CHAPTER III

RESEARCH METHODOLOGY

The previous chapter represents the literature and review of the work carried out in the development of intelligence tests, the relationship between intelligence and some related variables as school achievement, and sex differences in intelligence. This chapter describes the procedure adopted for this study. Discussion about the population and sample of the study, details about tool and data collection, the scoring and the data analysis, etc.

3.1. POPULATION

The purpose of this study is to study the relationship of secondary school students’ intelligence scores and their age, sex and school achievement and adapt (OLMAT) advanced level form (K) to the Yemeni students in Yemeni environment.

The population for this study consisted of all the secondary school students (boys and girls enrolled in the Tenth, Eleventh and Twelfth grades in the Capital city (Sana’a) of Republic of Yemen, during the academic year 2004-2005. It consisted of 46,808 boys and girls. Table 3-1 shows the distribution of the study population by sex and grades.
Table 3-1: Distribution of the study population according to sex and grade

<table>
<thead>
<tr>
<th>Grades</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenth</td>
<td>10408</td>
<td>9653</td>
<td>20061</td>
</tr>
<tr>
<td>Eleventh</td>
<td>6743</td>
<td>6976</td>
<td>13719</td>
</tr>
<tr>
<td>Twelfth</td>
<td>6587</td>
<td>6441</td>
<td>13028</td>
</tr>
<tr>
<td>Total</td>
<td>23738</td>
<td>23070</td>
<td>46808</td>
</tr>
</tbody>
</table>

3.2. SAMPLE OF THE STUDY

The sample of this study consisted of 1561 students, of which 801 were males and 760 were females. The study sample constituted approximately four per cent of the population. There are 64 secondary schools in the city of Sana’a, thirty four of which are for males and thirty for females. In all, 24 schools were selected by simple random procedure from the total number of schools, of which 12 schools were for boys and 12 schools were for girls. From among these 24 schools, a total of 47 classes for both sexes were randomly selected: 24 classes for boys, ten classes for the tenth grade, seven classes for the eleventh grade, and seven classes for the twelfth grade. Out of 23 classes for girls, nine classes were for the tenth grade, seven classes were for the eleventh grade, and seven classes were for the twelfth grade. Table 3-2 shows the distribution of the study sample according to sex and grade.
The sample for the pilot study consisted of 252 students, (150 males, 102 females), of this 106 were from the tenth grade, 78 were from the eleventh grade, and 68 were from the twelfth.

### 3.3. THE STUDY TOOL:

Since there was no measure of mental ability or intelligence standardized on Yemeni population it was planned that an appropriate tool would be developed. It is with this idea that the researcher used the Otis- Lennon Mental Ability Test (OLMAT) (Appendix 1). This instrument was published by Harcourt Brace Jovanovich. Inc, in 1968 and developed by Arthur Otis and Roger Lennon, it presents the earliest and most widely used group intelligence test. It is an outgrowth of Otis’s effort in the development of the Army Alpha Examination during World War I. Since then, many efforts have been made to refine and update the content and procedures of
OLMAT. The test was designed in two equivalent forms, form (J) and form (K). These tests are used for students from kindergarten to twelfth class. It consists of two parts: The first part consists of three levels, primary I level, primary II level and Elementary I level. In this part, the items are pictures to suit the individuals who cannot read and write.

The second part consists of high three levels, Elementary II level, Intermediate-level and Advance-level. In this part various types of verbal and nonverbal items sample a wide variety of mental processes. All these scales were constructed to measure verbal, numerical and abstract reasoning abilities important for success in academic or vocational settings, where emphasis is placed on the abstract manipulation of ideas expressed in verbal, numerical, figural or symbolic form.

The OLMAT was constructed to yield dependable measurement of the ‘g’ or general intellective ability factor. Thus, the single total score obtained at a given level summarizes the pupil’s performance on a wide variety of test materials, selected for their contribution to the assessment of this general ability factor (Otis & Lennon, 1968). The OLMAT series was considered appropriate for measuring general mental ability according to Hierarchical Theory of Human Abilities, proposed by Vernon and Burt (1960). In this theory the Spearman’s ‘g’ factor is placed at the top of the hierarchy. One level below ‘g’ are the two broad group factors corresponding to “verbal – educational” and “practical- mechanical” abilities. Immediately below the major group factors are the minor group factors. Thus, the broad “verbal-
educational” group factor can be further subdivided into a verbal factor, numerical factor, reasoning factor, etc. The minor group factors can be further subdivided to yield the specific factors placed at the bottom of the hierarchy. The OLMAT series was constructed to assess mental ability within the “verbal – educational” domain (Otis & Lennon 1969).

The six levels of the OLMAT have been developed to ensure comprehensive efficient measurement, of the range of ability commonly found in grades K – 12.

- **Primary I level**: This level is recommended for use with pupils in the last half of kindergarten. The two parts of the test must be administered in two separate sittings.

- **Primary II level**: This level should be used with pupils in the first half of grade 1. There are two editions of this test- one for hand scoring, the other for MRC (Measurement Research Center) machine scoring.

- **Elementary I level**: This level is recommended for use with typical pupils in the last half of grade 1 through the end of grade 3. There are two editions of this test – one for hand scoring, the other for MRC.

- **Elementary II level**: This level is recommended for use with typical pupils from grade 7th to 9th: it consists of 80 items administered in one sitting.

- **Advanced level**: This level is used in this current research, it is recommended for use with typical pupils from grade 10th to grade 12th: This test consists of 80 items: which were selected from 360 items, 112 items are related to verbal
comprehension, 120 items are related to verbal reasoning, 56 items are related to figural reasoning and 72 items are related to quantitative reasoning. Final form consists of 80 items, of these 25 items are of verbal comprehension and represent 31%, 25 items are verbal reasoning and represent 31%, 15 items are figural reasoning and represent 19%, and 15 items are quantitative reasoning representing 19% of the total.

3.3.1. Test validity:

Many types of validity data has been collected for the OLMAT series, as content validity, criterion-related validity, predicted validity and concept validity.

**Content validity:** As stated earlier, the Otis-Lennon tests were designed to assess general mental ability (Otis & Lennon, 1969), according to Vernon-Burt theory of mental ability. Vernon’s Hierarchical Theory of Human Abilities and Guilford’s Structure of Intellect Model were both used in an attempt to define more precisely the general behavior domain which the tests attempt to assess. Examination of the types and proportions of items within each level of Otis-Lennon indicates specifically the scope of the abilities measured, and serves as a basis for determining the extent to which these abilities are appropriate, for a broad-gauge measure of general cognitive ability (Otis & Lennon, 1969). This indicates that the OLMAT has good content validity.
**Criterion–related validity:** Criterion–related validity refers to establishing the relationship between scores obtained on a given test, and those obtained on other specific external–criterion measures, generally associated with the attribute measured by the test. Correlation between OLMAT and California Achievement tests range from 0.60 to 0.80, correlation between OLMAT and Metropolitan Achievement Tests was 0.62 and range from 0.56 to 0.71, correlation between OLMAT and Stanford Achievement test ranges from 0.63 to 0.80. Correlation coefficient between OLMAT and Iowa Tests of Basic Skills ranges from 0.71 to 0.94.

**Predictive validity:** The Ohio survey test was administered 12 months after the Otis-Lennon test (Otis & Lennon, 1969). They obtained correlation in the range of .33 - .87 (Otis & Lennon, 1969).

**Construct validity:** OLMAT was constructed to measure the general mental ability, and, the correlation coefficients value with other intelligence test indicates that similar attributes are being measured by both tests. The correlation between three upper levels of OLMAT and Raven’s Standard Progressive Matrices is in the range .56 to .61 (Otis & Lennon, 1969).

The latter was developed in England and is considered to be a relatively pure measure of Spearman’s “g”. Also correlation coefficient between OLMAT and the Lorge – Thorndike Intelligence Tests was in the range of .59 - .89.
3.3.2. The test reliability:

Reliability refers to the consistency of scores obtained by the same persons when they are reexamined with the same test on different occasions, or with different test of equivalent items, or under other variable examining conditions (Anastasi & Urbina, 2003).

Extensive analysis was undertaken with the OLMAT in order to estimate their reliability under a variety of conditions. In addition to the standard split-half, alternate- forms and Kuder–Richardson formula reliability estimates for single age or grade groups, special techniques were employed to determine standard errors of measurement at various DIQ levels.

Reliability coefficients by alternate–forms were in the range of 0.83 to .94. Split–half reliability was derived by applying the Spearman–Brown Prophecy Formula to the half–test correlation. Split-half reliability coefficients for OLMAT were in the range of .90 to .96, Kuder –Richardson Reliability coefficients were in the range of .88 to .95, and in advanced level they were in the range of .94 to .95.

The test–retest method which is one of the oldest and one of the most sensible methods of estimating the reliability of test scores. This reliability analysis for advanced level over 12 months periods, produced a test–retest coefficient in the range of .80 to .94.
3.3.3. **Translation of the Test Items:**

The original OLMAT, Advanced level, form K 80 items was translated to Arabic language. Some items were changed and modified to suit the Yemeni students. During the translation of the test, the following factors have been taken in to account:

1. The modified item should maintain the mental function of the original item.

2. The modified item should maintain the difficulty level of the original item.

3. Remove the content of the items which are not familiar (conventional) to the culture of Yemeni students.

4. The modifications included the following: change in the numbers from English to Arabic language in some items including items number 2, 7, 9, 18, 39, 45, 50, 68, 75, 79, 80, also change in the letters from English to Arabic in items number 14, 28, 34, 67, and the items 10, 26, 61 were also changed to new items.

3.3.4. **Judges of the Test:**

Three staff members of the Department of Psychology in Sana’a and Hodeidah universities participated as juries for assessing the relevance and meaningfulness of the Arabic version of the test (Appendix. 2). Changes in some of
the items were made according to their suggestions. Also the test was given to two specialists in English to make sure their accuracy of the translation. Thus, English to Arabic and from Arabic to English translations were done with the help of the language and psychology experts.

3.3.5. Try – out of the Arabic Version OLMAT:

The OLMAT was administered on 35 students to make sure of the time, clarity of items, and clarity of instructions. The mean time which the students took to answer all the items of the test was 45 minutes.

For pilot study of psychometric properties of the test items, like difficulty and discrimination indices, the test was administered to 252 students; 150 males and 102 females, in which 106 were from the tenth grade, 78 were from the eleventh grade, and 68 were from the twelfth grade. The sheets were scored and the item difficulty and item discrimination were calculated for all items (Appendix 3). The items difficulty ranged from 0.15 to 0.91 with a mean of 0.40. The items discrimination ranged from 0.09 to 0.59 with a mean 0.47. The results of the item analysis showed that the items difficulty and items discrimination were suitable for the students.

3.3.6. The Administration and Scoring:

After preparing the Arabic version of OLMAT (Appendix 4) the researcher personally went to the schools to determine the time, the classes, and the procedures
for the administration and control of the test, with the principals and teachers of the schools.

The administration of the test started on 28th November 2004 and continued till 6th January 2005. The researcher administered the test to the students in groups of 25-50 in one session. The teacher of the respective class helped the researcher to conduct the test.

The test booklet and the answer sheets were distributed, and then the students were asked to fill in the identifying information regarding name, age, sex, and class. Then the researcher read the instructions to the students, and asked them to read the instructions silently. Their doubts and queries were clarified, and it was made certain that every one did understand what to do, and how to go about the directions.

Consequently, the students were asked to start answering and the starting time was recorded on the chalkboard and the students were asked to stop writing after 45 minutes.

When, the students were working, the researcher moved quietly around the room to make certain that the testing was done in the proper manner and no help was given in answering any test questions. After exactly 45 minutes, the students were asked to stop writing, and check again to make certain that their name and age had been filled in, then the researcher collected all the answer sheets and test booklets.
Scoring

The responses were scored by using the scoring key developed for this purpose by the authors of the scale, giving a one score to a correct response, and zero to wrong response. A student’s score is the sum of the correct responses. Because the test consisted of 80 items, the students scores ranged from 0 to 80.

3.4. SCHOOL ACHIEVEMENT SCORES

The results (school examination marks) of the tenth and eleventh grades students were obtained from the schools records affairs at the end of the school year (2004-2005) as an index of their school achievement. The uniform and standard results of twelfth grade students were collected from office of Examination Public Center in the Ministry of Education as an index of their school achievement at the end of the school year (2004-2005).

3.5. STATISTICAL ANALYSIS

The following statistical techniques were used for data analysis. Descriptive statistics, analysis of variance (ANOVA), t-test to compare means, Pearson correlation coefficient, Point-Biseral correlations coefficient, and Regression analysis.
3.6. OPERATIONAL DEFINITION OF SOME TERMS

**Intelligence:**

Intelligence in this study is the score of the student from Otis- Lennon Mental Ability Test Advanced Level Form K (OLMAT), which consists of abilities like reasoning, abstract thinking, verbal, and numerical.

**Secondary school students:**

They are all the male and female students from tenth grade to twelfth grade who enrolled in Sana’a city schools from Yemen.