CHAPTER 3

3.0 RESEARCH METHODOLOGY

This chapter is a description of the methods used in collecting data for a study that aimed at establishing whether significant differences exist in secondary schools’ Educational Management practices in the six Management Task areas. The methodology for the research dealt with research design, targets population, the sample size, sampling procedures, research instrument, instruments validity, instrument reliability, data collection and analysis techniques.

3.1 Research Design

Borg and Gall (1989:351) define research design as the procedures used by researchers to explore relationships between variables to form subject into groups, administer measures, apply treatment conditions and analyse the data. This study used the descriptive survey design; which according to Kerlinger, (1964:393) “... is that branch of social scientific investigations which studies large and small populations or universe by selecting and studying samples chosen from the population to discover the relative incidence, distribution and interrelations.” The implication of the foregoing observations is that it is not possible to reach the entire population hence the need for choosing a representative sample.

Peedy (1985:133) observes that a survey enables a researcher to draw conclusions from one transitory collection of data to extrapolate what is likely to happen again under similar circumstances. Mulusa (1983:96) further notes that the survey method like the scientific model is based on precise definition of the problem to be studied, use of standardised research methods, representative samples and other smaller groups with an aim of generalising on the population under study. Although survey research cannot establish casual relationships with any degree of certainty, it can be successfully used to explore, relationships between variables.
(Borg and Gall, 1983:411) observe that the method is used in scientific disciplines and in the field of education to evaluate, study relationships effects of treatment and comparison between groups, which are being studied. In supporting the above sentiments, Good (1963:244) observed that “Descriptive studies may include present facts; current conditions concerning the nature of persons, a number of objects or class of events and may involve procedures of induction, analysis, classification, enumeration and measurement.”

It is in light of the above observation that the present study will seek to establish head teachers’ current levels of administrative proficiency as well as determining their preferred levels of training. Good (1963:244) enumerates the advantages of using descriptive survey, which include: (I) securing the evidence of the existing situations or current conditions. (II) To identify the standards or norms with which to compare present conditions in order to plan the next step. (III) To determine how to take next step having determined where we are and where we want to go. In view of the above observations, this study will establish whether there are differences in Management practices between those head teachers who have attended the in-service training organised by Kenya Education Staff Institute (KESI) and those who have not.

The descriptive survey was confined among secondary schools in Kitui and Machakos districts. The major focus will be the status of educational practices in secondary schools and its implication for training of educational personnel for effective teaching and learning. The four categories were based on schools’ reputation in national examinations, quality of teaching and learning, involvement in co-curricular activities among other variables. Schools were rated on all management aspects and the qualitative aspects were transformed into numeric scores. From the numeric scores obtained from the management practices, schools fell within a five-point scale. The scale had the following ratings: Excellent (5points), Very Good (4points), Good (3points), Satisfactory (2points) and unsatisfactory (1point). The basis of categorisation was the obtained data from self-appraisal reports as well as results of such schools in previous national examinations.
According to Best and Kahn (1993:137) independent variable are the “conditions or characteristics, which the experimenter manipulates or controls in an attempt to ascertain their relationship to observed data”. In this study, the following were taken as the independent variables, i.e. (I) in-service training or lack of training of head teachers by Kenya Education Staff Institute (KESI), (ii) school category (provincial, district and private secondary schools. Educational Management practices were taken to be the independent variable. Dependent variables are the conditions or characteristics that appear, disappear or change as the experimenter introduces, removes or changes independent variables. In this regard, secondary schools’ management practices as reflected in institutional means scores on the six-management task areas were treated as dependent variable.

The management practices were taken as dependent on the stated independent variables. Whether these variables have any effect on the institutional score obtained from the self-appraisal questionnaire is the focus of chapter four. From the management practices, the characteristics of effective schools were singled out from those schools ranked as very good and according to other stated variables. This study therefore sought to unearth other related factors, apart from training, which may contribute to poor or high performance.

The above position is in line with the observation by Wordy in Peter (1994:52) who defines research as comprising of “defining and redefining problems, formulating hypothesis or suggested solutions, collecting, organising and evaluating data, making deductions, reaching conclusions, and at last carefully testing conclusions to determine whether they fit the formulated hypotheses”. The foregoing observation notes the activities that are involved in research work, which seeks to define and redefine problems in light of emerging trends in a given field.
3.2 The Target Population

Borg and Gall (1989) define the target population as all members of a real or hypothetical set of people, events or objects to which a researcher wishes to generalize the results of the study. The target population in this study therefore was 195 secondary schools in Kitui and Machakos districts, Eastern province of Kenya. However, the number of schools was reduced to 168 because some schools did not have candidate classes, a necessary requirement for inclusion in this study.

3.3 Sample and Sampling Technique:

Peter (1994:69) defines a sample as a representative part of a population. Thus by studying the sample, we can know about that population. However, Peter (1994:69) further notes that human population by its very nature is highly heterogeneous complex body of men, women and children of varied ages, psychological temperaments, religious preferences, educational levels and socio-economic standards.

Thus, no sample of a human population, regardless of its quantity or quality can help us to make a one hundred per cent accurate conclusion about that population in the same way, as a small sip of a glass of milk would do (Kerlinger, 1973:119). In this case, we operate on a ‘near—accurate’ basis that is, choosing a sample, which can give near-accurate results about the population.

This study used stratified sampling method. The method involved dividing of the target population into various strata according to variables that are pertinent to a given study (Peter, 1994:73). Representative samples of secondary schools were obtained depending on their performance in national examinations in the last three years. Other criterion used in this study were the school category (provincial, district and private schools), level of administrative experience (the least experienced to the most experienced) the student enrolment among other variables that formed the necessary strata used.
From 168 secondary schools in Kitui and Machakos districts, this study focused on 110 schools to establish the educational management practices and their implications for in-service and pre-service training of head teachers. In such groups, head teachers who had attended in-service training by KESI and those who had not. At least a minimum of thirty per cent of the different categories were contacted according to Aryl and Razaviah (1972) who postulate that a study can use ten percent or a third of the population to represent the universe of the subjects.

The essence of such stratification was to obtain representative sample from each stratum to determine whether there are differences in educational management in schools whose reputation in effectiveness in the quality of learning and performance in national examinations is different. After stratifying the population according to the stated variables, the required representative sample was obtained from each stratum. This was done by use of simple random method. All names of all secondary schools were written and such names were transferred to chits of papers divided into different strata in proportion to the size of the stratum. From each stratum, chits bearing the names of each school in the sample were put in a container and then thoroughly churned.

Schools were categorised according to pertinent variables for this study. The sample schools were obtained by picking one chit, writing down the name of the school, returning the same and the process was repeated until each stratum had a representative sample which was added up to constitute the representative sample for this study of 110 secondary school head teachers in Kitui and Machakos districts.

3.4 Research Instruments/ Tools

Research instruments are the means by which primary data is collected (Peter, 1994:77). The survey used Self-Appraisal Report, which contained questions for obtaining primary data from respondents. This study used both primary and secondary data. Secondary data included summaries of research findings from theses,
journals, textbooks on educational administration and management, human resource management and
development, educational reports and reports from management training institutes such as KESI (Kenya).

Self-Appraisal Reports obtained primary data in this study on secondary schools’ Educational
Management practices and their implications for in-service and pre-service training of head teachers. Secondary
school head teachers’ perceptions regarding their training and administrative challenges were obtained by use
of an open-ended and closed questionnaire, which will be referred to as Self-Appraisal report (Appendix A). The
questionnaire was divided into two sections; namely A and B.

Section A contained nine items on secondary school head teachers’ demographic information and
training background. The essence of such items was to explore in depth the kind of administrative training and
support services available to head teachers. Some of these questions were open-ended to allow head teachers to
express themselves on issues that related to their training and general administrative preparation.

An item with seven sub-items that sought information on head teachers’ on preferred training
modalities (approaches) was formulated. The same section had seven items that required head teachers to rank
approaches that they wished to use in acquisition of Administrative and Management knowledge, skills and
attitudes for effective secondary school administration. The rationale for such an item was based on research
findings, which indicate that adults learn best when they feel their in-put has been taken into account.
Moreover, adults are different in their focus of learning and it is imperative to consider not only issues that are
relevant to their day-to-day challenges but also the manner in which such issues are presented.

Section B explored the educational management practices that head teachers and teachers had
initiated in provision of effective teaching and learning. The Management task areas examined in this study are
Curricular Design and Planning, Curricular Transaction and Evaluation, Research, Development and Extension,
Infrastructure and Learning Resources, Student Support and Progression and School Organisation and
Management. The items were formulated following the National Assessment and Accreditation Council (NAAC) format for National Council for Teacher Education Institutions in India. The items were intended to help head teachers to appraise themselves in various educational practices as well as indicating their challenges and the kind of training they might require in such activities.

The questionnaire items were derived from reviewed literature on those areas, which scholars agree to be of prime importance in school management. In the self-appraisal, head teachers were requested to appraise their schools on the following performance of various management tasks.

**Curricular Design and Planning: (School based planning for Teaching).**

The management task area of Curricular Design and planning dealt with schools’ admission procedures in terms of their perceived suitability on a five-point scale. The scale was as shown:

a) Excellent......................... 5 points

b) Very Good....................... 4 points

c) Good.............................. 3 points

d) Satisfactory..................... 2 points

e) Unsatisfactory............... 1 point.

The section also dealt with the number of days devoted to teaching in a term of fourteen weeks, which was rated using the same five-point scale. The number of weeks devoted to actual teaching and learning were rated as follows:

(i) Over 12 weeks..............Excellent

(ii) 12 weeks...............Very Good

(iii) 11 weeks.................Good

(iv) 10 weeks..................Satisfactory
The study looked into aspects of the then existing secondary school syllabi in terms of optional subjects, their variety, and the reason for opting for various subject modalities. By use of “Yes or No” responses, the study established existence of institutional mission, feedback mechanism, institution community networking among other aspects.

The task area of Curricular Design and Planning is referred to as curriculum Design Implementation and Evaluation in research parlance. It had twenty items with sub-items, covering a number of activities, conducted to facilitate effective teaching and learning. Such items deal with instructional leadership, supervision of teachers and evaluation of the curriculum implementation. This section had twenty items whose total rating was five points per item.

**Curriculum Transaction and Evaluation (Curriculum Implementation and Evaluation)**

The reviewed literature refers to Curriculum Transaction as instructional supervision. The major focus of this criterion is on aspects touching on curriculum transaction, teachers’ staff development practices, professional development seminars, appraisal techniques, and various forms of unique educational experiences offered in schools and teaching innovations. The existence of various student-centred programmes for making learning easy was explored from the schools under survey.

Such components included learner-centred pedagogy, interactive teaching and learning, co-curricular activities, Information Communication Technology, value education, civic responsibilities, personality development, community orientation and effective study habits. The study examined possible teaching innovations that were associated with schools that are reputed for their outstanding results in national examinations.
Research, Development and Extension (School Community Relations)

This was the third criterion used in determining educational management practices in secondary schools is that of Research Development and Extension (School-Community Relations as per research parlance from reviewed literature).

The task area sought to establish the kind of action research activities that secondary school teachers might have been undertaking in a bid to improve teaching and learning as well as improving themselves professionally. The section also sought to explore the school community relationships in terms of working with Government departments on matters touching on education, working with NGOs, semi-autonomous Government Agencies such as Kenya Education Staff Institute, and Kenya Institute of Education among others. This section had ten items, on a five-point scale rated as:

(I) Very Adequate ..................5 points
(ii) Adequate .......................4 points
(iii) Fairly Adequate .................3 points
(iv) Satisfactory ....................2 points.
(v) Unsatisfactory .................1 point

This section had 10 yes or no questions whose highest rating was two points, hence the total being 20 points. Another one question was a five-point Likert scale type hence the total points in this section was 25, which had to be divided by 5 and multiplied by 100 to get percent. The maximum marks allocated for this section was five.
**Infrastructure and Learning resources (School plant and learning materials)**

This section examined the existence of projected expansion plans, maintenance, utilisation and upkeep of school compounds. This study examined ways of raising funds for anticipated growth due to increase of students. The section further examined ways used by schools in maintenance, utilisation, upkeep of the school compound, library and its facilities, computers and science laboratories. These facilities were examined in terms of their level of adequacy on a five-point scale. The five-point scale consisted of:

(i) Very adequate ....................5 points  
(ii) Adequate...........................4 points  
(iii) Fairly Adequate...................3 points  
(iv) Inadequate..........................2 points  
(v) Unavailable..........................1 point.

Infrastructure and learning resources had 39 items. The section dealt with learning resources with focus on availability, adequacy of library, computers, and interactive audio-visual teaching materials.

**Students' Support and Progression (Students' welfare services)**

This section had 53 items that explored the level of system efficiency by comparing schools in Kenya Certificate of Secondary Schools’ Education examinations results as well as the kind of Management practices that they engaged in. Other aspects examined included existence of alumni associations, student feedback mechanisms and the use of the feedback provided. The section also examined whether schools had devised any strategies of assisting needy students financially, whether schools obtained feedback from students and the use of such feedback (if available). The section had items that delved into whether such services as guidance and counselling, academic counselling and career guidance services existed.

The section further delved into academic counselling and unique programmes that enable students to gain socially useful skills. Other issues addressed included student discipline, motivation, provision of
health and recreational services. It also assessed their quality of adequacy of leisure facilities by asking respondents to indicate such adequacy by use of Yes-No items and thereafter indicating how adequate such facilities were, if they were available. The types of cultural activities were also examined.

**School organisation and Management.**

The management task area of School Organisation and Management examined whether schools had mechanisms of evaluating internal organisation and monitoring parameters. The section also had 16 items that sought to establish whether school had put in place any steps for improvement and organisation and management. The study examined whether schools had academic calendars, modes of staff recruitment, professional development of non-teaching staff and grievance redress mechanisms.

The section also had questions dealing with details of financial mobilisation and expenditure, internal audits, types of expenditure experienced in the preceding three years (2001-2003) and sensitisation of schools to modern managerial concepts. The nature of possible linkages (exchange programmes or visits) with other schools was also explored. The task area had fifteen items.

Inadequacy of funds meant the researcher to depend on volunteers who were in such schools for corroboration of information. The study also used a Self-Appraisal Report (questionnaire format-Appendix C), filled by training staff at Kenya Education Staff Institute in a bid to obtain the status of staffing in relation to the training function and the remedial measures for any present challenges.

**3.5 Instrument Validity**

Validity is the degree to which an instrument measures what it purports to measure (Borg and Gall, 1989:249). Vernon (1974:43) supports this observation by adding that instrument validity is the capacity of an instrument to measure what the researcher designed it to measure. Vernon (1974:10) identifies different types of validity such as face validity; content validity. This study established content validity; explained by Vernon
(1974:41) as “a non-statistical type of validity, which explains the extent to which a text covers the intended content area. Content validity is therefore the degree to which the sample of test items represents the content that the text is designed to measure.

The main research instrument (head teachers’ Self-appraisal questionnaire-Appendix B) was availed to external lecturers (referees) appointed by the Department of Education, University Of Pune to appraise its suitability in obtaining data. This was done during the departmental preliminary defence before the researcher proceeded for data collection. This was crucial for fulfilling the stated research objectives and questions. The researcher also held discussions with head teachers who have exhibited depth of knowledge and understanding of Educational Administration and Management to determine whether the questionnaire items covered the crucial aspects in school administration. Recommendations for change were discussed with Research supervisor (guide) and incorporated in the final draft questionnaire.

3.6 Instrument Reliability

Mulusa (1988:113-114) states that an instrument is “reliable” when it can produce the expected results. Instrument reliability is the level of internal consistency or stability of a measuring device. According to Vernon (1974:37), the reliability of a behaviour measure is an index of the degree to which an instrument consistently measures the same attribute and it is related to the precision of a measuring instrument. The study established face and content validity (meant to ensure that all the major issues raised in the study objectives are addressed in the research instruments) by discussing with the research guide and other members of the department.

To establish the instruments’ reliability, a pilot study was conducted. Five head teachers were asked to indicate questions that they found difficult to understand, repetitive or ambiguous. A number of items were changed as a result of recommendations by respondents. Two items that sought to determine whether schools
had any linkages with Kenya Education Staff Institute (KESI) and Kenya Institute of Education (KIE) were shifted to Research Development and extension originally they had been placed under Curriculum Transaction and Evaluation, which is not their right topical location. In an item that was meant to rate different aspects of the school, the rating system was changed from a four-point scale to a five-point scale as shown:

a) Excellent....................................5
b) Very Good.................................4
c) Good.........................................3
d) Satisfactory.................................2
e) Unsatisfactory...............................1

The five respondents used for the pilot study were not included data analysis.

3.7 Data Collection Procedures

Researches of all types essentially deal with generating, collecting, collating and analysing data and drawing inferences from them (Peter, 1994:63). This study used both primary and secondary data. Primary data refers to information obtained from the field from head teachers’ self-appraisal questionnaire responses. After the approval of the research proposal by Research and Recognition Committee of University of Pune, the researcher applied for a research permit from the Ministry of Education, Science and Technology in Kenya. The researcher reported to District commissioners and District Education Officers in Kitui and Machakos in line with research permit requirements.

Since it would have been very expensive to call each school involved to seek for an appointment, the researcher visited individual schools and sought audience if it was practically possible. If it was not possible by the time of the visit, an alternative date was arranged.
In other cases, the self-appraisal reports were left in schools for filling and they were picked at an appointed time with the school authorities. In some of the schools, the respondents filled the self-appraisal questionnaire in presence of the researcher, which provided an opportunity to probe for clarifications regarding various management areas.

To ensure that information obtained was authentic, some official documents were obtained from district education offices. Such documents included Kenya Certificate of Secondary School Education Examination results for the years 2001-2003. Using Teachers’ Service Commission Staff Returns (Appendix F), the responses provided by respondents were corroborated regarding staff establishment, student enrolment and identify areas of understaffing. Appendix F was designed with a view to providing information on school particulars like location, school category, school type, name of the sponsor, and data summary.

The summary captures such aspects as enrolment, number of streams, number of classes, number of teachers on duty, on study leave, understaffed and overstuffed subjects and a list of the current teachers. This kind of information made it possible to corroborate much of the information provided in the self-appraisal reports. Moreover, by use of district annual reports, further verification was done. The annual reports of each district were further used to shed light on head teachers and schools’ major challenges in the preceding three years.

In some of schools, the researcher had time to interact with students, teachers and school administration as an invited guest speaker hence providing an opportunity to observe many aspects of school life in its natural setting. In case of any delay in questionnaire completion, telephone calls were made to persuade head teachers to complete the questionnaires. In three of the cases where it proved difficult to obtain the dispatched self-appraisal reports, such schools were replaced with others from their strata.
3.8 Data Analysis Techniques

In examining the use of qualitative data in a study, Management College of South Africa (2002: 13) postulated that that three elements need to be taken into account in analysis of qualitative data: (i) reduce the data by condensing the material in some systematic way to make it more manageable. (ii) Structuring the data in terms of themes, patterns and interrelationships; and (iii) De-textualising the data by converting extended texts into more manageable forms such as summaries, charts, diagrams and illustrations.

The qualitative data in this study was analysed thematically through discussion, comparing of possible relationships or significant differences between various variables as well as substantiating the possible causes of some research findings. The researcher modified and used the Self-Appraisal Report used by National Assessment and Accreditation Council of India for the current study, in order to suit the Kenyan secondary schools’ setting. In cases where differences existed, items from the Kenyan context were added since the focus was on Kenya. The judgement of institutional scores was based on six management tasks whose details are shown on table 3.8.1 below:

**Table 3.8.1: Summary of Criteria Weight-age on Numeric Items**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Total number of numeric items</th>
<th>Total Raw scores:</th>
<th>Total points per criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Curricular Design and Planning</td>
<td>34</td>
<td>72</td>
<td>10</td>
</tr>
<tr>
<td>(2) Curriculum Transaction and Evaluation</td>
<td>23</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>(3) Research, Development and Extension</td>
<td>16</td>
<td>32</td>
<td>05</td>
</tr>
<tr>
<td>(4) Infrastructure and Learning Resources</td>
<td>37</td>
<td>140</td>
<td>20</td>
</tr>
<tr>
<td>(5) Student Support and Progression</td>
<td>53</td>
<td>124</td>
<td>10</td>
</tr>
<tr>
<td>(6) School organisation and Management</td>
<td>16</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>179</strong></td>
<td><strong>483</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
1. Section one; dealing with Curriculum Design has a total of 10 points. The maximum raw score that a school could score was 72 points obtained by multiplying the number of items by the weight-age of each item. The maximum points a school could score in any criterion had to be converted to percent.

2. Curriculum Transaction and Evaluation had 23, some being yes or no, while others were on a five-point scale. The maximum points that an institution could score was 80 points. The points obtained were then converted into percentage and the open-ended items were discussed in prose since they could not be captured numerically.

3. Research, Development and extension had a total of 5 points. The section had 16 items on a two-point, hence 32 points. The marks allocated for the section was five. Any other questions that were not captured numerically could be explained in prose form.

4. Infrastructure and Learning Resources had 37 items, some being yes/no and others on five-point scale. The total points for the criterion were 140, which had to be converted into percentage.

5. Student support and Progression had 53 items, some being yes/no and others on five-point scale. The total points for the criterion were 124, which had to be converted into percentage.

6. School organisation and Management had 16 items whose total raw score was 35, which had to be converted into percentage for purpose of comparison between different study variables.

In summary, the overall institutional score was obtained by use of the formula shown below:
Institutional score = \[ \frac{\sum W_i C_i}{\sum W_i} \]

Where \( i = \text{criterion 1, 2... 6} \)

\( W_i = \text{Weight-age of the } i^{th} \text{ criterion} \)

\( C_i = \text{Score of } i^{th} \text{ criterion.} \)

By adding the weight-ages of the six criteria, the institutional score was obtained. The institutional score was used to determine the ratings of schools and their overall grade. In cases where schools obtained more than 55 percent, they were rated as having satisfactory practices. By use of the Statistical Package for Social Sciences version 11.5, frequency tables, percentages, group means and case summaries were obtained.

The schools were graded on a five-point scale with the following values:

A++ .......................... 95-100 ............................. (Excellent)
A+ ............................ 90-94 .............................. (Excellent)
A .............................. 85-89 ............................... (Very Good)
B++ ........................... 80-84 ............................... (Very Good)
B+ .............................. 75-79 ............................... (Good)
B ............................... 70-74 ............................... (Good)
C++ ........................... 65-69 ............................... (Satisfactory)
C+ .............................. 60-64 ............................... (Satisfactory)
C ............................... 55-59 .............................. (Fairly Poor)
No Grading ........................ > 55 ............................. (Very Poor)

By use of frequencies and percentages, institutional scores were obtained on various Management practices at different schools. By use of Yes or No items, the study established existence of some practices like academic counselling. Through open-ended questions, it was possible to get a list of the actual topics covered in such programmes. The standard deviations were used in this study to show the extent to which scores in a distribution on average deviated from their means. By use of t-test, the study established whether secondary school head teachers’ educational management practices were affected by being trained by Kenya Education
Staff Institute (KESI) or not. By use of the group means, it was possible to establish whether any differences within or between means are due to chance or whether they represent differences within samples.

To determine whether any differences existed between schools under head teachers exposed to management training by Kenya Education Staff Institute (KESI) and those who lacked such exposure, t-test was used. The 0.05 level of significance was used. The level of significance used for rejection of hypothesis and adoption of the alternative was .05. Although there were no clearly stated hypotheses, it is assumed that those schools under head teachers exposed to management training by Kenya education Staff Institute (KESI) would ideally be better managed than schools under head teachers lacking exposure to management training. Data from open-ended questions will be analysed by use of descriptive method and critical analysis and synthesis of such data. The preferred administrative training approaches, administrative challenges and other forms of qualitative data will be discussed thematically and a comparison made with research findings. To determine the nature of administrative training programmes and support services available to secondary school head teachers, information obtained from secondary school head teachers’ self-appraisal questionnaire was examined. Percentages were computed on the task areas, which were highly rated as posing challenges or not adequately covered. Thematic discussion was used to delve into each of the study objectives. By use of simple descriptive statistics like mode, preferred modes of training for management tasks were established. Likewise, percentages were used to indicate the head teachers’ responses on their required training in different Management task areas. The study established the most challenging areas of operation for head teachers and its implication for in-service and pre-service training. The genesis of head teachers’ administrative challenges were discussed and diagnosed along thematic lines. From such information, research questions were answered by examining all the available data and other research findings, which is the focus of chapter 4.