems, they should be considered as possible influences and further researchers should be conducted on them.

The study has further revealed that the academic achievement of secondary school students in general and those with hearing impairment in particular with reference to Algebraic word problems is dwindling and this need to be addressed.

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There are certainly other factors and instructional strategies having significant effects on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems apart from collaborative learning strategies.

5.5 Suggestions for Further Studies

From the findings of the study and the limitations identified therein, the following suggestions are hereby made:

1. There is the need for the study to be further delineated on the basis of school types such as integrated and inclusive special schools, rural and urban special school, public and private special schools among others so as to further deepen the findings of the study.
2. Other types of collaborative learning strategies such as small group discussion, fishbowl debate, roundrobin and guided design, should be identified and their effects and influence on academic achievement of senior secondary school students with hearing impairment in Algebraic word problems.
3. The study should also be repeated on a longitudinal scale to cover the more special schools in Oyo State.
4. Other social, economical, psychological, home-related, school-related and government-related variables capable of influencing academic achievement of senior secondary school students in Algebraic word problems should be investigated.
5. The study should also be extended to cover other core concepts and topics in Mathematics.

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Appendix I

Lead City University, Ibadan
Department of Science Education (Mathematics Education Unit)
Student Achievement Test on Algebraic Word Problems

Instruction: the instrument aims at measuring the achievement of Senior Secondary School students with hearing impairment in Algebraic Word problems in Oyo State. Kindly respond to each item by circling the desired option among the alternatives provided therein. Your response will be kept confidential. Thanks

Section A

Name of School:

Gender: Male ( ) Female ( )

Students Achievement Test on Algebraic Word Problems

Instruction: Answer the following questions by picking the correct answer from the available options

1) The product of two and the sum of x and twelve is sixty-four. Find the value of x.

(a) 32

(b) 64

(c) 41

(d) 20

2) x represents a certain number. When the number is multiplied by 3, the result is the same as adding 34 to the number. Find *x*

(a) 32

(b) 16

(c) 34

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(d) 17

3) A rectangle is 3 times as long as it is wide. If its perimeter is 56cm, find the width of the rectangle.

(a) 7

(b) 21

(c) 56

(d) 28

4) A woman is three times as old as her daughter. Six years ago, the sum of their age was 36. Find the current age of the daughter.

(a) 36

(b) 12

(c) 6

(d) 15

5) A total of m matches are needed to fill 30 matchboxes with the same number of matches in each box. How many matches are in each box?

(a) 30m

(b) m/30

(c) 30 + m

(d) 30/m

6) Anna has 300 naira and Ojo has 1860 naira. If Anna saves 50 naira a day and Ojo spends 70 naira a day, after how many days will they have equal amounts?.

(a) 10 days

(b) 25 days

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(c) 13 days

(d) 72 days

7) Divide 59ml into two parts so that one part is 7ml less than five times the other part.

(a) 7, 52ml

(b) 11, 48ml

(c) 22, 37ml

(d) 24, 35ml

8) I think of a number. I add 22. I then subtract 35. My answer is 45. What was the original number?

(a) 68

(b) 72

(c) 58

(d) 64

9) The result of taking 3 from x and multiplying the answer by 4 is the same as taking 3 from five times x. find the value of x.

(a) -15

(b) 15

(c) 9

(d) -9

10) The sum of 6 and one-third of n is one more than twice n. find the value of n.

(a)3

(b)2

(c) 5

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(d) 7

11) A boy is 10 years old and his mother is 37 years old. In how many years time will the mother be twice as old as her son?

(a)17

(b) 12

(c) 15

(d) 10

12) A school girl spends a quarter of her pocket money on books and one-third on dress. What fraction remains?

(a) 1/5

(b) 3/5

(c) 5/12

(d) 7/12

13) The sum of four times a certain number and nine is equal to the sum of the number and 12. What is the number?

(a) 1

(b) 2

(c) 3

(d) 4

14) Dauda and Alice shared a certain amount of money in the ratio 5:3. If Dauda collected ₦175, how much was the total money shared?

(a) ₦280

(b) ₦ 105

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(c) ₦295

(d) ₦315

15) The sum of eight and a certain number is equal to the product of the number and 3. What is the number?.

(a) 6

(b) 4

(c) 3

(d) 8

16) When two is added to two-fifths of a number, the result is six. Find the number.

(a) 12

(b) 8

(c) 15

(d) 10

17) When three is divided by the sum of a certain number and eight, the result is the same as dividing 2 by the sum of that nu8mber and 3. Find the number.

(a) 12

(b) 10

(c) 7

(d) 15

18) I think of a number. I add 15. I then divide my answer by 11. My answer is 5. What was the original number?

(a) 40

(b) 72

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(c) 58

(d) 64

19) The sum of 2 times a number and 3 times another number is 4. The first number minus the second is -3. What are the numbers?

(a) 1, 2

(b) -1, -5

(c) 1, -3

(d) -1, 2

20) Twice the sum of forty-eight and a certain number is equal to a third of 96. What is the number?

(a) 15

(b) 12

(c) 32

(d) 20

21) Divide 36 by the positive difference between the product of 3 and 6 and the square root of 36.

(a) -7

(b) 4

(c) 3

(d) -5

22) If the product of four and the sum of six and a certain number is equal to half of a dozen, what is the number?

(a) 14

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(b) -10

(c) -3

(d) 10

23) The mean age of five girls is 16 years. If three of them are eight, twelve and sixteen years old, how old is one of the other two girls if they are of the same age?

(a) 16

(b) 44

(c) 24

(d) 22

24) Two-thirds of a certain number is equal to the sum of three-seventh and one-third. Find the number.

(a) 8/7

(b) 3/4

(c) 3/2

(d) 8/5

25) The difference between two numbers is 4. The result of adding twice the first to the second is 20. Find the numbers

(a) 2, -4

(b) 3, -5

(c) 8, 4

(d) -4, 3

26) The product of three numbers is 180. If two of the numbers are -3 and -4, what is the third number?

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(a) 10

(b) 12

(c) 15

(d) -15

27) Adding 42 to a certain given positive number gives the same positive result as squaring the number. Find the number.

(a) 6, 7

(b) 7, -6

(c) 6, -7

(d) -6, -7

28) Sunny is twice as old as Wale. Four years ago, he was four times as old as wale. When will the sum of their age be 66?

(a) 24

(b) 12

(c) 15

(d) 18

29) The sum of six and one-third of x is one more than twice x. find x.

(a)15

(b) 10

(c) 5

(d) 3

30) When three is divided by the sum of a certain number and eight, the result is the same as dividing 2 by the sum of that number and 3. Find the number.

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(a) 7

(b) -5

(c) 10

(d) -3

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Appendix II

Algebraic Word Problems Lesson Plan for Experimental Group

Week	Topic	Sub-Topic	Behavioural Objectives
1st	Algebraic Word problems	Algebraic Word problems involving brackets	Students should be able to: **i**.translate Algebraic word problems into mathematical expressions. **ii.** incorporate brackets into the Algebraic expression **iii.** solve Algebraic word problems involving brackets.
2nd	Algebraic Word problems	Algebraic Word problems Involving Fractions	Students should be able to: **i**.translate Algebraic word problems into mathematical expressions. **ii.** incorporate fractions into the Algebraic expression **iii.** solve Algebraic word problems involving fractions.
3rd	Algebraic Word problems	Algebraic Word problems Involving Brackets and Fractions	Students should be able to: **i**.translate more Algebraic word problems into mathematical expressions. **ii.** incorporate both brackets and fractions into the Algebraic expression **iii.** solve Algebraic word problems involving both brackets and fractions.

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Appendix III

Algebraic Word Problems Lesson Plan for Control Group

Week	Topic	Sub-Topic	Behavioural Objectives
1st	Algebraic Word problems	Algebraic Word problems Involving Brackets	Students should be able to: **i**.translate Algebraic word problems into mathematical expressions. **ii.** incorporate brackets into the Algebraic expression **iii.** solve Algebraic word problems involving brackets.
2nd	Algebraic Word problems	Algebraic Word problems Involving Fractions	Students should be able to: **i**.translate Algebraic word problems into mathematical expressions. **ii.** incorporate fractions into the Algebraic expression **iii.** solve Algebraic word problems involving fractions.
3rd	Algebraic Word problems	Algebraic Word problems Involving Brackets and Fractions	Students should be able to: **i**.translates more Algebraic word problems into mathematical expressions. **ii.** incorporate both brackets and fractions into the Algebraic expression **iii.** solve Algebraic word problems involving both brackets and fractions.

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Appendix IV

Algebraic Word Problems Lesson Notes I for SS II Experimental

Algebraic Word Problems Lesson Notes: First Week

Class: Senior Secondary School II

Subject: Mathematics

Topic: Algebraic Word Problems

Sub-topic: Algebraic word problems involving brackets

Period: First Period

Duration: 40 minutes

Instructional Material:

Reference Book: New General Mathematics for Senior Secondary Schools Book 1 & 2. 2017 Edition.

Learners Entry Behaviour: Students can carry out mathematical operations involving figures and translate simple operational words into mathematical symbols.

Behavioural Objectives: at the end of the lesson, students will be able to

(i) translate simple statements and Algebraic word problems into mathematical expressions

(ii) solve Algebraic word problems involving brackets

Teaching Procedures:

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Introduction:

Algebraic word problem is a Mathematics problem where significant background information on the problem is presented in ordinary language rather than in Mathematics notation. In this case, one is expected to apply mathematical concepts to real-life situations, mostly involving applying algebraic applications and identities.

Example1: A certain number is multiplied by 3, the result is the same as adding 34 to the number. Find the number.

Solution

Let the number be x

Multiply by 3: 3x

The result is the same as adding 34 to the number: 3x = x + 34

3x –x = 34

2x = 34

2x/2 = 34/2

X = 17

Example 2: A rectangle is 3 times as long as it is wide. If its perimeter is 56cm, find the width of the rectangle.

Solution

Let the length of the rectangle be Xcm and the width be Ycm.

Length = 3 width

L = 3W

Perimeter of a rectangle = 2(L + B)

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$$2(3W + W) = 56$$

$$2(4W) = 56$$

$$8W = 56$$

$$W = 7\text{cm}$$

The width of the rectangle is 7cm.

Exercise

1) The result of taking 3 from x and multiplying the answer by 4 is the same as taking 3 from five times x. find the value of x.
2) A boy is 10 years old and his mother is 37 years old. In how many years time will the mother be twice as old as her son?

Assignment

1) If the product of 4 and the sum of 12 and a certain number is equal to 8, what is the number?
2) The sum of 2 times a number and 3 times another number is 4. The first number minus the second is -3. What are the numbers?
3) Sunny is twice as old as Wale. 4 years ago, he was 4 times as old as wale. When will the sum of their age be 66

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Appendix V

Algebraic Word Problems Lesson Notes II for SS II Experimental

Algebraic Word Problems Lesson Notes: Second Week

Class: Senior Secondary School II

Subject: Mathematics

Topic: Algebraic Word Problems

Sub-topic: Algebraic word problems involving fractions

Period: First Period

Duration: 40 minutes

Instructional Material:

Reference Book: New General Mathematics for Senior Secondary Schools Book 1 & 2. 2017 Edition.

Learners Entry Behaviour: Students can carry solve Algebraic word problems involving fractions.

Behavioural Objectives: at the end of the lesson, students will be able to

(j) translate simple statements and Algebraic word problems into mathematical expressions

(ii) solve Algebraic word problems involving fractions

Teaching Procedures:

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Introduction:

Algebraic word problem is a Mathematics problem where significant background information on the problem is presented in ordinary language rather than in Mathematics notation. In this case, one is expected to apply mathematical concepts to real-life situations, mostly involving applying algebraic applications and identities.

Example1: The mean age of five girls is 16 years. If three of them are eight, twelve and sixteen years old, how old is one of the other two girls if they are of the same age?.

Solution

The last two girls are of the same age

It mean the five girls are aged 8, 12, 16, x, x respectively

The mean age of the five girls is 16 years.

$\frac{8+12+16+x+x}{5} = 16$

$\frac{36+2x}{5} = 16$

$36 + 2x = 80$

$2x = 80 - 36$

$2x = 44$

$X = 22$

The remaining two girls are 22 years old each

Example 2: Two-thirds of a certain number is equal to the sum of three-seventh and one-third. Find the number

Solution

Let the number be x

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Two-thirds of a certain number: $\frac{2}{3}x$

Equal to three-seventh and one-third: $\frac{3}{7} + \frac{1}{3}$

$\frac{2}{3}x = \frac{3}{7} + \frac{1}{3}$

$\frac{2}{3}x = \frac{9+7}{21}$

$\frac{2}{3}x = \frac{16}{21}$

$21\left(\frac{2}{3}x\right) = 21\left(\frac{16}{21}\right)$

$14x = 16$

$X = \frac{16}{14}$

$X = \frac{8}{7}$

$X = 1\frac{1}{7}$

Exercise

1) A school girl spends a quarter of her pocket money on books and one-third on dress. What fraction remains?
2) Divide 36 by the positive difference between the product of 3 and 6 and the square root of 36.

Assignment

1) When three is divided by the sum of a certain number and eight, the result is the same as dividing 2 by the sum of that number and 3. Find the number.

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Appendix VI

Algebraic Word Problems Lesson Note III for Experimental Group

Algebraic Word Problems Lesson Notes: Third Week

Class: Senior Secondary School II

Subject: Mathematics

Topic: Algebraic Word Problems

Sub-topic: Algebraic word problems involving brackets and fractions

Period: First Period

Duration: 40 minutes

Instructional Material:

Reference Book: New General Mathematics for Senior Secondary Schools Book 1 & 2. 2017 Edition.

Behavioural Objectives: at the end of the lesson, students will be able to

(i) Identify Algebraic word problems involving a combination of both brackets and fractions

(ii) Solve Algebraic word problems involving a combination of both brackets and fractions

Learners Entry Behaviour: Students can solve Algebraic word problems involving fractions and those involving brackets..

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Behavioural Objectives: at the end of the lesson, students will be able to

(i) translate simple statements and Algebraic word problems into mathematical expressions

(ii) solve Algebraic word problems involving both fractions and brackets

Teaching Procedures:

Introduction:

Algebraic word problem is a Mathematics problem where significant background information on the problem is presented in ordinary language rather than in Mathematics notation. In this case, one is expected to apply mathematical concepts to real-life situations, mostly involving applying algebraic applications and identities.

Example 1:When three is divided by the sum of a certain number and eight, the result is the same as dividing 2 by the sum of that number and 3. Find the number.

Solution

Let the number be x

The sum of a certain number and eight: x + 8

The result is same as dividing 2 by the sum of that number and 3: $(x + 8) = \frac{2}{x+3}$

$(x+8)(x+3) = 2$

$x^2 + 3x + 8x + 24 = 2$

$x^2 + 11x + 24 = 2$

$x^2 + 11x + 22 = 0$

Example 2: Divide 36 by the positive difference between the product of 3 and 6 and the square root of 36.

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Solution

The product of 3 and 6: 3 x 6 = 18

The square root of 36: $\sqrt{36} = 6$

The positive difference between the product of 3 and 6 and the square root of 36 can therefore be expressed as:

18 – 6 = 12

Divide 36 by the positive difference between the product of 3 and 6 and the square root of 36

$\frac{36}{12} = 3$

Therefore, by dividing 36 by the positive difference between the product of 3 and 6 and the square root of 36, the answer is 6,

Example 2: Two-thirds of a certain number is equal to the sum of three-seventh and one-third. Find the number

Solution

Let the number be x

Two-thirds of a certain number: $\frac{2}{3}x$

Equal to three-seventh and one-third: $\frac{3}{7} + \frac{1}{3}$

$\frac{2}{3}x = \frac{3}{7} + \frac{1}{3}$

$\frac{2}{3}x = \frac{9+7}{21}$

$\frac{2}{3}x = \frac{16}{21}$

$21\ (\frac{2}{3}x) = 21(\frac{16}{21})$

14x = 16

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$$X = \frac{16}{14}$$

$$X = \frac{8}{7}$$

$$X = 1\frac{1}{7}$$

Exercise

1) A school girl spends a quarter of her pocket money on books and one-third on dress. What fraction remains?
2) Divide 36 by the positive difference between the product of 3 and 6 and the square root of 36.

Assignment

1) The sum of six and one-third of x is one more than twice x. find x.
2) When three is divided by the sum of a certain number and eight, the result is the same as dividing 2 by the sum of that number and 3. Find the number.

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Appendix VII

Algebraic Word Problems Lesson Notes I for SS II Control Groups

Algebraic Word Problems Lesson Plan: First Week

Class: Senior Secondary School II

Subject: Mathematics

Topic: Algebraic Word problems

Sub-topic: Algebraic word problems involving brackets

Period: First Period

Duration: 40 minutes

Instructional Material:

Reference Book: New General Mathematics for Senior Secondary Schools Book 1 & 2. 2017 Edition.

Learners Entry Behaviour: Students can carry out mathematical operations involving figures and translate simple operational words into mathematical symbols.

Behavioural Objectives: at the end of the lesson, students will be able to

(k) translate simple statements and Algebraic word problems into mathematical expressions

(ii) solve Algebraic word problems involving brackets

Teaching Procedures:

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Introduction:

Algebraic word problem is a Mathematics problem where significant background information on the problem is presented in ordinary language rather than in Mathematics notation. In this case, one is expected to apply mathematical concepts to real-life situations, mostly involving applying algebraic applications and identities.

Example1: A certain number is multiplied by 3, the result is the same as adding 34 to the number. Find the number.

Solution

Let the number be x

Multiply by 3: 3x

The result is the same as adding 34 to the number: $3x = x + 34$

$3x - x = 34$

$2x = 34$

$2x/2 = 34/2$

$X = 17$

Example 2: A rectangle is 3 times as long as it is wide. If its perimeter is 56cm, find the width of the rectangle.

Solution

Let the length of the rectangle be Xcm and the width be Ycm.

Length = 3 width

$L = 3W$

Perimeter of a rectangle = $2(L + B)$

$2 (3W + W) = 56$

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$$2\,(4W) = 56$$

$$8W = 56$$

$$W = 7\text{cm}$$

The width of the rectangle is 7cm.

Exercise

3) The result of taking 3 from x and multiplying the answer by 4 is the same as taking 3 from five times x. find the value of x.

4) A boy is 10 years old and his mother is 37 years old. In how many years time will the mother be twice as old as her son?

Assignment

4) If the product of 4 and the sum of 12 and a certain number is equal to 8, what is the number?

5) The sum of 2 times a number and 3 times another number is 4. The first number minus the second is -3. What are the numbers?

6) Sunny is twice as old as Wale. 4 years ago, he was 4 times as old as wale. When will the sum of their age be 66?

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Appendix VIII

Algebraic Word Problems Lesson Notes II for SS II Control Groups

Algebraic Word Problems Lesson Plan: Second Week

Class: Senior Secondary School II

Subject: Mathematics

Topic: Algebraic Word Problems

Sub-topic: Algebraic word problems involving fractions

Period: First Period

Duration: 40 minutes

Instructional Material:

Reference Book: New General Mathematics for Senior Secondary Schools Book 1 & 2. 2017 Edition.

Learners Entry Behaviour: Students can carry solve Algebraic word problems involving fractions.

Behavioural Objectives: at the end of the lesson, students will be able to

(l) translate simple statements and Algebraic word problems into mathematical expressions

(ii) solve Algebraic word problems involving fractions

Teaching Procedures:

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Introduction:

Algebraic word problem is a Mathematics problem where significant background information on the problem is presented in ordinary language rather than in Mathematics notation. In this case, one is expected to apply mathematical concepts to real-life situations, mostly involving applying algebraic applications and identities.

Example1: The mean age of five girls is 16 years. If three of them are eight, twelve and sixteen years old, how old is one of the other two girls if they are of the same age?.

Solution

The last two girls are of the same age

It mean the five girls are aged 8, 12, 16, x, x respectively

The mean age of the five girls is 16 years.

$\frac{8+12+16+x+x}{5} = 16$

$\frac{36+2x}{5} = 16$

$36 + 2x = 80$

$2x = 80 - 36$

$2x = 44$

$X = 22$

The remaining two girls are 22 years old each

Example 2: Two-thirds of a certain number is equal to the sum of three-seventh and one-third. Find the number

Solution

Let the number be x

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Two-thirds of a certain number: $\frac{2}{3}x$

Equal to three-seventh and one-third: $\frac{3}{7} + \frac{1}{3}$

$\frac{2}{3}x = \frac{3}{7} + \frac{1}{3}$

$\frac{2}{3}x = \frac{9+7}{21}$

$\frac{2}{3}x = \frac{16}{21}$

$21\ (\frac{2}{3}x) = 21(\frac{16}{21})$

$14x = 16$

$X = \frac{16}{14}$

$X = \frac{8}{7}$

$X = 1\frac{1}{7}$

Exercise

3) A school girl spends a quarter of her pocket money on books and one-third on dress. What fraction remains?

4) Divide 36 by the positive difference between the product of 3 and 6 and the square root of 36.

Assignment

When three is divided by the sum of a certain number and eight, the result is the same as dividing 2 by the sum of that number and 3. Find the number.

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Appendix IX

Algebraic Word Problems Lesson Note III for Control Group: Third Week

Class: Senior Secondary School II

Subject: Mathematics

Topic: Algebraic Word Problems

Sub-topic: Algebraic word problems involving brackets and fractions

Period: First Period

Duration: 40 minutes

Instructional Material:

Reference Book: New General Mathematics for Senior Secondary Schools Book 1 & 2. 2017 Edition.

Behavioural Objectives: at the end of the lesson, students will be able to

(iii) Identify Algebraic word problems involving a combination of both brackets and fractions

(iv) Solve Algebraic word problems involving a combination of both brackets and fractions

Learners Entry Behaviour: Students can solve Algebraic word problems involving fractions and those involving brackets..

Behavioural Objectives: at the end of the lesson, students will be able to

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(iii) translate simple statements and Algebraic word problems into mathematical expressions

(iv) solve Algebraic word problems involving both fractions and brackets

Teaching Procedures:

Introduction:

Algebraic word problem is a Mathematics problem where significant background information on the problem is presented in ordinary language rather than in Mathematics notation. In this case, one is expected to apply mathematical concepts to real-life situations, mostly involving applying algebraic applications and identities.

Example 1:When three is divided by the sum of a certain number and eight, the result is the same as dividing 2 by the sum of that number and 3. Find the number.

Solution

Let the number be x

The sum of a certain number and eight: x + 8

The result is same as dividing 2 by the sum of that number and 3: $(x + 8) = \frac{2}{x+3}$

(x+8)(x+3) = 2

x^2 + 3x + 8x + 24 = 2

x^2 + 11x + 24 = 2

x^2 + 11x + 22 = 0

Example 2: Divide 36 by the positive difference between the product of 3 and 6 and the square root of 36.

Solution

The product of 3 and 6: 3 x 6 = 18

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The square root of 36: $\sqrt{36} = 6$

The positive difference between the product of 3 and 6 and the square root of 36 can therefore be expressed as:

$18 - 6 = 12$

Divide 36 by the positive difference between the product of 3 and 6 and the square root of 36

$\frac{36}{12} = 3$

Therefore, by dividing 36 by the positive difference between the product of 3 and 6 and the square root of 36, the answer is 6,

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Solution

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Two-thirds of a certain number: $\frac{2}{3}x$

Equal to three-seventh and one-third: $\frac{3}{7} + \frac{1}{3}$

$\frac{2}{3}x = \frac{3}{7} + \frac{1}{3}$

$\frac{2}{3}x = \frac{9+7}{21}$

$\frac{2}{3}x = \frac{16}{21}$

$21\ (\frac{2}{3}x) = 21(\frac{16}{21})$

$14x = 16$

$X = \frac{16}{14}$

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$X = \frac{8}{7}$

$X = 1\frac{1}{7}$

Exercise

3) A school girl spends a quarter of her pocket money on books and one-third on dress. What fraction remains?
4) Divide 36 by the positive difference between the product of 3 and 6 and the square root of 36.

Assignment

3) The sum of six and one-third of x is one more than twice x. find x.
4) When three is divided by the sum of a certain number and eight, the result is the same as dividing 2 by the sum of that number and 3. Find the number.

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Appendix X

Measure of Mindset (Child & Adolescent)

Jack A. Naglieri & Kathleen M. Kryza - Copyright © 2015

Name _____

Date _____

Instructions: These 10 questions ask about how you think and feel. The answers you give can help us know your thoughts about how you learn. Please read every question carefully and circle the number under the word that tells what you do.

		Never	Sometimes	Most times	Always
1	I don't give up easily.	0	1	2	3
2	When things get hard I say, "I can do it!"	0	1	2	3
3	When I fail I try harder until I get it done.	0	1	2	3
4	I believe that I can learn from my mistakes.	0	1	2	3
5	I think I can do almost anything if I try hard enough.	0	1	2	3
6	When I don't understand something I give up.	0	1	2	3
7	I do not like to be challenged.	0	1	2	3
8	When work is hard I think, "I can not do it."	0	1	2	3
9	When things get hard I do something else.	0	1	2	3
10	When I fail I do something else that is more fun.	0	1	2	3

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Appendix XI

Bio-data

1	**Name:**	Abiodun Teslim BALOGUN
2.	**Date and Place of Birth**:	10TH November 1978, Oyo
3.	**Nationality:**	Nigerian
4.	**State of Origin and Local Government Area**:	Oyo state, Oyo West Local Govt
5.	**Marital Status:**	Married
6.	**Present Postal Address**:	P.O Box 56, Oyo, Oyo State
7.	**Permanent Home Address:**	Block 7, Plot 7, Abojupa Housing Scheme, Opposite Rufuk Filling Station, Old Ibadan Road, Eleekara, Oyo, Oyo State
8.	**Email:**	teslimbalogun78@gmail.com
9.	**Phone Numbers:**	08062147110 (SMS only)

10. Educational Institutions attended with dates

a. University of Ibadan	2010
b. University of Ilorin	2003
c. Federal College of Education (Special), Oyo, Oyo State	2000
d. Olivet Baptist High School, Oyo	1995
e. St. Michael Anglican Primary School, Araromi, Oyo.	1989

11. Academic and Professional Qualifications obtained with Dates

a.	M.Ed Mathematics Education	2010

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b. B.Sc.(Ed) Mathematics 2003
c. NCE, Special Education/Agric 2001
d. Diploma in Data Processing, Management, Accounting and Finance 2004
e. Senior School Certificate 1995
f. Primary School Leaving Certificate 1989

12. List of Publications

Balogun, A.T, Abdulkareem T.Y, Atikpui F.N.B & Ajobiewe, A. (2023). Assessment of Information and Communication Technology, E-Learning, Covid-19 Knowledge and Awareness among Inclusive Secondary School Mathematics Teachers in Oyo State.

Balogun, A.T (2024). Artificial Intelligence as a Veritable Tool for Improving Mathematics Teaching and Learning among Nigerian Deaf Students in an Inclusive Classroom. A Book of Reading in Honour of Dr Tola Odusanya. Federal College of Education (Special), Oyo

Balogun, A.T & Olakulehin, D.M (2024). Investigating The Use Of Computer Aided Assessment For Mathematics Assessment Of Students With Hearing Impairment In Federal College Of Education (Special) Oyo State

Balogun, A.T & Abdulkareem T.Y (2024). Relationship between Deviant Behaviours, Behavioural Counselling and Academic Performance of Secondary School Students with Hearing Impairment in Mathematics in Oyo State

Balogun, A. T; Yara, P. O & Raji, B. W (2025). Effects of Class-wide Peer-Tutoring Strategy on Academic Achievement of Secondary School Students with Hearing Impairments' in Exponential Equations in Ibadan, Nigeria

Balogun, A. T & Yara, P. O (2025). Hearing Loss Type, Mindset and Academic Achievement Of Secondary School Students With Hearing Impairment In Mathematics in Ibadan North Local Governement Area Of Oyo State

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Signature Date

The University Compliance Certificate

This is to certify that the thesis by Abiodun Teslim BALOGUN in the Department of Science Education, Faculty of Education, Lead City University, Ibadan, Oyo State, is in full compliance with the approved university format and style.

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Name Date

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