Chapter 5  Empirical Research Design

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5.1. Introduction

Learners with attention difficulties impact on education because educators must spend extra time to encourage the learners to pay attention, to complete assignments, and to repeat learning material. The other learners in the class also suffer because the learners with attention problems often disrupt the learning situation, and require and obtain more of the educator's attention. The impact of a learner with attention problems on educators and learners is stressful, and adds to the already heavy load that teachers and learners experience in our current school set-up. A study, focusing on a different method to combat attention problems, was timely.

5.2. Objectives of the Study

The researcher explored Berard Auditory Integration Training as a possible intervention for learners between the ages of six and twelve years, who experienced problems with sustained attention and who had difficulty in shifting their attention from task to task (cf. 1.7).

Berard AIT is proposed to re-train the listening system. This intervention could result in a normalization of hyper-sensitivity to sound, a normal arousal of attention, sustained attention, and a flexible attention system. The aim was to investigate if Berard AIT would enable the learner with learning difficulties to stay calm, relaxed yet alert, with focused attention and thus achieve improved concentration, with appropriate reflection before action.

The intervention was to help learners with attention problems to reach:

- a state of physiological readiness,
- a state of mental readiness, and
- a state of active mental work.

5.3. Hypothesis
The alternative hypothesis was that Berard AIT would change the intrinsic locus of attention control so that the learner could pay appropriate attention without effort. Electroencephalographs would become flexible so that attention will shift from intense concentration, to scanning incoming information, to discerning which stimuli are important enough to give attention to.

The null hypothesis was that Berard AIT would not change the intrinsic locus of attention control so that the learner could pay appropriate attention without effort. Brainwaves would not become more flexible and attention would shift from intense concentration, to scanning incoming information, to discerning which stimuli are important enough to pay attention to.

5.4. Research design

A quantitative experimental research design was followed in this study. McMillan and Schumacher (2006:23) assert that the quantitative research design comes from a positivist philosophy of knowing. It emphasizes objectivity and quantification of phenomena. A quantitative research design maximises objectivity by using numbers, statistics, structure and control (McMillan & Schumacher, 2006:23). Since the researcher will manipulate what the subjects will experience an experimental design will be implemented (McMillan & Schumacher, 2006:23; Leedy & Ormrod, 2005:217).

5.4.1. Research methodology

The experimental method is a systematic approach in which the researcher manipulates one or more variables, and controls and measures any change in other variables (Leedy & Ormrod, 2005:217). McMillan and Schumacher (2006:255) affirm that the experimental method is the best approach for determining the causal effect of an intervention, since there is a high degree of control of extraneous variables and the power of manipulation of variables. A pretest-posttest group design was used to investigate the effect that Berard AIT has on learners with attention problems. According to Leedy and Ormrod (2005:225) as well as McMillan and Schumacher (2006:267) the pretest-posttest group design includes an experimental group and a control group which are selected through randomization procedures. The
experimental group is observed/tested, subjected to the experimental intervention and observed/tested again afterwards. The control group is observed/tested at the beginning with the experimental group as well as at the end of the experimental intervention, but are not subjected to any intervention during the experiment (Leedy & Ormrod, 2005:225).

In this study both the experimental and control group underwent all the assessments needed to ensure that possible variables were investigated (cf. 4.6). Thereafter, the experimental group received Berard AIT intervention and after three months (cf. 1.5) both groups were assessed again. The experimental group and control group were compared to determine if the experimental group demonstrated a statistical significant change after the intervention.

Checklists were completed and various measurements (cf. 4.5) were conducted before the training started and repeated three months after the training had been completed, to monitor whether there had been any change in the learners' capacity to pay attention. The checklists also indicated if there had been a change in the learners' problematic behaviour, if such were present initially. To increase the validity and reliability of the study, the decision was made to incorporate a variety of different testing methods (cf. 1.8.6). A variety of variables that could have an effect on attention, were controlled.

5.4.2. The population and sampling

The selection of the learners was done bearing the research objective in mind (Mason, 2005:30). The current study's research objective concerned learners with attention problems; thus the crucial inclusion criterion for participants was difficulty with paying attention.

Systematic sampling was chosen to select participants for this research study. According to Leedy and Ormrod (2005:203) systematic sampling involves selecting individuals according to a predetermined sequence which must originate by chance. Consequently every nth element is selected from a list, beginning with a randomly
selected element (McMillan & Schumacher, 2006:121). The requirements needed for inclusion in the group out of which the sampling were done, was very simple. The learner had to be between 6 and 12 years and the learner had to experience attention difficulties.

Parents, an educational psychologist, as well as teachers submitted names of learners between 6 and 12 years that they felt demonstrated difficulty with attention control and who may therefore benefit from Berard AIT. Learners were randomly placed in either the experimental (case) group or the control group as described below.

A list of names was submitted from both Knysna Primary School for the experimental group as well as Stepping Stones Primary School for the control group. After 100 names had been submitted from each school no further names were accepted. The names on each list were numbered. Systematic sampling was done, where every 10th learner on the Knysna Primary School list were selected for the experimental group. Every 10th learner on the Stepping Stones Primary School list was chosen for the control group. The experimental group and the control group were chosen from different schools to minimize the influence of teacher expectations and involvement. If those learners were unavailable the next name on the list was selected. According to Babbie (in Strydom, 2005: 200) systematic sampling is considered as having a higher validity value than simple random sampling.

Ten learners were chosen for the experimental group and ten for the control group. All these learners showed consistent attention problems according to the parents, teachers and educational psychologist. The learners who were chosen were not on any stimulant medication at the time of the research study and came from the same educational and socio-economic background. Therefore these variables were kept as similar as possible.
Table 5.1. A documentation of the learners who participated in the experimental and the control group.

<table>
<thead>
<tr>
<th>Experimental group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learner</td>
<td>Name</td>
</tr>
<tr>
<td>1</td>
<td>JG</td>
</tr>
<tr>
<td>2</td>
<td>IB</td>
</tr>
<tr>
<td>3</td>
<td>KW</td>
</tr>
<tr>
<td>4</td>
<td>DaB</td>
</tr>
<tr>
<td>5</td>
<td>MiE</td>
</tr>
<tr>
<td>6</td>
<td>NE</td>
</tr>
<tr>
<td>7</td>
<td>DS</td>
</tr>
<tr>
<td>8</td>
<td>DB</td>
</tr>
<tr>
<td>9</td>
<td>CR</td>
</tr>
<tr>
<td>10</td>
<td>IH</td>
</tr>
</tbody>
</table>

5.4.3. The size of the sample

As this study required high costs, a great deal of time, a vast number of testing items, as well as intensive one-on-one intervention, the researcher used only a small number (10 per group) of learners for the sample. Although the chosen sample was quite small, the precision of the measurements was high (Hopkins, 2000:8).

5.5. Phases of research procedure

The investigation was conducted in nine phases.

Phase 1: A literature study was conducted.

Phase 2: A meeting with the principal, as well as the head of the learner support section of the school, was held. An educational psychologist was approached to
contact the parents of learners. She informed the parents that the researcher would approach them to set up a meeting to introduce the research project to them.

**Phase 3:** An interview was held with each learner's parents of both the experimental and control group. The aim and process of Berard AIT intervention was explained as well as that of the study to be conducted. An informed consent form was signed by the parents. (A copy of the informed consent form is included in Annexure A).

**Phase 4:** Pre-intervention studies were conducted (cf. 1.8.5). These included:

a) Two checklists;
   i) Copeland Symptom Checklist for Attention Deficit Disorders
   ii) Aberrant Behaviour Checklist (ABC)

b) Primitive Reflex testing;

c) Recording of a Listening Profile for both right and left ears;

d) Obtaining a quantitative electro-encephalograph (QEEG);


**Phase 5:** The Berard AIT intervention was conducted for the ten learners in the experimental group. The control group did not receive any intervention.

**Phase 6:** The pre-intervention studies, mentioned in phase 4, were conducted for both the experimental and control groups. These studies were repeated for the experimental group three months after Berard AIT was completed. The pre-intervention studies were also repeated for the control group after three months, although no intervention was conducted.

**Phase 7:** Subsequently, a report of the findings were given to and discussed with the parents. Further interventions that could be beneficial to the specific learners were discussed. (A copy of this letter is included in Annexure H).
Phase 8: In the light of the favourable effects on the experimental group, Berard AIT training was conducted with the ten learners in the control group, after the completion of the study.

Phase 9: A report of the findings was then given to and discussed with the parents of the learners in the control group. Further interventions that could be beneficial to the specific learners were also discussed.

The procedures intrinsic to each phase are discussed below:

5.6. Literature search

A literature study was conducted on the following:

- Learners with attention problems;
- Functioning of the auditory system, and influence of re-training the auditory system;
- Berard AIT as an intervention and the influence that sound stimulation has on the brain.

5.7. The covering letter

A covering letter as well as a consent form accompanied the checklists that were sent out to the parents. The same covering letter was sent to the educators informing them that the parents received two checklists as well as a consent form. The letter explained the nature and purpose of the research project and enlisted the educator's co-operation. A copy of the covering letter is included in Annexure B.

5.8. Research instruments

5.8.1. Checklists were completed by parents to indicate how they experienced the learners' attention and subsequent behaviour problems. The aim of the checklists was to categorize the problems that the parents experienced with their children and
to allow analysis of the effect of AIT on different aspects or factors involved in paying attention.

a) Copeland Symptom Checklist for Attention Deficit Disorders

This checklist was developed from the experience of many specialists in the field of Attention Deficit Disorders and Hyperactivity. It was designed to help determine whether the learner has ADHD or ADD, to what degree, and if so, in which area(s) difficulties are experienced. The Copeland checklist measures 11 behavioural and attention problems and is applicable to the South African context (Copeland, 2003).

b) Aberrant Behaviour Checklist – ABC

The ABC – this is a well-validated questionnaire with 58 questions covering many behavioural problems that are grouped under 5 main headings. The Score Sheet indicates in which categories the most difficulties are experienced. These categories are: Irritability, Lethargy, Stereotypy, Hyperactivity and Inappropriate Speech. This checklist is applicable to the South African context (Aman et al., 1985 a & b).

(Copies of the two checklists are included in Annexure C).

5.8.2. Primitive reflex testing

Every learner was tested by the researcher to determine if any retained primitive reflexes, which indicate an immature central nervous system, were present. This was done by moving certain body parts, or by noticing if a reflex was elicited when certain parts of the hands, feet or face were touched. If these reflexes are not inhibited, immature patterns of physical behaviour may be the result and gross- and fine-motor as well as sensory perception and cognition can be affected. Detection of uninhibited reflexes can help isolate the causes of a learner's attention difficulties so that remedial training can be targeted more effectively. Different uninhibited
reflexes will have different effects on the functioning of the learner (Hocking, 2007:3) (cf. 1.4.) (Hannaford, 2002:111; Goddard, 2000:21; Freeman, 1998:86; Hannaford, 1995:17). Although it has been contested that testing of only the ATNR reflex is required to establish the immaturity of the nervous system, this study measured a range of primitive reflexes in order to have a more semi-quantitative assessment of the impact of AIT on primitive reflex integration.

5.8.3. A Listening Profile (cf. 4.6.4.1.)

Each learner’s listening skills were tested by presenting sounds through headphones, similar to a standard audiology test, except that this test assessed the learner’s ability to hear sounds in a naturally occurring environment, rather than in a sound-proofed room. The learner had to respond when a sound was presented. The softest level at which sounds at different frequencies could be heard was plotted on a graph. This was done for 11 frequencies from 125Hz to 8000Hz, in both ears. (A copy of the listening profile is included in Annexure E).

5.8.4. QEEG – Quantitative Electroencephalogram data was collected

This data was collected to monitor whether neurotransmission, as measured by brainwave production, improved as a result of the auditory intervention. If there was an improvement between the ratios of the different frequencies of encephalographs, or if certain regions of the brain improved in terms of activation, it may assist the learners in assessing auditory information more effectively. This will have a positive influence on attention control and enable the learner to pay attention according to the situation.

Quantitative Electroencephalogram (QEEG) measurements were taken from 9 different points on the scalp. This was done on internationally recognized sites according to the ten-twenty system for electrode placement for easy comparison and replication (Demos, 2007:45). The data extracted was analyzed according to the following five criteria:
• The ratio of slow Theta in relation to the Alpha, Low Beta and Beta waves;
• The ratio of High Beta waves in relation to the other waves;
• Asymmetrical balances between the left frontal and right frontal hemisphere;
• Balance of brainwaves between left and right hemispheres; and
• Theta-Beta ratio at the central point of the sensory-motor strip – Cz (Demos, 2007:45).

An analysis of the QEEG data is provided in Table 5.2

Table 5.2. Analysis of QEEG data:

<table>
<thead>
<tr>
<th>Brainwave ratios</th>
<th>Relevance of brainwave relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive Theta 3-7Hz</td>
<td>This will cause a drowsy, dreamy state in the learner and will be seen as attention problems – unable to maintain attention given to a task.</td>
</tr>
<tr>
<td>Insufficient 12-15Hz</td>
<td>12-15 Hz low Beta waves indicate a state of calm, focused attention.</td>
</tr>
<tr>
<td>Excessive high Beta 20Hz</td>
<td>This indicates a ruminating, anxious state.</td>
</tr>
<tr>
<td>Theta – Beta ratio</td>
<td>If the ratio is more than 2.5, it is indicative of attention problems</td>
</tr>
</tbody>
</table>

Balance of cortical areas

| Left versus right pre-frontal area | A person’s positive or negative disposition is situated in the pre-frontal lobes. If there are too many slow Theta, alpha and low Beta waves in the left frontal part of the brain, the person will experience an undefined anxious state. If there are too many fast Beta brainwaves in the right frontal area, a state of depression will be experienced. |
| Left versus right hemisphere     | The left hemisphere hosts the language areas and is more focused on detail, time-conscious, logic and structure. A learner with a dominant left brain will have little difficulty with the school situation and the way that information is presented in schools. The right hemisphere is focused on the bigger picture, |
own insight is important and there is no time-sense. These qualities are not highly valued in our schools.

| Theta –central versus parietal | Slow Theta and Alpha levels should be more in the back of the head at the parietal and occipital areas compared to the central regions. If this is not the case it is indicative of a state of prolonged anxiety. |

(Thompson & Thompson, 2003:10).

(A copy of a mini-QEEG assessment is included in Annexure F.)

5.8.5. Integrated Visual & Auditory (IVA) Continuous Performance Testing

The learners were asked to complete the IVA test so that the results could be used in the pre-, post tests to enhance validity of the study. The test evaluates the learner’s ability to sustain attention in less stimulating environments. The Integrated Visual & Auditory Continuous Performance Test measures how the learner responds to visual and auditory cues and determines the learner’s ability to give attention to and respond correctly to the various stimuli. This 20 minute test is done on the computer, where the learner has to respond when a ‘1’ is presented visually and/or auditory, while the presented ‘2’s should be ignored. Different aspects of auditory and visual attentions were tested.

An example of how the performance of the learner is rated by the computer software is included in Annexure G.
5.9. Administrative and ethical procedures

1. A meeting was set up with an educational psychologist who has assisted learners with attention difficulties. The project was explained to her and her assistance was sought in identifying learners with possible attention difficulties.

2. Parents of learners who were chosen to participate in the study were contacted by the teachers or the psychologist to inform them that the researcher would phone them and explain the research project.

3. A letter was sent out to the parents of the learners in the research group to let them know what the purpose of the research is.

4. The same letter was sent to the teachers of the learners in the research study.

5. A meeting was set up with the principals of the schools where the research was to be conducted. The principals and the teachers involved were informed of the particulars of the study.

6. A consent form was given to the parents to be discussed and signed before the start of the intervention. This is included in Annexure A.

7. Copies of the two checklists were given to parents of the 20 learners participating in the research study to complete. This was collected for analysis and to serve as a pre-test baseline.

8. Interviews with the parents and learners were held at the researcher's private rooms. During this initial meeting the reason for the study, the potential benefits and possible negative reactions were explained to the parent/s. It was explained that it was possible that the child may exhibit physical and/or behaviour problems for a period of time during or following the auditory training, as explained below.

9. The following responses might be observed:
   - Irritability and hyperactivity, which might result from fatigue;
   - Emotional outbursts;
   - Expression of previously blocked anger by the child;
Independence and assertiveness, which the parents may perceive as challenging behaviour;

The need for extra sleep. Some children have been reported to sleep up to 14 hours during AIT;

Change in appetite - they may sometimes eat more or else have a diminished appetite for a while;

Shift in perception as a new world is opening up – they see and hear things differently;

Hypo-sensitive smell may normalize.

Berard believed that these responses are transitional and indicate that the learner’s system is undergoing change, therefore, one should not be alarmed if reactions occur. At the same time, Berard’s experience showed the training to be effective even if the participant experienced no negative reactions (Berard, 1993:5).

10. The following support was suggested to minimize negative responses (Brockett, 2003:45):

a. If the child experienced any of the above mentioned behaviours the parents were requested to contact the researcher immediately. If necessary, the following techniques were conducted by the researcher with the parents’ help and permission, to minimize negative responses to the training:

b. Sensory input:
   - Sensory integration input was encouraged during the AIT training;
   - Deep pressure and/or massage could be applied;
   - Joint compression. The joints are pushed together to make the body aware of proprioception; and
   - Wheelbarrow walks and wall presses have a very calming effect.

11. A letter was sent to the principals of the schools to ask permission to conduct the research project on the school premises. Letter included in Annexure B.
12. The listening profiles were done at the researcher's private rooms. The training itself was done at the local Knysna Primary School.

13. The control group was from Stepping Stones Primary School. No intervention was conducted for the control group in the three month time period of the study.

14. The participants as well as the parents of the participants were informed of every aspect regarding the research method.

15. Participants had the right to withdraw from the study at any time. Participation in the study was strictly voluntary.

16. Records of the data collected during the pre-tests were printed and saved in the various learners' files.

17. Three months (cf. 1.5.) after the Berard AIT intervention was executed, the same checklists were again distributed to the parents and collected after it had been completed. No drop-out was experienced.

18. Data from the post-tests were printed and added to the various learners' files. This data were then compared to the data collected during the pre-tests.

19. The pre-and post checklists were compared and plotted on graphs to make comparison of the data more accessible. This is included in Annexure I & J.

20. The right to privacy was respected. Participants' names were withheld from the study.

5.10. Berard AIT intervention procedure (cf. 4.6)

The Berard AIT training was presented to the research subjects at the school. Learners listened to music twice a day for ten consecutive school days. Two 'Earducators' were used so that two learners could listen to the music at the same time. This minimized the time that the classes were disrupted with learners moving in and out of the classroom.

- Berard AIT consists of three Listening Profiles and a series of 20 half-hour listening sessions.
Music with a lively tempo and wide range of frequencies was processed through a system of filters in the AIT device, the Earducator.

The music presentation was heavily processed to randomly attenuate different frequency bands, as well as random volume shifts.

The music was selected from a series of compact disks, which presented the full spectrum of frequency ranges. All children in the experimental group were exposed to the same music, which supports the reliability of the study.

The training was structured as follows:

- Each session involved thirty minutes of listening time. There was an interval of at least three hours between sessions. This was necessary to let the auditory system rest and re-integrate. Two thirty minute sessions were provided daily for ten days. A rest period of two days was taken after the first five days. The training was done Monday to Friday for two consecutive weeks.

- A mid-point assessment was done after ten sessions to reassess the learner's listening profile and to note any changes that occurred. If necessary, different filters were activated on the electronic device at this stage. (A copy of the filter selection is included in Annexure K).

- A third assessment was done after the completion of the twenty sessions.

- The training was done at the school, to minimize disruption in the learner's routine.
• The training was interrupted for two days over the weekend. Training was thus conducted from Monday to Friday, and during the second week from Monday to Friday.

• The music was played at a comfortable listening level and later increased to 80dB. The volume varied from individual to individual, based on the provider's observations. The listening was never an uncomfortable experience.

• The researcher fetched the learner from the classroom and took him/her back after the session. Two learners did the training simultaneously to make the experience more relaxing.

• There were no dangers involved with the training, but as the training was done through the ears, the parents of the learners had to have the outer ear examined by a health care worker before the training started. This was to ensure that there were no existing pathologies and to see if the outer ear was free of excessive ear wax and unnatural objects. Since there were no torn tympanic membranes or grommets identified all the learners could take part in the research study.

5.11. Acquisition of physical and neural function

Detection of underlying physical and neural problems are vital if a learner is to receive relevant remedial help.

5.11.1. Primitive reflexes

Primitive reflexes are automated, stereotyped movements, directed from the brain stem and executed without cortical involvement. Detection of primitive reflexes can help to isolate the causes of a learner's attention problem. Reflex assessment can be used to identify the level at which the learner's development remediation should be aimed (Hocking, 2007:12).

It is important to examine which area presents the greatest stumbling block for the individual learner. Testing the presence of an aberrant reflex is done by letting the learner either do the movements that simulate the reflex, or by eliciting the reflex through pressure on different body parts (Goddard, 1996:iv).
The researcher has been trained in this technique by Claire Hocking, an Educational Kinesiologist from Australia.

5.11.2. Listening Profile

The Listening Test for Berard AIT was administered in a quiet, but not sound proof room. (The door of a sound proof booth must be left open). This was done to see what the effect was on learners when background noise was present while there listening abilities were tested. Instructions were simple and brief, as many of the individuals participating in this test might have active auditory processing problems.

The listening assessment required that the learner be fitted with headphones. A soft tone was presented in the left ear at different frequencies. The preferred response for the listening test is to instruct the learner as follows: “Say ‘yes’ when you hear the sound, and say ‘no’ when you do not hear the sound”. Eleven frequencies were tested in each ear. Testing both ears did not take longer than ten minutes.

Method 1:
- Increase the loudness of the tone quickly from -10dB until the learner says he can hear the tone.
- Decrease in steps of 10dB until the learner says: “no”.
- Increase again in steps of 5dB until the learner says: ‘yes”.
- Decrease in steps of 5dB until the learner says “no”.
- Cross over the threshold three times to check reliability.
- Before starting the next frequency, reset the response to -10dB.

The results were plotted on a graph. This profile was used to see if there were peaks that might cause discomfort in daily living. Narrow band filters were used for peaks that met Berard’s criteria for filtering.

After the first five days in which five hours were spent listening to music, the listening profile was repeated to see if there were any other peaks that met the criteria for filtering. Narrow band filters were activated as indicated, for the next five days of listening to music (Brockett, 2003:140).
The researcher was trained in this technique by Rosalie Seymour, a Speech Therapist, in 2001, and an updated course was done in 2003 in Connecticut, USA, conducted by Sally Brockett. Since 2003 the researcher has been an internationally accredited trainer in Berard AIT and has taught this method of obtaining a Listening Profile to students in South Africa, Australia, Israel, Abu Dhabi and the USA.

5.11.3. Quantitative electroencephalograph (EEG)

Quantitative EEG is the measurement, using digital technology, of electrical patterns at the surface of the scalp which primarily reflect cortical electrical activity or “brainwaves.” A multi-electrode recording of brain wave activity is recorded and converted into numbers by a computer. These numbers are then statistically analysed and are converted into a colour map of brain functioning (Demos, 2005:45).

QEEG data acquisition is a comprehensive method of data gathering. The goal is to reach an accurate estimate of cerebral functioning. Two-channel assessments have great value. They can find gross abnormalities, lateral asymmetries, posterior-to-anterior differences as well as Theta-to-Beta ratios. The more data acquired at the same time, the better. The data are organized by pre-determined bandwidths. When finished, the data is printed to facilitate comparisons (Demos, 2005:159).

The researcher was taught this method of data acquisition in 2002 in Los Angeles, USA and has used it since in her private practice. She has taught this method of assessment to students in Australia, Israel and South Africa since 2004 when she became an accredited Neurofeedback trainer.

5.11.4. Integrated Visual and Auditory (IVA) Continuous Performance Test

The IVA is a programme which is used to test and accumulate information in the diagnosis and quantification of the symptoms of ADHD. The programme is designed to give detailed performance information, and to make the most accurate diagnosis possible, so that the nature of a person’s self-control problems can be understood (Sandford, 2000:viii,1).
For testing a quiet room, free from auditory and visual distractions, should be used. The test task requires the test taker to click the mouse when he sees and hears a “1”. He must not click the mouse when he sees or hears a “2”. Thus, test takers must remember the following:
Click when you see a “1”
Click when you hear a “1”
Do not click when you see a “2”
Do not click when you hear a “2”
IVA is the first commercially available CPT (Continuous Performance Test) to combine using a counterbalanced design, both visual and auditory CPT of impulsivity and inattention.

The basis for statistical analysis used by the IVA is similar to the analysis used for most IQ tests. The IVA enables the professional to apply familiar interpretive guidelines, making it easier to interpret the test results. These attributes and validity scales help the clinician to understand a person’s best modality of learning, need for structure, maturation level, comprehension and possible learning, emotional and neurological problems (Sandford, 2000:viii,1).

5.12. Response

All the learners in the research group stayed in the programme for the duration of the research project. One of the learners in the control group did not complete the last three days of the Berard AIT intervention which was presented after the research had been completed. This did not influence the results as the before and after data had already been collected.

5.13. Statistical techniques

Repeated-measures ANOVA (analysis of variance), was used to compare the result of the pre- and post tests. This showed if a statistically significant difference existed between two means (Leedy & Ormrod, 2005: 274). The researchers looked for a significance level of 0.05, which means only a 5% probability of the observed patterns occurred due to chance or error (Leedy & Ormrod, 2005: 270). The significance level determines whether the null hypothesis is rejected and is thus a
crucial part of the hypothesis testing (Hopkins, 2000:5). Although the normal distribution of data from such a small group is not readily ascertained, the assumption of normal distribution was made, based on normal-distribution plots which indicated that the vast majority of measurements did not demonstrate noteworthy skewing.

The following comparisons were made:

i. The pre-measurements of the ten learners in the experimental group were compared with the pre-measurements of the ten learners in the control group to determine if significant differences existed between these two groups at the outset.

ii. The pre- and post measurements of the experimental group, who received the Berard AIT intervention, and the control group, who did not receive AIT during the study, were compared.

The main analysis was done by a statistician, Prof Martin Kidd at the Centre for Statistical Consultation of the University of Stellenbosch.

5.14. Reliability and Validity

Leedy & Ormrod (2005:29) state that reliability is the consistency of results over time and the accuracy of the sample as representative of the total population under study. As the sample were chosen according to good research practices and a consistency of results were found over time, this research study was reliable.

Validity is the reliability of the measuring instrument over time (Leedy & Ormrod, 2005:28). Validity of findings is determined by the scientific procedures of the method (Mason, 2005:30). The larger the sample, the more it will represent a certain population. Experimental designs tend to be high in internal validity but lower in external validity.

Research studies are valid if the research:

a) Generates or tests theory
b) Is based on empirical, logical evidence
c) Produces results that can be generalized to other contexts and
d) Acknowledges the influence of the researcher or the research methods on the results (Mason, 2005:31).

Validity and reliability reflect if there are errors in the measurements (Leedy & Ormrod, 2005:29). The validity of the research study was proven as the results can be generalized to other contexts. Empirical evidence, tested with pre- and post tests, showed that the research design was high in internal validity.

5.15. Ethics

Ethical principles used in research design are based on three broad principles (Terre Blanche, Durrheim & Painter, 2008:66). According to Terre Blance et al., (2008), the first principle is autonomy where the research participants must be respected on all levels. The study was done in the school with as little disruption as possible to their academic education. They did not have to travel to an outside office twice a day. The second principle is nonmaleficience where no harm is done before, during or after the research project. The music that the learners listened to were appropriate for young children and the volume of the music was kept to a comfortable level. The third principle is beneficience. The outcome of the study should be of benefit to the research subjects but also to the general society as the aim of the study was to enhance the learners attention efficiency.

The participants as well as the parents of the participants were informed of every aspect regarding the research method. Participants had the right to withdraw from the study at any time. Participation in the study was strictly voluntary.

Informed consent was obtained from the parent or guardian of the participants.

The right to privacy was respected. Participants' names were withheld from the study. Findings were reported in a complete and honest fashion, without misrepresentation.

The study was furthermore approved by the Ethics Committee of the North West University.

5.16. Conclusion
The research design was discussed in this chapter as well as the objectives of the study method of research; pre-and post-tests; population, sampling and the intervention. In the next chapter the research data of the various pre- and post-measurements will be discussed.

Chapter 6. Presentation and Discussion of Results

Overview of chapter 6

- Introduction
- Statistical analysis
- Data comparison

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