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## **Brainfeed Intervention Programme: an Alternative Approach for Supporting People living with dyslexia**

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### **Abstract**

This study investigated the effectiveness of Brainfeed intervention programme as an alternative approach for supporting people living with dyslexia. The study adopted a quasi-experimental research design. The population of this study is made up of twenty four thousand seven hundred and twenty seven (24,727) senior secondary school students (S.S.2) in all the public secondary schools in Port Harcourt Local Government Area (Phalga and Obio/Akpo Local Government Areas of) Rivers State used for the study. The study adopted a purposive sampling method. Three public schools were selected from the secondary schools in Phalga and Obio/Akpo LGA of Rivers State. The result proved that brainfeed intervention programme contributes significantly to the improvement of students' working memory for those with dyslexia.

**Keywords:** brainfeed, dyslexia, people living with dyslexia, working memory.

### **Manuscript History**

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A lot of students are faced with different degrees and types of difficulties in their studies. Most times they are not bold enough to talk about their struggles with their teachers or parents. A number of students have specific learning disabilities. Specific learning disabilities represent a number of learning difficulties that students go through in their academic pursuit. Ugwu, (2015) views Learning disability as a neurological condition that affects individual's capability to process, store, and reproduce information. This is to say that learning disabilities are disabilities which are neurological in nature, and has to do with cognition. Students with learning disabilities have poor; reception, recognition, organization, storage, retrieval and reproduction of information. Succinctly put, at contact with most information, student with specific learning difficulty do not receive, recognize, store, decode and reproduce such information on demand. Thus it is imperative to deduce that information transiting from the senses to the brain may encounter some difficulties or may be distorted. Specific learning disabilities include; dyslexia, dysgraphia, and dyscalculia, Prominent among specific learning disabilities is dyslexia.

Dyslexia is a learning disability that basically affects how students read. It is simply put difficulty in reading. According to Ugwu (2015), dyslexia is a severe problem in learning to read with normal proficiency despite conventional instruction, proper motivation, intact senses, normal intelligence and freedom from gross neurological deficit. Thus dyslexia is a language based disability and results from poor decoding ability; this according to Snowling & Hulme (2011) affects more than half of students with learning disabilities. Students living with dyslexia may be able to read, but reads at a level lower than expected for their age and level of study. Their proficiency in reading is poor and sometimes below average depending on the severity of the disability. This difficulty in reading is irrespective of required motivation from both teachers and learning environment. For a student to be labeled Dyslexic, such student's senses are intact and functions maximally. This also means that students diagnosed for dyslexia are not at the same time diagnosed for mental retardation, health impairments and behavioral or emotional disturbances. Thus a student is labeled dyslexic when these impairments and disturbances are carefully removed.

Over the years, teachers have shown concern over students who are intelligent, normal, and healthy but at the same time struggle with reading, spelling and writing. Reading and spelling difficulties are key features in the concept of dyslexia. Research has shown that about fifteen to twenty percent of school children especially in the English- speaking population are estimated to experience one level of difficulty or the other in the acquisition of basic reading skills (Washburn, Joshi & Binks-Cantrell, 2011). An estimated 5-10% of people have a specific learning disability which is referred to as developmental dyslexia

The International Dyslexia Association posits that an estimated 15-20% of the world's population experience at least one symptom of dyslexia or the other (IDA, 2007). Some researchers conducted study in Britain, America and Sweden and their findings indicate that 30-52% of prison inmates in these countries are dyslexic (Andersson & Wagovich, 2010). This finding is very significant, this is to say that a significant percentage of people in the world show one symptom of dyslexia or the other, and a hand full of the population of British, American and Swedish prisoners are dyslexic. So also, Washburn et al, (2011) assert that one out of every five persons in the United States of America show one or more symptoms of dyslexia, thus one fifth of Americans show symptoms of dyslexia. This makes it a problem to be taken seriously by the educational system whose responsibility it is to combat this phenomenon with the required and necessary force. An earlier survey by the researcher showed that one out of every three children in public primary schools in Phalga and

Obio/Akpo Local Government Areas of Rivers State Nigeria showed at least one symptom of dyslexia and have a reading disability.

The question on the lips of parents and teachers have always been why is it so easy for some student to read, solve mathematical problems, spell and write effectively while some other students of same age and in same class struggle endlessly to achieve a pass grade on any reading, math, spelling and writing tasks?. The greater Part of this problem has been how to effectively understand these disabilities and subsequently manage them. To this end lots of researches have been carried out and are ongoing into these learning disabilities with the aim of understanding the etiology, epidemiology and management of these learning disabilities.

### **Working Memory Deficit**

In recent times, there is increased interest in the awareness of the numerous negative effect of working memory deficit amongst psychologists, educationist, neurologist and health practioners. This has given rise to the quest for necessary alternative intervention. Holmes, (2012) opines that the two current approaches to tackling this cognitive skill deficit would be; firstly to focus on accelerating learning for the children with working memory problems by adapting the child's environment. This classroom environment-based approach lays emphasis on increasing the teachers' awareness of the warning signs of poor working memory and to adapt their teaching methods or styles in order not to overload such students' memory during class activities. To achieve this, the teacher has to carefully break tasks into simpler and smaller steps, and try to represent some information using other means that will help students' memory and promoting an environment in which students are free to ask for a repeat of instructions when lost in a task. This also entails that students with working memory deficit was exposed to strategies that will help them excel academically irrespective of their cognitive weaknesses. Elliot, Gathercole, Alloway, Holmes & Kirkwood, (2010) opines that this approach will help students with poor working memory improve academically to the extent that it is applied, especially within existing curricular activities. It will make teachers to know that most academic failures or underachievement basically results from the fact that students forget due to poor ability to retain and retrieve information in the working memory and that students can benefit immensely if working within their own working memory limits with higher rates of success when these techniques are applied (Fuchs & Fuchs, 2001; Gobel & Snowling, 2010).

The second approach is to target enhancing working memory functions directly through practice on working memory tasks. There are various computerized training applications and exercises available. This requires that the student trains intensively for a continued period on various tasks that match their current capacity limit. The nature and activities involved in each of these trainings depend on the exercise (Long, Macblain & McBlain, 2007). subscribe to practicing on a number of working memory tasks. There are different alternative intervention programmes which have proved to be effective in enhancing cognitive skills of struggling learners, amongst which are CogMed, BrainRx, NOW, LearningRx, Pace, Edublox programmes, etc.

Brainfeed program is an alternative intervention programme created by the researcher to target the core cognitive skills that are deficit in dyslexics. This programme is born out of the passion to help struggling learners and dyslexics. After many years of research and study on the core cognitive skills involved in learning, the researcher reviewed various internet games and digital applications and finally the Brainfeed programme was put together. The Brainfeed programme is combination of exercises that challenge; attention, concentration, Logic and

reasoning, memory, speed and accuracy. These include flash exercises, rapid automatic naming exercises, word and face memory exercises, speedy recall and reaction exercises, speed math exercises, mental flex exercises, etc (Lovett, Steinbach & Frijters, 2000; Majerus & Cowan, 2016). The exercises for working memory include flash, recall, match, path memory and visual memory exercises. While exercises for processing speed include Schultz Table, maths operation, mirror images, order and pairs. A brief description of the items of Brainfeed programme was discussed below.

**Flash Exercise:** In flash, numbers are shown and withdrawn. Thereafter, the respondents are required to indicate where the number was shown. After completing a series of 10 of these exercises, respondents are scored on their performance.

**Recall:** Series of numbers are shown in boxes and are later hidden. Thereafter a prompt is provided for the respondents to indicate where the numbers were shown.

**Path Memory:** Figures are arranged across a path. This is later withdrawn and students are asked to draw the pattern shown earlier.

**Changing Focus:** Respondents were shown shapes in box with specific colours and are prompted to match either the colours or the shapes.

**Visual memory racer:** Respondents are shown nine images in boxes and another page is provided where they are expected to identify the images as shown in the previous pages.

**Schultz Table:** This is a brain feeding programme that is composed of 25 boxes with serial numbers or letters placed in the boxes randomly. The time it takes for a respondent to completely select boxes with numbers is computed and used to assess the processing speed of respondents

**Maths Operation:** This programme is aimed at improving mathematical processing speed of respondents. In this programme, respondents are required to state mathematical operations that can correctly fill spaces provided. For example

2  5 = 7. The correct response is a plus (+).

A person's score is provided at the end of a minute. This game is expected to boost brain power of processing speed.

**Mirror Images:** This is a programme that is designed to improve processing speed by providing mirror images of figures e.g. 3 is first presented and then an image such as “ε” is presented which is a mirror of the figure 3. Thereafter respondents are asked to indicate if they are actual number or mirrored. This programme improves dyslexia by presenting active word recognition and processing speed.

**Order:** Order is a programme that seeks to boost brain processing power by arranging four numbers in a disorganized sequence and respondents are expected to click the numbers in increasing order of magnitude. The process by which respondents arrange the items is used to develop their processing speed.

**Pair:** This programme is composed of eight boxes with different numbers, but two numbers in the eight boxes are provided that are same. Respondents are expected to match the two numbers that are pair. Ability to do this improves processing speed.

Thus these exercises in the Brainfeed alternative intervention programme target the core cognitive skills such as working memory and processing speed which this study will address.

### **Statement of Problem**

The inability of students to do well academically has been traced to the various issues they face within and outside the learning environment. Most of the students have specific learning disability especially dyslexia. Dyslexia is a neurological condition that affects students' ability to follow the alphabetic principle of grapheme phoneme correspondence, making it difficult to have mastery of reading and spelling, this sometimes presents with other dys constellation (like dysgraphia and dyscalculia) and comobits with depression, anxiety, ADHD, Autism Spectrum Disorder etc. This laden's the student with constant stress and academic failure. The persistent difficulties experienced by poor readers will make them get frustrated as their grades begin to continuously fail with the increasing difficulty they experience with school work. These difficulties if not attended to may cause the student to experience a catalogue of emotional and social problems; gradual loss of self esteem and frustration leading to some juvenile delinquencies which can linger to adulthood. This deficit in phonological awareness is more so as a result of deficit cognitive skills, especially poor working memory and slow processing speed.

The main aim of this study is to determine alternative intervention approach for supporting people living with dyslexia. Specifically, the study was built under three major objectives; (i) the effectiveness of Brainfeed programme on the improvement of working memory of students living with dyslexia in the experimental group receiving pretest and post test; (ii) the effectiveness of Brainfeed programme on the improvement of working memory of students living with dyslexia in the experimental group receiving post test only and pretest and post test; (iii) the effectiveness of Brainfeed programme on the improvement of processing speed of students living with dyslexia in the experimental group receiving pretest and post test; (iv) the effectiveness of Brainfeed programme on the improvement of processing speed of students living with dyslexia in the experimental group receiving post test only and pretest and post test.

Dyslexia is a condition that affects people across the society's rank and file. It is not only limited to children or people from the low socio economic background, but adults as well as people in the high socio-economic background can also be affected by dyslexia. This makes this study both unique and important. The findings from this research will help teachers to evaluate their current knowledge of the concept of dyslexia. It will create awareness for dyslexia both amongst students, teachers and parents. It will increase knowledge of dyslexia as a step forward to helping teachers understand that some students' inability to read efficiently may be signs of dyslexia and recommend such students for proper diagnostic evaluations and intervention. The study will contribute to knowledge in the areas of awareness, various options and approaches available for helping students living with dyslexia and make referrals for them. With appropriate intervention programmes, students living with dyslexia will regain self esteem and snap out of their frustration, anxiety and depression.

Through findings of this study, policy makers will be able to influence educational policies to become dyslexia friendly. Policies that will incorporate the various effective interventions in the school curriculum to enhance the working memory and processing speed of students living with dyslexia will be put in place (Lavie, Hirst, de Fockert & Viding, 2014; Hulme & Melby-Lervag, 2012; Hulme, Goetz, Gooch, Adams & Snowling, 2007). This will adequately

enhance the available support to students living with dyslexia, and promote efficient management of dyslexic students within the learning environment.

### **Research Questions**

Based on the study specific objectives, the following research questions were formulated to guide the study;

- What is the effectiveness of Brainfeed programme on the improvement of working memory of students living with dyslexia in the experimental group who received pretest and post-test?
- What is the effectiveness of Brainfeed programme on the improvement of working memory of students living with dyslexia in the experimental group who received only post-test and pretest and post-test?
- What is the effect of Brainfeed programme on the improvement of processing speed of students living with dyslexia in the experimental group receiving pretest and post-test?
- What is the effect of Brainfeed programme on the improvement of processing speed of students living with dyslexia in the experimental groups who received pretest and post-test and those who received post-test only?

### **Hypotheses**

The following hypotheses were formulated and tested at 0.05 level of significance;

- There is no significant effect of Brainfeed alternative intervention programme on the improvement of working memory of students living with dyslexia in the experimental group receiving pretest and posttest.
- There is no significant effect of Brainfeed alternative intervention programme on the improvement of working memory of students living with dyslexia in experimental groups who received post-test only and pretest-posttest.
- There is no significant effect of Brainfeed alternative intervention programme on the processing speed of students living with dyslexia in the experimental group receiving pretest and posttest.
- There is no significant effect of Brainfeed alternative intervention programme on the improvement of processing speed of students living with dyslexia in the experimental groups who received pretest-post and posttest only.

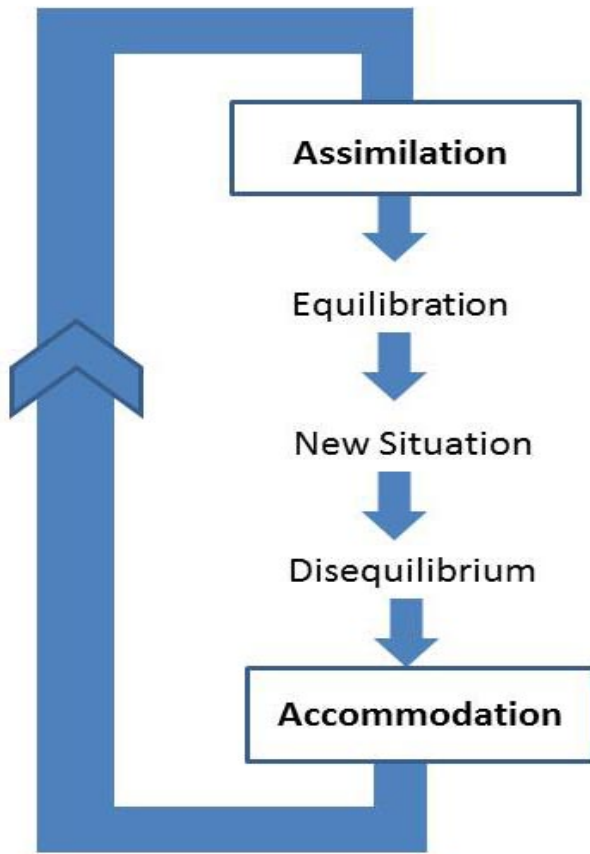
### **Theoretical Underpin for Alternative Intervention**

There are a number of theories of learning and intelligence which have formed the premise and backing for alternative intervention programmes; this study tries to review some of them most appropriate for the current study.

#### *Piaget's four stage theory of cognition*

Piaget proposes that infants are born with reflexes which control behavior and are used to adapt to the environment throughout life. The aim of Piaget's theory is to explain the processes involved in growing from infancy/childhood and how he develops into a person with ability to think hypothetically (Gathercole & Alloway, 2008). For Piaget, cognitive development is a progressive restructuring of mental processes which results from biological maturation and experiences from ones environment (Spencer-Smith & Klingberg, 2016; Snowling, Bishop & Stothard, 2000). He posits that the two processes used by an individual to adapt are; Accommodation which is the process of changing cognitive structures in order

to accept something from the environment and Assimilation which is the process used in transforming the environment in order to place it in preexisting cognitive structures. Thus using existing schema (blocks of Knowledge) to deal with new situations and lastly Equilibrium is the force that moves development along. Thus the progresses in cognitive development are not steady but come in leaps and bounds. These are used concurrently and alternatively throughout life. As structures become difficult, they are organized in a hierarchical manner (Tallal, 2004).



Piaget is notable for his four stages in cognitive development, namely; sensorimotor, preoperational, concrete operational and formal operational stages.

Sensorimotor Stage (0-2yrs) is the stage in which intelligence is shown during motor activities. Symbols are not recognisable at this stage. Child's intellectual ability improves as they increase physical mobility. At the Preoperational Stage (2-4yrs) which is preschool period, symbols begin to make more sense, language skills become better and in use, imaginative ability and memory are also developed. Child thinks egocentrically and usually both non logical and non reversible. Concrete Operational stage (7-11yrs) is elementary school age and beginning of the adolescent period. Child becomes more logical and systematic in manipulating symbols and other concrete operations. Egocentric behaviour and thoughts gradually disappears and mental actions become more reversible. The last stage is the Formal Operational Stage (11-15yrs), this stage starts from adolescence to adulthood. At this stage the child demonstrates a more logical use of symbols related to abstract concepts (Pfister, 2013).

This cognitive theory sees biological development as a driving force for cognitive improvement from one level to the other, but data from cross sectional studies do not support this assertion that all individuals will automatically move from one cognitive stage to the other as maturity takes place (Kerr, 2001; Kendeou, Van Den Broek, Helder & Karlsson, 2014) whose findings indicate that 30-35% of high school seniors attained the cognitive development stage of formal operations. Thus a special and enhance environment is needed for most adolescents and adults to achieve formal operations. This theory is criticized for the following; it is more concerned about children rather than all learners, he underestimates children abilities as theory of Mind research proved that 4-5year old have more sophisticated understanding of their own mental processes as well as other people, and finally for using observation of his three children and unrepresentative samples as a basic for his theory. These findings gave way for more theories of intelligence and cognition.

### *The Triarchic Theory of Intelligence*

The Triarchic theory is a theory of human intelligence by Robert J. Sternberg. He defines intelligent behavior as adapting to your environment, changing your environment or selecting a better environment. In his view intelligence revolves around analytical, practical and creative aspects of the mind (Swanson & Vaughn, 2011; Szmalec, Loncke, Page, & Duyck, 2011). He is of the view that measuring intelligence does not only involve assessing how much of a particular ability we individually have but also how we employ and or combine our abilities to solve problems and adjust to certain environments. Thus people with equal intelligence might merge metacomponents quite differently. It then might be the combination, use or directed application of the metacomponents that could make one person seem more intelligent or more successful than the other in handling certain tasks.

This theory comprises of three sub theories, namely (i) the Componential Sub Theory also known as Analytical Intelligence which outlines the composition and mechanisms that bring about intelligent behavior such as metacognition, performance or knowledge acquisition mechanisms. Thus it specifies the mental processes underlying the generation of a behavior. It includes abstract thinking, logic and reasoning, verbal and mathematical skills. (ii) The Experiential Sub Theory also known as Creative Intelligence which addresses the likely association between a behavior in a given task and the wealth of experience of the person in that task. It is of the view that intelligent behavior be interpreted a long side a range of experience from new to highly recognizable tasks, this includes divergent thinking (generating new ideas), ability to deal with new situations and (iii) the Contextual Sub Theory also called Practical Intelligence, which specifies that intelligent behavior is explained by the sociocultural context in which it takes place and involves adjustment to the setting, selection of better environments and shaping of the present environment. It relates intelligence to the external world, how it interprets what and where both intelligence and behavior are. Thus it includes capacity to relate knowledge to the real world and ability to form ones surroundings.

Thus to adequately explain intelligence requires an understanding of the interaction of these three sub theories. The most popular aspect of this theory is the componential sub theory which presents an information processing perception for abilities (Shipstead, Redick, & Engle, 2012). Hence, metacognition or executive processes that manage the strategies and approaches used in intelligent behavior are the most fundamental element. The Triarchic theory explains exceptional intelligence (giftedness and retardation) in children as well as criticizes existing intelligence tests (that measures only the componential/ analytic aspects of



intelligence); it outlines the implications of the theory for skill training, learning styles and creativity.

Sternberg's Triarchic theory sees intelligence as a malleable rather than static score, thus consideration should be given to constructs like culture, age, gender, parenting style, personality, schooling etc. one can deduce from this standpoint that intelligence can be manipulated by ones context and experience and might even improve with practice (Shinaver, Entwistle & Soderqvist, 2014). The principles of this theory include; Training of intellectual performance has to be socioculturally applicable to the individual, Training programs should provide links amid the training and significant world behavior, Training program ought to present explicit instruction in executive and non executive information processing and connections between the two. Training programs ought to actively support individuals to show their differences in strategies and styles. Sternberg also pays attention on the processing ability and delves more into how the information is used to decipher problems in a realistic way.

Sternberg's theory provides very useful basis for analysing both gifted and struggling learners levels of achievement. Most remarkably, it suggests that deficit in certain aspects of cognitive ability may affect the general perception of intelligence of the person. Thus from this awareness, the fusion of a new concept of remediation which becomes achievable if the deficiency can be secluded and repaired begins to emerge.

## **Methodology**

This study adopted a quasi-experimental research design. Quasi- experimental research design is an investigation that uses designs suitable in estimating situations of true experiment in a circumstance that does not allow the direct manipulation of relevant variables (Kaplan, Dewey, Crawford, & Wilson, 2001). Thus when total randomization cannot be applied to manage all extraneous variables necessary for a true experiment, a quasi-experimental research design is the most suitable research design. Nwankwo (2013) defined quasi experimental study as that in which some threats to validity cannot be appropriately controlled due to unavoidable situations associated with the study when human beings are used for experimental study. Nwankwo (2013) is of the view that amongst other conditions, when subjects for a study are selected and randomisation of the subject is not feasible, so that intact classes are used, such study is quasi-experimental. This research design is appropriate as it provides opportunity to investigate the effect of the independent variables on the dependent variables of the study.

This experimental design is a combination of between subject before-after designs and between subject after-only designs to determine the effect of the independent variable (Brainfeed alternative intervention programme) on the dependent variables (working memory and processing speed of dyslexics). This design contains two experimental groups and two control groups. One experimental group takes both the pre test and post test, while the other experimental group takes only post test. One control group takes both the pre test and post tests while the other control group takes just the post test.

**Table I: Randomized Solomon 4 group design.**

Groups	Pre-test	Treatment	Post-test
EG1	01	X	02
CG1	03	-	04
EG2	-	X	05
CG2	-	-	06

**Randomized Solomon 4 group design key**

EG1	Represents Experimental group1
EG 2	Represents Experimental group2
CG1	Represents Control group1
CG2	Represents Control group2
X	Represents Treatment
O1, O3	Represents Pre test
02,04,05,06	Represents Post tests
-	Represents no Treatment
--	Represents no Pre test.

**Population of Study**

The population of this study is made up of twenty four thousand seven hundred and twenty seven (24,727) senior secondary school students (S.S.2) in all the public secondary schools in Port Harcourt Local Government Area (Phalga and Obio/Akpo Local Government Areas of) Rivers State used for the study. (Statistical records at Rivers State senior secondary schools board 2017). The choice of using this population is based on the belief of the researcher that the students in the senior secondary class will do well as participants in the research.

**Sample and Sampling Techniques**

This study adopted a purposive sampling method. Three public schools were selected from the secondary schools in Phalga and Obio/Akpo LGA of Rivers State. These schools were chosen because of their proximity, suitable learning environment and other amenities to enable the application of the testing conditions and the treatment regimen. This consideration is to enable easy administration of the programme in its digital form and the need for the researcher to administer and supervise the participants during the training. To get the final sample for the study, series of tests was conducted. Firstly, an adapted form of Davis Dyslexia Association International (DDAI) pre assessment (informal assessment) questionnaire was administered to the senior secondary two (SS2) students; Respondents responded to the questionnaire using a 3 point scale of Absolutely, Sometimes and Rarely, to indicate their level of agreement or disagreement with the issues raised, this was used to determine students’ eligibility for the study, and also reveal the areas of students’ major struggles. Respondents who scored 40 points and above were selected for further assessments; in addition, the following test were administered; Rapid Automatic Naming (RAN) test which is a test comprising of similar items like letters, numbers, and objects, to which a child is required to name the items as quickly as possible. A Reading and spelling test from Dyslexia international and University of London. A pre-test of Gibsons test of Cognitive Skills of Cognitive Skills was administered to further determine dyslexic students with working memory and processing speed deficits. All students whose raw scores are less than 90 in auditory processing, visual processing are selected as having dyslexia, and those who scored less than 90 in working memory and processing speed are considered below average and will form sample for this study. All the students selected for this study were

between the ages of 13-20years old during the periods of this study and finished from a public junior secondary school. This is to ensure that the participants have similar characteristics.

### **Instruments for Data Collection**

An adapted version of the Davis Dyslexia Association International Questionnaire (DDAIQ) titled Dyslexia Assessment Questionnaire (DAQ). The original version of the DDAIQ was developed by the Dyslexia International and contained 41 items constructed in a 3-point likert scale. The researcher adapted the instrument by modifying the items in the instrument reducing the items to 20 and was constructed using a modified 3 point Likert scale of Always, Sometimes and Rarely/Never which was scored as 3, 2, and 1 point(s) respectively. To get the criterion of students with dyslexic symptoms, the criterion mean of each item (2) was multiplied with the number of items (20), which yielded 40. Therefore, students that scored 40 points and above was considered as displaying dyslexic symptoms. Thereafter, the RAN object test developed by Dyslexia International was used. The test consists of a framework, presented in A4 paper, with four different figures that are repeated in random order, making a total of forty figures, number and or letter games, and the student was told to name quickly the figures, presented in sequence, from left to right. To mark the time required for the rapid naming, the researcher used a stopwatch. The scoring procedure of the instrument involves naming letters, numbers and objects and contains 40 items to be named by respondents. A threshold of 25 seconds was established to identify those who are symptomatic of dyslexia based on the recommendation of Atkins, Sprenger, Colflesh, Briner, Buchanan, Chavis & Doherty, 2014).

For the actual data collection the Gibson test of Cognitive Skills was administered as pre-test for working memory and processing speed on the sample to know their present working memory and processing speed status, and as post test at the end of the treatment period. Gibson test of Cognitive Skills is a screening tool used to ascertain a person's cognitive performance. It includes tasks which measure working memory, long term memory, processing speed, auditory processing, visual processing, logic and reasoning as well as word attack. The Brainfeed programme is the treatment for this research. The Brainfeed programme is a combination of exercises that challenge; attention, concentration, Logic and reasoning, memory, speed and accuracy. These include flash exercises, rapid automatic naming exercises, word and face memory exercises, speedy recall and reaction exercises, speed math exercises, mental flex exercises, etc.

### **Validity of Instrument**

The validity of the instruments for this research is based on extensive review of related literature and decades of applied research in the field of dyslexia and cognitive skills necessary for learning which includes; memory, attention, processing speed, phonological awareness, visual processing, logic and reasoning etc. The researcher ensured that the contents of the dyslexia questionnaire meets the criteria for dyslexia diagnosis and the Gibson test of Cognitive Skills instrument meets the factors for intelligence as identified by the Cattell-Horn-Carroll (CHC) theory of cognitive abilities. In addition, copies of these instruments was given to two expert psychometricians, two lecturers in the Department of Educational Psychology, Guidance and Counselling, University of Port Harcourt and two experts in the field of dyslexia to validate it for content and face validity. Face validity confirmed that the instrument can measure what it intends to measure (dyslexia) and the

content validity confirmed that the instruments contents cover the necessary. The input of these experts was put into consideration in the final copies of the instrument

### **Reliability of Instrument**

For the reliability of the instruments in this research, different reliability techniques were used. For the DAQ, split-half reliability technique was used. In doing this, the instrument was administered on 10 students who were identified as dyslexic on the basis of their performance in the DAQ, RAN and GTCS. The scores from the administration were subjected to split half analysis which yielded a Spearman Brown coefficient of 0.94. For the RAN, test-retest reliability was used to estimate the reliability of the instrument. The instrument was administered twice on 10 students and the times in seconds it took them to responds were correlated using Pearson Product Moment Correlation. From the administration of the instruments, it was discovered that the correlation coefficient of both administration was 0.803. This indicates that the instrument possessed adequate reliability. The instrument was pilot-tested upon, (dyslexia questionnaire, Gibson test of Cognitive Skills). A Test-Retest method of reliability was employed. This is an estimation of the reliability of a test which is determined by correlating the scores on two different administrations of that test to the same sample. These Tests were administered twice to same set of persons within two weeks interval. Same test items was shuffled and reworded to reduce the effect of the inherent weaknesses of Test-Retest method of reliability. The test retest reliability coefficients were determined by correlating the scores of the two separate test administrations. Split half method was used to measure the internal consistence.

### **Experimental Procedure:**

The procedure for this quasi experimental research was divided into four stages. It was carried out as follows;

#### **Stage 1 Selection**

This stage involved administration and scoring of tests that will determine qualification for selection. The stage will last for one week. At this stage the various selection tests were administered to the students namely; the DAQ test, RAN tests and reading and spelling tests. All students who scored below 40 on the DAQ, show slow speed and are unable to name all the objects in RAN test in less than 25 seconds will qualify for the next stage of the study.

#### **Stage 2 Pre Test**

After the selection stage the next process involves randomizing the students into different groups before the application of treatment. At this stage selected students received a pre test of Gibson test of Cognitive Skills. This will separate the students into the various areas of cognitive deficit. This test will further indicate the levels of the students cognitive functioning; needing intervention, optional intervention, not needing intervention respectively in Participants with deficit working memory and processing speed. Those who fall under the urgent intervention were selected and placed in the experiment and control groups respectively.

#### **Stage 3 Treatment**

The treatment for this experiment is Brainfeed intervention programme. The Brainfeed programme is an alternative intervention programme. The treatment stage lasted for a period of one month. This stage was divided into two phases.

### **Treatment Phase 1**

This is the briefing and training stage, it was a day meeting. All participants and research assistants were briefed on what the experiment will entail. A formal introduction of all research assistants was made and the students were trained on the use of androids, ipads and laptops that was involved in the experiment. Students were made to understand that cheating is not allowed and they are expected to put in their best.

### **Treatment Phase 2**

This phase is the treatment proper. It was further divided into two sections of 30mins each making a total of 1hour per day for 5 days weekly. A total of 20 hours was used for this treatment period.

#### **Treatment Phase 2 Section 1**

This section includes exercises that challenge attention, long term memory and working memory. Participants in the treatment group participated in five exercises in this section daily, this was played three times each, and the mean score was recorded. The exercises increased in intensity beginning with less intensive in levels 1 and more extensive in level 3. The attention and memory exercises in this section took 30mins five days weekly. The exercises included for this session were flash, recall, match, path memory and visual memory exercises.

#### **Treatment Phase 2 Section 2**

This section included exercises that challenged processing speed, logic and reasoning and attention. Participants in the treatment group participated in five exercises in this section daily, this was played three times each, and the mean score was recorded. These exercises increased in intensity beginning with less intensive in levels 1 and more extensive in level 3. The processing speed, logic/reasoning and attention exercises in this section will take 30mins daily; five days weekly. They include; Schultz Table, Maths Operation, Mirror Images, Order, Pair

### **Stage 4 Post test**

After the one month period of the experiment, the participants received a post test of Gibson test of Cognitive Skills to evaluate the impact of the treatment on the working memory and processing speed of the participants.

### **Administrations of the Instruments**

After the treatment period of one month, all four groups (1, 2, 3 and 4) in the research received a post test of GTCS. This test is to determine the post mean scores of the groups in the research. Three research assistants who were duly supervised helped the researcher in the administration of the instruments and training sessions.

### **Methods of Data Analysis**

The research questions was answered using mean, standard deviation of the pre test and post test scores, while dependent t-test, one way and two way analysis of covariance (ANCOVA) was used to analyse the null hypothesis.

**Results**

*Effectiveness of Brainfeed programme on the improvement of working memory of students living with dyslexia in the experimental group who received pretest and post-test.*

The pretest and post test scores of students living with dyslexia on the component of working memory from the Gibson’s test were subjected to descriptive analysis of mean and standard deviation. For testing the corresponding null hypothesis, the pretest and posttest scores obtained were subjected to dependent sample t-test. From the analysis done regarding the effectiveness of brainfeed programme on the working memory of students living with dyslexia, it is shown that at pre-test the students had a mean score of 83.83 (Sd = 9.56), and at post-test phase had a mean of 102.13 (Sd = 7.70). This resulted in a mean difference of 18.60, which indicates that brainfeed intervention programme contributed in improving the working memory of students living with dyslexia. When these values were subjected to a dependent sample t-test analysis, a t-value of 5.75 was obtained at 14 degrees of freedom and a p-value of 0.0005 which was statistically significant at 0.05 level of significance. Furthermore, the cohen’s d value obtained was 2.13 which showed a large effect size. This result therefore showed that brainfeed intervention programme leads to a statistically significant improvement in the working memory of students living with dyslexia. Thus the null hypothesis was rejected (see table 2).

Table 2:

Dependent samples t-test of working memory for pretest-posttest experimental group

<b>Experimental Group I</b>	<b>N</b>	<b>Mean</b>	<b>Mean Dif.</b>	<b>df.</b>	<b>t</b>	<b>Sig.</b>	<b>d</b>
Pretest	15	83.73	9.56	14	5.75	0.05	2.13
Posttest	15	102.13	7.70				

*Effectiveness of Brainfeed programme on the improvement of working memory of students living with dyslexia in the experimental group who received only post-test and pretest and post-test*

For the analysis of the research, the working memory post-test scores of students in experimental group I (pretest and post-test and those in experimental group II (post-test only) were subjected to mean and standard deviation analysis. Hypothesis two was tested using independent samples t-test. This was done by subjecting the means and standard deviations of students in experimental group I (pretest-posttest) and those in group II (post-test only) to independent samples t-test. From table 3, students living with dyslexia in the experimental group where they received both pre-test and posttest had a mean working memory score of 102.13 (Sd = 7.70), while those who were in the experimental group who received only post-test had a mean working memory speed of 96.40 (Sd = 6.84)., which yielded a mean difference of 5.73. This indicates that the pretest relatively contributed in the improvement of processing speed among students living with dyslexia. When these values were subjected to an independent sample t-test analysis, a t-value of 2.15 was obtained at 13 degrees of freedom with a corresponding p-value of 0.04, and an effect size of 0.79. This result indicates that students in experimental group I who received pretest before treatment, had a significant

improvement in working memory than those in experimental group two who were not tested before the brainfeed intervention. The null hypothesis was therefore rejected (see table 3).

Table 3:

Independent sample t-test of working memory for pretest-posttest and posttest only experimental groups

Groups	N	Mean	Sd	Mean df	df	t	Sig.	d
Experimental Group I	15	102.13	7.70	5.73	13	2.15	0.05	0.79
Experimental Group II	15	96.40	6.84					

*Effect of Brainfeed programme on the improvement of processing speed of students living with dyslexia in the experimental group receiving pretest and post-test*

From the analysis of research, it can be observed that the pretest mean scores from the administration of the Gibson Test of Cognitive Functioning (GTCF) was 80.73 (Sd = 9.06), while their post-test scores yielded a mean value of 99.33 (Sd = 4.16), which resulted in a mean difference of 18.60. This result therefore suggests that brainfeed intervention programmes improves the processing speed of students living with dyslexia. When these values were subjected to a dependent sample t-test analysis, a t-value of 7.37 was obtained at 14 degrees of freedom and a p-value of 0.0005 which was statistically significant at 0.05 level of significance. Furthermore, the Cohen’s d value obtained was 2.81 which showed a large effect size. This result therefore showed that brainfeed intervention programme contributed significantly to the improvement in the processing speed of students living with dyslexia in Rivers State. The null hypothesis was therefore rejected. The scores of students living with dyslexia in the experimental group who received pretest and post-test were computed using mean and standard deviation. These values were further subjected to an independent sample t-test analysis (see table 4).

Table 4

Dependent samples t-test of processing speed for pretest-posttest experimental group

Group	N	Mean	Sd	Mean df	df	t	Sig.	d
<b>Experiment 1</b>								
Present	15	80.73	9.06		14	7.37	0.000	2.81
Posttest	15	99.33	4.17	18.60				

*Effect of Brainfeed programme on the improvement of processing speed of students living with dyslexia in the experimental groups who received pretest and post-test and those who received post-test only*

From the analysis, students living with dyslexia in the experimental group where they received both pre-test and post had a mean processing speed of 99.33 (Sd = 4.16), while those

who were in the experimental group who received only post-test had a mean processing speed of 99.27 (Sd = 11.03)., which resulted in a mean difference of 0.067. This indicates that the pretest contributed a very small effect in the improvement of processing speed. Testing these scores using independent sample t-test, a t-value of 0.022 was obtained at 13 degrees of freedom with a corresponding p-value of 0.983, and an effect size of 0.009. This result indicates that students in experimental group I who received pretest before treatment, had no significant improvement in processing speed than those in experimental group II who were not tested before the brainfeed intervention. The null hypothesis was therefore accepted. For the analysis also, the post-test processing speed scores of students in experimental group I (pretest and post-test and those in experimental group II (post-test only) were subjected to mean and standard deviation analysis (see table 5).

Table 5

Independent sample t-test of processing speed for pretest-posttest and posttest only experimental groups

<b>Group</b>	<b>N</b>	<b>Mean</b>	<b>Sd</b>	<b>Mean df</b>	<b>df</b>	<b>t</b>	<b>Sig.</b>	<b>d</b>
Experimental Group I	15	99.33	4.17	0.067	13	0.022	0.983	0.009
Experimental Group II	15	99.26	11.03					

## **Discussion**

The result from the study showed that brainfeed intervention programme had a significant effect in improving the working memory of students' living with dyslexia. According to result obtained from the study, those who students who were exposed to brainfeed intervention programme, consistently performed better than those not exposed to the programme. This was despite the fact that some of the students in the experimental groups were not exposed to pretest on the GTCF. More specific analysis however showed that students in experimental group I who were exposed to both pretest and posttest had the highest score on working memory, followed by students in experimental group two who were only tested after administration of treatment. In the control groups, students who received both pretest and post-test performed better on working memory than those who received only post-test.

In addition, testing of the hypotheses associated with working memory did reveal significant difference in the working memory if students in the experimental groups who received both pretest and post-test as shown by the mean difference of 18.40. This result suggest that brainfeed intervention programme contributed effectively in improving the working memory of students with dyslexia when further tested using independent sample t-test. This result was not surprising but expected by this researcher as brainfeed intervention programme are useful in exercising relevant part of the brain that has the potency of stimulating the effectiveness of working memory. In addition, this result might be attributed to the fact that working memory is often inhibited in dyslexic because their ability to at encoding, storage and manipulation of information is fundamentally impaired, which brainfeed intervention programme helps in removing such barriers.



The result from this study is similar to that obtained by (Awh, Vogel, & Oh, 2006) who found out that among 1,277 adolescents, cognitive rehabilitation therapy significantly improved memory. The sample in the study showed significant improvement in working memory on the basis of their performance in the Woodcock Johnson Test III before and after treatment was administered. Despite the similarity in the finding of this study and that of (Alloway, Wootan & Deane, 2014), significant difference exist in that the sample used were different from that of the present study. Furthermore, the intervention programme used differ in that (Pelli, Farrell & Moore, 2003) used cognitive restructuring, while this study used technological based brainfeed intervention programme.

Another finding from this study showed that students who were exposed to brainfeed intervention programme who received only post in experimental group two and those who received pre-test and post in experimental group one was slightly different, albeit significant. This result is not surprising because experience with the GTCF at the pre-test level may have contaminated the performance of the students at the post-test stage, irrespective of treatment effect. However, in both groups of students, the post-test performance score was significantly higher in those students who did not received treatment at all. This further confirms the efficacy of the brainfield intervention programme among students living with dyslexia in Rivers State. This result is similar to that obtained by Andersson & Wagovich (2010) who showed that among students with learning difficulties, cognitive intervention strategies often leads to improvement in their working memory of the students. This finding is in consonance with that of Shipstead et al (2012) who found out that cogmed working memory training significantly improve students working memory who had learning difficulties.

In the final related analysis of the effectiveness of brainfeed intervention programme on working memory, the result of the ANCOVA summary showed that after adjusting for the pre-test as a covariate, it was shown that a statistically significant improvement was obtained on the working memory of students. This showed that after the effect of pre-test were adjusted between the experimental and control groups, brainfeed intervention programme contributes significantly to the improvement of students' working memory for those with dyslexia. This means that the improvement in working memory can be reasonably attributed to the treatment applied on the students (Snowling & Hulme, 2011).

### **Conclusion**

Most students living with dyslexia showed evidence of weak cognitive skills especially working memory and processing speed. Slow work pace and inability to hold information in a retrievable form for task at hand is no doubt contributory to weak phonological awareness and poor understanding of the alphabetic principle. Thus students living with dyslexia may continue to struggle if these weak skills are not targeted and with necessary exercises remediated. The difference in the mean scores within and between the four groups showed that the experimental groups who received the Brainfeed alternative intervention programme significantly improved more than those in the control groups who did not receive the Brainfeed alternative intervention programme.

### **Recommendations**

Based on the findings of this study, the following recommendations were made;

- i. Dyslexia assessment should be administered to students at various entry points; primary, secondary and tertiary institutions of learning.

- ii. Cognitive skills assessments should be giving to struggling learners to know their cognitive skills status this will enable the teachers to know what help a student will be needing
- iii. Brain training exercises should be made available to students living with dyslexia as this will help to target weak cognitive skills
- iv. Experts in psychologist and Special Education and Needs (SEN) teachers should be empowered and trained for the purposes of assessment and assistance to students living with dyslexia.

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