Chapter III

METHODOLOGY

Research methodology involves the systematic procedure by which the researcher starts from the initial identification of the problem to its final conclusion. The role of the methodology is to carry out the research work in a scientific and valid manner.

The purpose of the study was to find out the effectiveness of an Interactive Computer Assisted Instruction and Traditional Instruction method in teaching Hurdles. This chapter discusses the methodology used in the selection of subjects, selection of variables, selection of tests, orientation to the subjects, competence of the tester, reliability of the instruments, reliability of the data, awareness of computer and multimedia literacy, training programme, collection of data, administration of tests, experimental design and statistical techniques.

Selection of Subjects

To achieve the purpose of the study, forty five subjects were selected randomly from The Madurai Diraviyam Thayumanavar Hindu College, Pettai, Tirunelveli, Tamil Nadu, India. All the subjects were studying B.Sc., Physical Education, Health Education, and Sports. Their age ranged from 17 to
21 years. The subject, Track and Field is included in the undergraduate course in Physical Education, Health Education and Sports as theory and practical papers. They had Hurdles as one of the important event of Track and Field paper.

The selected subjects were randomly divided into three different experimental groups: Computer Assisted Instruction Group (CAIG) (n=15), Traditional Instruction Group (TIG) (n=15) and Combined Instruction Group (CIG) (n=15). The Computer Assisted Instruction Group received teaching components through computer programmes such as video shows, clippings, and so forth for hurdle events for 20 minutes duration followed by 40 minutes self practice in the play ground. Traditional Instruction Group received a 20 minutes lecture/ demonstration covering the same instructional content followed by 40 minutes self practice in the play ground with the hurdles and the Combined Instruction Group received both instructions 10 minutes each (total 20 minutes) followed by self practice for 40 minutes duration with the assistance of the investigator. The duration of the experiment lasted for eight weeks and the number of sessions per week was confined to three alternative days, in addition to the regular academic programme as per the curriculum. The pre and post test data were collected from the subjects before and after the
experimentation respectively on the selected dependent variables such as hurdling skill, performance and cognitive knowledge.

**TABLE I**

CHARACTERISTICS OF SUBJECTS BY GROUP

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>Age (Yr)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICAG</td>
<td>15</td>
<td>19.1 ± 2.23</td>
<td>166.5 ± 5.33</td>
<td>62.5 ± 5.22</td>
</tr>
<tr>
<td>TIG</td>
<td>15</td>
<td>18.6 ± 1.57</td>
<td>164.5 ± 4.21</td>
<td>60.7 ± 3.61</td>
</tr>
<tr>
<td>CIG</td>
<td>15</td>
<td>17.8 ± 2.21</td>
<td>166.5 ± 4.43</td>
<td>59.5 ± 4.45</td>
</tr>
</tbody>
</table>

**Selection of Variables**

Computers have been used over two decades as an assisting tool for the given information by teachers and coaches at all levels of education and sports training. In many educational programmes computers have been used not only as an educational mean, but as an active part of the educational procedure.

It is commonly accepted that the development of the technology and the inventions of the computers is radical and so, resulting in the development of software and multimedia. Software technology is used for different subjects and different levels.

The concept of multimedia includes the use of one or more means that they have text, images, graphics, digital video, sounds, etc. Such multimedia programmes are used not only
concepts, ideas and theories but also the skill components. Obviously they are used at best in disseminating Physical Education major. Its main features are the correct performance of a certain sport skill, information about regulation and rules, giving feedback to the student or the athlete. Films and videos of individual and performances of teams have long been used by athletes, coaches and sport scientists to analyze and improve the performance in technical skills and team tactics.

The use of the conventional instruction can positively affect the learning of skills, when it is being used as a mean for the demonstration of the technique, but it is not superior to mental practice. The use of the conventional instruction is not practical for on–field research because of the heavy equipment and the lack of portability. Furthermore the presence of an expert is necessary for the correction of skills executed by the athletes. In addition conventional instruction lacks the advantages of the mental captures of the correct technique of hurdles.

Hurdles are perhaps the most easily recognizable of all track events after sprinting, and it involves running over a set of hurdles that are kept at equal distances from each other. In order to master the art of hurdling, an athlete will need to train for many hours a day, and develop his ability to jump higher without
breaking his stride and momentum. Comparing to other events the hurdle event is one of the track and field events that combine skill, flexibility, coordination, strength, technique and conditioning.

Coaching hurdle is very technical. Not only a coach has to be able to explain, possibly demonstrate, and know what hurdlers need to do with their limbs and for training. He also need to be able to visualize the small or sometimes big things that hurdle athletes are doing resulting in holding them back from progressing.

Keeping the above concept in mind, the following dependent and independent variables were selected for this study.

**Dependent Variables**

The following criterion variables were selected as dependent variables such as Hurdling Skill, Performance, Cognitive Knowledge and Attitude.

**Independent Variables**

1. Computer Assisted Instruction
2. Traditional Instruction
3. Combined Instruction (Traditional Instruction with Computer Assistance)
Selection of Tests

As per the available literature the selected variables were tested by using the following standardized tests and they were presented in Table II.

**TABLE II**

**TEST SELECTION**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Variables</th>
<th>Tests</th>
<th>Units of Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hurdling Skill</td>
<td>Expert rating</td>
<td>10 point scale</td>
</tr>
<tr>
<td>2</td>
<td>Performance</td>
<td>110 meters Hurdling with 0.914 height</td>
<td>In seconds</td>
</tr>
<tr>
<td>3</td>
<td>Cognitive Knowledge</td>
<td>Questionnaire</td>
<td>In scores</td>
</tr>
<tr>
<td>4</td>
<td>Attitude</td>
<td>Attitude Scale</td>
<td>In points</td>
</tr>
</tbody>
</table>

Orientation to the Subjects

The investigator explained the purpose of the study to the subjects and their part in the study. For the collection of the data, the investigator explained the procedure of testing the selected dependent variables, and gave instructions about the procedure to be adopted by them. Four sessions were spent to familiarize the subjects with the techniques involved to execute the training of hurdling skills. It helped them perform training perfectly and avoid injuries. Further the subjects were specially oriented, and advised
to avoid the special practice of any of the specific training programme till the end of the experimental period. The participants of all the groups were sufficiently motivated to perform their maximal level during the training and the testing periods. The participant’s consent form was presented in the Appendix – V.

**Preparation of CD-ROM**

The content of the lesson, hurdles in CD-Rom format was developed by the investigator by incorporating the various teaching stages based on the training schedule for eight weeks duration. The CD was shown to the experimental group I (CAI) and experimental group III (CI) for 10 minutes duration before the commencement of each and every training session, and they were advised to perform accordingly. The CAI training schedule CD-ROM is appended with thesis soft copy.

**Competence of the Tester**

All the measurements in this study were taken by the investigator with the assistance of students from the Department of Physical Education, Health Education and Sports, The Madurai Diraviyam Thayumanavar Hindu College, Tirunelveli, Tamil Nadu, India. To ensure that the investigator and his assistants were well versed with the techniques of conducting tests, they had a number
of practice sessions in the correct testing procedure prior to the tests.

**Reliability of Instruments**

Instruments used for this study were stop watches and Hurdles availed from the Department of Physical Education, Health Education and Sports, The Madurai Diraviyam Thayumanavar Hindu College, Tirunelveli, Tamil Nadu, India. The instruments were purchased from reliable and standardized companies and were considered accurate enough to serve the purpose of the study.

**Reliability of the Data**

Test and retest method was followed in order to establish the reliability of the data by using ten subjects at random. All the dependent variables selected for the present study were tested twice by the same personnel under similar conditions. The Intra-class co-efficient of correlation was used to find out the reliability of the data and the results are presented in Table III.
TABLE III

INTRA CLASS CO-EFFICIENT OF CORRELATION ON SELECTED VARIABLES

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Variables</th>
<th>R -Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hurdling Skill</td>
<td>0.83*</td>
</tr>
<tr>
<td>2</td>
<td>Performance</td>
<td>0.82*</td>
</tr>
<tr>
<td>3</td>
<td>Cognitive Knowledge</td>
<td>0.87*</td>
</tr>
<tr>
<td>4</td>
<td>Attitude</td>
<td>0.82*</td>
</tr>
</tbody>
</table>

*Significant at 0.01 level of confidence.
(Table value required for significance at 0.01 level of confidence is 0.77)

Since the obtained 'R' values were much higher than the required value, the data were accepted as reliable in terms of instrument, tester and the subjects.

Construction of Cognitive Knowledge Test

Questionnaire

A tool was constructed to evaluate the cognitive knowledge of hurdles event and to compare the learning achievement of the students through Computer Assisted Instruction Traditional Instruction and Combined Instruction. The questionnaire was constructed covering all the aspects of hurdles chosen for this study. Equal weightage was given to each stage.
Objective type questions were framed without omitting any stage. Multiple choice and fill in the blanks were the types of questions used in this cognitive knowledge test. The questions were framed to suit the understanding level of Bachelors Degree students in Physical Education. Utmost care was taken to avoid ambiguity and ambivalences. Item analysis was done to finalize the questions.

Initially 60 questions of objective type in nature were framed for tryouts. Sixty percent multiple choice question items and 40 percent fill in the blanks items were framed from the contents of the questionnaire. Multiple choice test items were composed of a stem followed by a set of four options including possible responses or distractors. The stem is a direct question or an incomplete statement with four options of which only one is the correct response. Due importance and weightage were given to multiple choice test items because its level of difficulty can be varied with relative ease, and it is capable of reflecting simple student behavioural patterns such as recall of information as well as complex student behavioural patterns such as the ability to analyze and synthesize.

Fill in the blank test items constitute 40 percent of the achievement test items. These test items were questions or
incomplete statements which require highly short and specific answers. The answer is usually a significant word or expression.

**Item Analysis**

After pooling of 60 test items, the framed test items were subjected to careful scrutiny and critical judgment by a panel of subject experts. Each item was critically examined for what might be termed ‘formal defects’. The next stage was tried out; the whole pool of items was given as a test to twenty students belonging to the target population. The obtained data were then used for an elaborate set of statistical procedures known as item analysis, which gave the investigator information regarding the following items. *(Robert, 2004)*

1. Item difficulty
2. Item discrimination and
3. Error or distraction analysis

**Test Item Difficulty**

Test item difficulty refers to the percentage of students who correctly answered to the given test item. The level of difficulty was determined by using the formula

\[ P = \frac{N_r}{N_t} \times 100 \]
Where,

\( P \) = Percentage of students who answered the test item correctly

\( N_r \) = Number of students who answered the test item correctly

\( N_t \) = Total number of students who attempted to answer the test item

In most of the cases the percentage clustered around the 50 percent level. On the basis of this analysis, too easy and too difficult test items were deleted in the final form of Cognitive Knowledge test.

**Test Item Discriminating Power**

A test item possesses adequate discriminating power when it is capable of differentiating between superior and inferior students. To determine item discriminating power, the following simple formula was used even though there are many different computational schemes

\[
D = \frac{U - L}{N}
\]

Where,

\( D \) = Index of item discriminating power.

\( U \) = Number of students in the upper group who answer the test item correctly (usually 27% of the total group).
L = Number of students in the lower group who answer the test items correctly (usually 27% of the group).

N = Number of students in each group.

For more than fifty percent of the test items, the computed D value exceeded + 0.4 which indicated that the test items were good and for the remaining items, the computed ‘D’ value ranged between +0.40 and +0.20 which was a clear indication to the satisfactory condition of the test item. Those items which failed to differentiate between the superior and the inferior students were not included in the final form of Cognitive Knowledge test.

Hence, eighteen objective type questions and 12 filling the blanks type questions were selected to design the cognitive knowledge questionnaire.

**Reliability of Cognitive Knowledge Tool**

A pilot test was conducted administering the test to ten students belonging to the target population. The main purpose of the pilot study was to establish the reliability of the knowledge test. The scores obtained by the students in the pilot study formed the basis for establishing reliability of the test.

The test reliability means the consistency with which a set of test scores measures what they previously measured. It
relates to the accuracy with which skills and knowledge are measured. Reliability is a necessary condition for validity. Reliability co-efficient provides the most revealing statistical index of validity that is ordinarily available.

In the present study, the split half method is used to estimate the reliability of the test. The split half method is considered to be one of the best methods for measuring reliability because all the data for computing reliability are obtained by one testing. Also, the variations likely to be brought about by difference between the two testing situations are eliminated.

The test was conducted to ten Bachelor Degree students of Physical Education, Health Education, and Sports and studying in The M.D.T. Hindu College, Pettai, Tirunelveli, Tamil Nadu. In this method, the test items were divided into two equivalent halves by pooling the scores on odd numbered items and then pooling the scores on even numbered items, and then correlation was found for these halves by using the Karl Pearson’s Correlation Coefficient (‘r’= 0.78).

**Validity of Cognitive Knowledge Tool**

A research tool is said to be valid when it measures what it purports to measure. Any knowledge test should possess validity. Validity indicates how adequately the content of the test is
sampling that domain about which inferences are to be made. It is particularly very important for knowledge test.

**Nunnally (1978)** observes that rather than establishing the validity of measures after their construction, it is more meaningful that it should ensure the validity of a tool by the plan and procedure of the test construction. According to him, there are two major tools for ensuring content validity. They are,

1. A representative collection of item and

In developing the tools for the present study, the above standard guidelines are followed. The different procedures employed in the tool construction are adequately outlined in this chapter. In the light of the procedures adopted for developing the questionnaire, it can confidently be said that the tools have sufficient content validity.

**Scoring Procedure for Cognitive Knowledge Tool**

The knowledge test questionnaire constructed by the investigator was used to collect data from the learners of the Computer Assisted Instruction. The responses given by the students in the test formed the vital data required for the analysis. The knowledge test consisted of thirty questions. Out of thirty questions, eighteen objective type questions and twelve fill in the
blanks type questions were present. The total score of the test was thirty. For each correct answer, the score was one, and for each wrong answer the score was zero.

**Awareness of Computer and Multimedia Literacy**

Prior to the formal study sessions, the subjects were made to get the awareness of computer and multimedia literacy, so that they can handle the computer with ease during their training periods. The orientation about computers was given to the students. They were asked to learn the fundamentals of operating computers. They were taught how to use the computers for their study. The operational systems include how to open the files, close the files, switching over to next page/programmes and so forth. They got familiarized with computers within seven days. They had the capacity to individually handle the computers on the eighth day.

**Training Programme**

The training programme was imparted at the Department of Physical Education, Health Education and Sports, The Madurai Diraviyam Thayumanavar Hindu College, Pettai, Tirunelveli, Tamil Nadu, India. First they were familiarized with each exercise which they had to undergo with the help of an expert. It was an eight week progressive training programme for the three experimental
groups. Pre test and post test data were collected from experimental groups. The training programme of eight weeks were given in Appendix - VIII

The students were taught through Computer Assisted Instruction (CAI) for a period of three days (Monday, Wednesday and Friday) up to eight weeks at the rate of 20 minutes per day in the evening. The students were taught individually by using computers. Hurdles techniques were covered in the period of investigation. The students were asked to make self practice with the help of the Computer Assisted Instruction. All the stages in the sequence were arranged in a sequential order. The students were not allowed to use the handbook at home.

**Group I (Computer Assisted Instruction Group)**

Group I consisted of fifteen subjects, who received teaching components through computer programmes such as video shows, clippings, and so forth for hurdle events for 20 minutes duration followed by 40 minutes self practice in the play ground for a period of eight weeks with three alternative days per week. They were never allowed to avail any special teaching/coaching other than their regular practice as per the curriculum.
**Group II (Traditional Instruction Group)**

Group II consisted of fifteen subjects, who underwent traditional hurdles training 20 minutes with the help of three experts including the instructor, who was a qualified person with Diploma in Coaching (N.I.S) in Track and Field and self-practice 40 minutes for a period of eight weeks with three alternative days per week. They were never allowed to avail any special teaching/coaching other than their regular practice as per the curriculum.

**Group III (Combined Instruction Group)**

Group III consisted of fifteen subjects, who underwent combination of computer assisted hurdles training and traditional hurdles training 10 minutes each, followed by self practice 40 minutes for a period of eight weeks with three alternative days per week. They were never allowed to avail any special teaching/coaching other than their regular practice as per the curriculum.

The duration of training session in all days was ranging from one hour to one and half hours approximately which included warming up and limbering down. All the subjects involved in this study were carefully monitored throughout the training programme to be away from injuries. They were questioned about their health
status throughout the training programme. None of them reported with any injuries. However, muscle soreness appeared in the earlier period of the training programme and was reduced in due course.

**Collection of Data**

The pre and post tests data were collected on the selected criterion variables prior to and immediately after the training period from the selected subjects at the Department of Physical Education, Health Education and Sports, The Madurai Diraviyam Thayumanavar Hindu College, Tirunelveli, Tamil Nadu, India, during the academic year 2010-11. The tests were administered in the evening sessions. The data on selected variables were collected by standardized tools.

**Administration of Tests**

1. **Skill of the Hurdles Event (Technique)**

**Purpose**

To find out the skill of hurdling technique of the subjects.

**Equipment Needed**

Hurdles and Stop watch.

**Procedure**

In this test, the experts were placed in such a way that they can see all the ten hurdles as well as the hurdling skills by the
subject. Then the subjects were asked to do hurdling technique with full speed and the experts were asked to rate their skills subjectively, under several headings. This was done for pre and post test.

**Scoring**

A total of 10 points were given by the experts under five different categories. The average of three experts was taken. The experts’ scale was presented in Appendix – VI & VII.

**2. 110 meters Hurdles Performance**

**Purpose**

To find out the performance of 110 meters Hurdles event by the subjects.

**Equipment Needed**

Hurdles and stopwatch.

**Procedure**

In this test, the distance of the hurdles was fixed as 110 meters. The height of the hurdle was 0.914 meters, the distance from start to first hurdle was 13.72 meters, distance in between the hurdles was 9.14 meters and the last hurdle to finish line was 14.02 meters. As they were novice to this event, except the height of hurdles, other items were not altered. The subjects were asked to run the 110 meters hurdles with their fullest effort.
Scoring

The score was the elapsed time to the nearest one-tenth of a second between the starting signal and the instant the subject crossed the finished line. The fractions were rounded to the next longest one-tenth of a second.

3. Administration of Cognitive Knowledge Questionnaire

Purpose

To find out the Cognitive knowledge about hurdling event by the subjects.

Equipment Needed

Questionnaire, Paper, Pencil/Pen.

Procedure

The cognitive knowledge test questionnaire constructed by the investigator was administered to the learners. The subjects were tested twice. Pre test was conducted before the administration of experiment and post test was done after the completion of Instruction. The responses given by the students in the test formed the vital data required for the analysis. The questionnaire was presented in Appendix II. The key to the cognitive knowledge test also was presented in Appendix III.
**Scoring**

The Cognitive knowledge test consisted of thirty questions. The total score of the test was thirty. For each correct answer, the score was one and for each wrong answer the score was zero.

**4. Administration of Attitude Scale Questionnaire**

**Purpose**

To find out the Attitude towards Computer Assisted Instruction by the subjects.

**Equipment Needed**

Questionnaire, Paper, Pencil/Pen

**Procedure**

The attitude scale developed by **Loyd and Gressard (1984)** was used to measure the attitude of the students towards using the computer and Computer Assisted Instruction, and it was administered after the subjects completed the Computer Assisted Instruction. Frequency counts were computed for the data collected by the use of the questionnaire on a five point Likert scale, based on the Loyd Gressard Computer Attitude Scale (1984). Mean scores of the respondents on each item of Likert scale were then calculated. The statements on the Likert scale were scored as follows: ‘Strongly Agree’ = Five points, ‘Agree’ =
Three points, ‘Undecided’= Three points, ‘Disagree’= Two points, ‘Strongly Disagree’= One point. The questionnaire was presented in Appendix IV.

**Scoring**

A mean score of above the Three was interpreted to denote a positive attitude, a mean score of the Three denoted a neutral attitude and a mean score of below the Three denoted a negative attitude. The total score of the attitude scale was 215 and it was then converted to 100.

**Experimental Design**

This study was conducted to determine possible cause and effect of the relationship of Computer Assisted Instruction, Traditional Instruction and Combined Instruction. A pre and post test randomized design was employed for this investigation. This study consisted of three experimental groups, Group-I (n=15) underwent Computer Assisted Instruction, Group-II (n=15) underwent Traditional Instruction and Group III (n=15) underwent Combined Instruction. All the subjects were tested prior to and immediately after the experimentation on hurdling skill, performance and cognitive knowledge. The students’ attitude was tested after the completion of training period.
Statistical Technique

The data collected from the subjects were analysed with descriptive statistics and paired sample ‘t’-test to find out the influence of the selected independent variables on the criterion variables. No attempt was made to equate the groups in any manner. Hence, to make adjustments for difference in the initial means and test the adjusted post test means for significant differences, the analysis of covariance (ANCOVA) was used (Broota, 1989). The scheffe’s test was used as post-hoc test to determine which of the paired means differed significantly where the differences in adjusted post test means resided in univariate ANCOVA among three groups. All the above statistical analysis tests were computed at 0.05 level of significance (P<0.05).

Justifications for Using One-Way ANCOVA

One-way univariate analysis of covariance (ANCOVA) was used to determine how each dependent variable was influenced by independent variables while controlling for a covariate (pre test) (Hair, Anderson, Tatham, and Black., 1998). Analysis of covariance adjusts the mean of each dependent variable to what they would be if all groups started out equally on the covariate. In this study, pre test scores of selected variables have been shown to correlate with the post test scores, thus they were considered as appropriate covariates.
Assumptions for ANCOVA

A preliminary analysis was conducted to determine whether the prerequisite assumptions of ANCOVA were met before preceding the univariate analysis. Thus, the assumption of equality of variance (homogeneity) and the homogeneity of regression slopes were examined.

Levene’s test of equality of error variances on selected variables was calculated and presented in table IV.

TABLE IV

LEVENE’S TEST OF EQUALITY OF ERROR VARIANCES ON SELECTED VARIABLES AMONG GROUPS

<table>
<thead>
<tr>
<th>Variables</th>
<th>F- Ratio</th>
<th>df 1</th>
<th>df 2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skill</td>
<td>0.698</td>
<td>2</td>
<td>42</td>
<td>0.503</td>
</tr>
<tr>
<td>Performance</td>
<td>0.073</td>
<td>2</td>
<td>42</td>
<td>0.930</td>
</tr>
<tr>
<td>Cognitive Knowledge</td>
<td>0.601</td>
<td>2</td>
<td>42</td>
<td>0.553</td>
</tr>
</tbody>
</table>

(The table value required for 0.05 level of significance with df 2 & 42 is 3.22).

Homogeneity of variances is a term that is used to indicate that the groups have the similar variances. Thus, in Levene’s test of equality of error variances table, the obtained F-values of the selected dependent variables were less than the confidence interval value of 0.05, which indicates that the variance of each group was not significantly different from one another.
Therefore, the homogeneity of variance of comparing the three groups regardless of the ability level for each of the dependent variables indicated that homogeneity of variance has been met for all the three dependent variables. Hence it was concluded that the assumption of homogeneity of variance has been met for computing univariate ANCOVA.

The test of significance of the regression of post test (dependent variable) on pre test (covariate) were analysed and presented in table V.

**TABLE V**

**TESTING THE SIGNIFICANCE OF THE REGRESSION OF POST TEST ON PRE TEST OF SELECTED VARIABLES**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skill</td>
<td>Regression</td>
<td>57.25</td>
<td>1</td>
<td>57.25</td>
<td>12.53*</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>196.52</td>
<td>43</td>
<td>4.57</td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>Regression</td>
<td>10.00</td>
<td>1</td>
<td>10.00</td>
<td>13.11*</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>32.80</td>
<td>43</td>
<td>0.76</td>
<td></td>
</tr>
<tr>
<td>Cognitive</td>
<td>Regression</td>
<td>69.88</td>
<td>1</td>
<td>69.88</td>
<td>153.18*</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Residual</td>
<td>19.62</td>
<td>43</td>
<td>0.46</td>
<td></td>
</tr>
</tbody>
</table>

* Significant at .05 level of confidence.
(The table value required for 0.05 level of significance with df 1, 43 is 4.065)

From the above table it was observed that regression based (ANCOVA) predicts the post test scores significantly well
from the pre test scores on all the dependent variables. It shows that the pre and post test scores of selected dependent variables were significantly associated. As in regression, it is important that the association between the outcome and the covariate is linear.

After determining the assumptions for computing ANCOVA have been met with the pre data analysis, the univariate ANCOVA statistical output was examined. Then, providing the ANCOVA result was statistically significant, the univariate results were examined for each dependent variable. For the significant univariate results, the post hoc comparisons were performed to identify where the differences resided. The pair wise comparisons statistics was used for the post hoc results. The results of the descriptive analysis, paired sample ‘t’ test, univariate tests, the pair wise comparisons among the three dependent variables are reported in chapter four. All the calculations were given in Appendix – I.