ANALYSIS OF TESTS MADE AND USED BY PHYSICS TEACHERS IN
THE ASSESSMENT OF PHYSICS IN SECONDARY SCHOOLS OF
KAKAMEGA DISTRICT, KENYA

BY

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THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF EDUCATION OF
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1999
DECLARATION

This work is my original work and has not been presented for a degree in any other university.

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DEDICATION

This work is dedicated to Josephine Wanga Masasa, my most loving niece.
ABSTRACT

The study focused on the assessment practices of physics teachers at the secondary school level in Kakamega district. It examined the nature of tests made and used by physics teachers in the assessment of their students. The study limited its scope to describing the present situation as regards these tests.

The choice of the topic was influenced by the increased emphasis on continuous assessment tests (CATS) at the school level, despite the emphasis and the much time spent on assessment performance in physics has remained low. Secondly, recent worldwide trends indicated a shift from terminal examinations to the use of teacher based assessment results in the evaluation of students. There was need, therefore, to study the assessment situation in Kenyan schools so as to describe this situation in view of the tests made and used by the teachers in the assessment of their students.

In carrying out this study, a questionnaire was used to collect data from the teachers about their assessment practices and a checklist for the analysis of the tests. The questionnaire was administered to form three physics teachers in sampled schools and test papers previously used to assess students in physics were collected from sampled teachers for analysis. The percentages of the various responses to various questionnaire items were calculated and presented in appropriate tables. From the test papers the percentage of question items assessing various domains of science learning were also calculated and tabled.
The study investigated five aspects of assessment; teachers' reasons for assessment, methods of assessment, domains of science learning that are assessed, methods used to assess each of the domains and response to the trends in assessment. Each aspect was discussed separately and conclusions made from the emerging findings.

The findings showed that the teachers engaged in assessment for various reasons. Evaluation was done for formative and summative reasons. Diagnostic evaluation of students before the instructions process was, however, very low. It was also found that most teachers are aware of and are using a variety of methods in the assessment of their students. However, project work, which is key to assessment of creativity and process skills domains of science, was rarely used by the teachers. As a result the creative domain was also rarely assessed. It was also found that assessment in the affective domain was low. On trends in assessment, it was observed that teachers realized the importance of process skills in science. Assessment in this domain was more dominant and criterion referenced assessment dominated over norm-referenced assessment.

The implications of these findings towards improved performance in physics and the use of teachers' assessment results in national evaluation were discussed and recommendations made. The key recommendation was the need to have a national policy to govern assessment in schools so as to make the practices similar. This would make it possible for the national examination body to reliably draw conclusions about the use of teachers' assessment records in the evaluation and grading of students.
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1.0 BACKGROUND INFORMATION

The role and methods of assessment in science have been changing over time the world over. These changes have been necessitated by changes in the kind of science that is taught, and the role that the assessment is to serve. Initially, there was the traditional science, which emphasized the products or content of science, the scientific method and the cumulative nature of scientific knowledge (Lee, 1967: 43; Jevons, 1969:20). The role of assessment then, was therefore, to determine the terminal abilities of the learner at the end of a course. This kind of assessment was conducted at the end of the learning period. It was assumed to measure the learners’ performance on a particular task. Assessment was, therefore, seen as a measure of learning and not part of the learning process.

New developments in the cognitive process of science, especially the works of Piaget (1959) Bloom (1956) Brunner (1957), Gagne (1974) and others, spearheaded the guide for change from traditional science. They called for active participation of the learner in the acquisition of knowledge. This led to process-based science learning (Wellington, 1989:9). These developments also necessitated a shift in the assessment practices. It changed from the assessment of the product of learning to a process-based assessment in which what the learner had learnt was assessed together with how it was learnt.

This shift to process-science led to a greater emphasis on practical work, which is one of the media through which process science can be implemented (Woolnough and Alsopp,
An equivalent increase in assessment of practical work then made terminal assessments less important particularly in developed countries. As a result, there was an increased participation of teachers in the assessment of their students on practical work. Assessment thus became an important part of the learning process in science. In this context, assessment is seen as a feedback process, which is intended to motivate the learner (Sumner, 1991:29). This is likely to lead to an improvement in the learner’s performance.

These changes marked a starting point of the focus on the role teachers play in assessment. Hartog and Rhodes’ (1985:85) findings indicate that:

“Since late 1970s and early 1980s there has been a steady trend away from formal examinations to the school or teacher-based assessment of students’ practical skills and abilities”

These findings also point to the same trend towards teacher-based assessment in schools. The shift that assessment has undergone with developments in science has been associated with a variety of advantages in teacher-based assessment. One important feature, which places teacher made tests at the advantage position, is the frequency with which they occur notwithstanding the fact that they are spread over the learner’s whole learning period. In general the following can be listed as the advantages of teacher made tests over external-terminal examinations.
i) Process assessment

Teacher-made tests have the ability to assess both the process and product in practical work. Studies have shown that there is low correlation between the results obtained from laboratory exercises on a laboratory task and the results based upon direct observation of students' practical performance on the same exercises (Buckley, 1970; Kempa, 1979:38). This points towards the need for any assessment to have an assessment programme of both the product and process through which the learner undergoes to reach the product. This is a limitation of external examinations, which assess the processes through the finished product (KNEC 1990:88).

ii) Varied domains of science

Teacher-made tests can assess the learner's ability in all the domains of science learning. Yager and McCormack (1989:46) numerates five domains of science teaching as:

- Information domain
- Process science domain
- Creativity domain
- Attitudinal domain
- Applications and connections domain

The external assessment programmes in use have very much dwelt on the assessment of the cognitive domain as noted by Kempa (1986:53); and McComick (1988:39)

"External assessment procedures currently in use aim at measuring students achievements or performance in the cognitive domain...." (Kempa 1986)

"...with only little (or not at all any) assessment of other domains of science teaching" (McComick 1988:39)
Teacher-made tests have the ability to assess all these science domains through the use of projects and observation of students' work. The processes of science, creativity in science, feelings and values of science and the ability to use and apply scientific knowledge can best be assessed by the teachers.

iii) High content validity

Content validity is relatively high in teacher made tests than in the external examinations. The Kenya National Examinations Council (KNEC) examinations, for example, are limited in variety and the whole examination lasts only a few hours and occur in only two papers (KNEC, 1990:109). This limitation can be removed in teacher-made tests, which may be conducted on the basis of the topics covered.

In Kenya, the move towards teacher-based assessment has been intensified by the introduction of the 8-4-4 System of education. The objectives of the 8-4-4 physics course at secondary school level show a shift from traditional science to the modern process based science with an emphasis on how scientific knowledge is acquired (K.I.E.’ 1992:14). It recommends teachers' involvement in the assessment of students in practical work and in the development of practical skills. Since the inception of the 8-4-4 system of education, there has been an increased involvement of teachers in assessment. This has led to the use of continuous assessment tests (CATs) as part of the feedback process in the learning programmes and as a means of motivating the learning process. A general survey shows that many schools are emphasizing CATs at various intervals some going as close as having weekly tests.
It is also expected that in an examination oriented system of education such as Kenya's, increased use of CATs provides the learners with an opportunity to get used to examination situations. Thus continued use of these tests should lead to improved performance in physics as it provides the learners with the required examination skills and psychological orientation. Assessments have made teachers to spend a proportionate amount of teaching time on assessment but performance has unfortunately remained low in physics. This is indicated from the National Physics results at the national and provincial levels as shown in table 1.1 below.

Table, 1.1  Physics performance in Western Province: Kenya

<table>
<thead>
<tr>
<th>Year</th>
<th>National mean score (out of 12)</th>
<th>Western Province mean scores (out of 12)</th>
<th>Kakamega</th>
<th>Vihiga</th>
<th>Bungoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>3.405</td>
<td>3.001</td>
<td>3.001</td>
<td>3.005</td>
<td>2.995</td>
</tr>
<tr>
<td>1991</td>
<td>2.805</td>
<td>2.503</td>
<td>2.555</td>
<td>2.417</td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>2.031</td>
<td>2.030</td>
<td>2.000</td>
<td>2.101</td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td>2.415</td>
<td>2.042</td>
<td>2.150</td>
<td>2.300</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>2.112</td>
<td>2.045</td>
<td>2.040</td>
<td>2.031</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>2.100</td>
<td>2.201</td>
<td>2.100</td>
<td>2.199</td>
<td></td>
</tr>
</tbody>
</table>

Source: Provincial Education Office (Western Province)

1.1  STATEMENT OF THE PROBLEM

It has been observed that there has been an increased emphasis on continuous assessment tests in physics at the secondary school level in Kenya since the inception of the 8-4-4 system
of education. As a result, assessment of students takes a great proportion of teaching time and there is an increased involvement of teachers in the assessment of their students.

Although these continuous assessment tests are supposed to improve performance, there has been no steady improvement in performance in physics despite the emphasis on internal assessment. This could be due to a number of factors related to the mode and nature of these tests, which in the end affect methods of instruction.

Literature shows that no study has been carried out in Kenya to investigate school assessment in Physics, particularly:

- the quality of the test
- reasons for testing
- methods of assessment and
- frequency of assessment

It is necessary, therefore, to analyse the tests made and used by physics teachers with the purpose of establishing the above aspects.

1.2 OBJECTIVES OF THE STUDY

The objective of this study was to analyse assessment practices in secondary schools with a view of establishing the following aspects of assessment:

- role of assessment
- quality of the assessment
- frequency of assessment and
the policies that govern assessment in schools.

The study aimed at describing the assessment situation in secondary schools.

1.3 RESEARCH QUESTIONS

The study was guided by the following research questions:

1. Why do teachers assess their students in science?
2. What aspects of physics learning are assessed by the teachers?
3. What methods of assessment do teachers use in the assessment of physics?
4. How frequently do teachers assess their students on various aspects of physics?
5. What policies govern assessment programmes in schools?

1.4 SIGNIFICANCE OF THE STUDY

The significance of this study was centred on three main groups; the teachers, the teacher trainers, and the curriculum developers.

1. To the physics teachers

The findings of the study aim at guiding teachers’ to evaluate the quality of their assessment procedures and how to improve on it so as to enhance performance in physics.

2. To the physics teacher trainers

The findings will guide the teacher trainers on the direction to take on training in assessment. It may also indicate whether or not there is need for in-service training of the teachers on assessment techniques in view of the changes in physics curriculum.
3. **To the curriculum developer**

It seems there is no national policy on school-based assessment in Kenya. Schools, therefore, establish their own policies that govern their assessment procedures. The findings of this study may guide the curriculum developers and policy makers on the need for having a national policy on assessment in schools.

1.5 **ASSUMPTION OF THE STUDY**

This study was based on two assumptions:

1. all schools offer either physics or physical science (Physics), or both, as teaching subjects and

2. all teachers engage in the internal assessment of their students in physics or physical science (physics).

1.6 **SCOPE OF THE STUDY**

The study focused on the tests made and used by physics teachers in the assessment of physics. It did not consider any other examinations done in the school, which are set externally, such as joint-schools examinations, mock examinations or national examinations set by the Kenya National Examinations Council (KNEC).

The survey covered selected public schools in Kakamega district. Private schools were not covered by the study partly because of the difficulty of classification as some offer varied curricula from that in public schools.
1.7 OPERATIONAL DEFINITIONS

Assessment: A process of gathering and providing information to the learner about his or her performance on a learning task.

Criterion referenced assessment:
A system of assessment in which a student's achievement is shown as a proportion of what he/she has learnt (or could have learnt) in a given task.

Norm referenced assessment:
A system of assessment, which compares a student's performance with others in the same group by stating the proportion of those who performed better or worse than him/her.

Process-Science:
An approach in the study of science, which lays emphasis on how scientific knowledge, is got rather than the knowledge itself.

Teacher-made Tests:
Tasks aimed at measuring the performance of the learner, which are made and used by the learners' teacher.
CHAPTER TWO: LITERATURE REVIEW

2.0 INTRODUCTION

The chapter reviews various aspects of school-based assessment with the purpose of highlighting the findings of some research done in this area of teacher-based assessment. It also considers the current trends in assessment and the areas that relate to assessment, which are the main focus of this study.

2.1 PURPOSE OF ASSESSMENT

Engel-Clough et al (1984:71) and Kempa (1986:1) have stated the following as the reasons why teachers engage in the assessment of their students.

i) to assess students’ attainment at the end of a course or study programme

ii) to evaluate diagnostically students’ academic progress and/or learning difficulties

iii) to estimate students’ aptitudes, possibly for the purpose of assigning them to different courses or teaching sets.

iv) to evaluate the effectiveness of an educational programme or curriculum.

In general, assessment is done either before, during or after an instructional process. Depending on when it is done, the purposes of assessment can summarily be stated as:

- to determine the learners readiness for instruction
- to check the progress of the learner on an educational programme and
- to measure the achievement of the learner at the end of a programme
2.2 DOMAINS OF SCIENCE LEARNING

In the context of physics education, assessment seeks to measure the particular qualities that a curriculum or course seeks to foster in the students. These qualities are usually expressed in form of objectives. The objectives of science in general and physics in particular can be divided into five broad domains (Bloom, 1956; Krathwohl, 1964; Yager and McComack, 1989):

1. Cognitive skills domain

The relative importance attributed to the cognitive domain in science education is readily seen from the relative weighting accorded to it in the national examinations. The weighting given to practical work is 20% while the rest goes to the cognitive aspects of science (KNEC), 1992:29). The assumption made here is that the teachers are constantly assessing students' development in practical skills. One may then ask, “Why are the teachers’ reports about this development not put into consideration?”

The cognitive abilities that science education seeks to develop in the students are fairly diverse in nature, and range from acquisition and memorisation of factual knowledge to sophisticated problem solving and evaluation skills. This domain as proposed by Bloom (1956:129) contains six different levels, but for science examinations, three of these can be combined giving a four level classification of the following type:

Level 1: Knowledge and recall of scientific facts, hypotheses, theories and concepts as well as terminology and convention.
### Level 2: Comprehension (understanding) of scientific knowledge and relationships

which manifests itself in the student’s ability to explain and interpret information presented and to express it in alternative communication modes.

### Level 3: Application of scientific knowledge and understanding to everyday situations.

The ability to apply knowledge implies that the student is able to select from his knowledge reservoir those items of knowledge and relationships that are relevant in everyday life.

### Level 4: Analysis, synthesis and evaluation of scientific information, which involves the breaking down of information into its constituent parts (analysis) and reorganizing it so that a new structure emerges (synthesis). Additionally, the information may have to be evaluated in terms of its validity and underlying assumptions and consequences.

Too often, tests are prepared assuming the importance of having items at all of the above levels. However, unvariably there is an imbalance in favour of the facts level (Yager, 1989:46). This could be because teachers and students find such items easier to create and answer. They may indeed be easier because of the enormous amount of time-spent teaching for the acquisition of factual knowledge. At the same time students expect teachers to examine them on the information presented to them.

2. **Processes of science domain**

All science teaching has an empirical basis and this involves practical pursuits and activities. In physics education, practical work tends to be laboratory based and experimental in nature. In some cases the activities that students engage in tend to be field based. In both cases,
observation and deductions are necessary and are used for the purpose of problem solving (Wellington, 1989:101).

Processes of science are those individual steps that the student goes through when solving a scientific problem. In schools, these processes are utilized by students in experimental work. In general, the following broad stages are associated with experimental work in physics (Iraki, 1994:24).

i) Preparation for experimentation
This involves the recognition and formulation of the problem or the experiment. Here the learner needs to:

- put forward a hypothesis regarding the problem
- identify variables to be studied and those to be controlled
- choose the experimental conditions and apparatus
- decide on the measurements to be taken
- plan for the general situation of operations.

ii) Performing the experiment
This involves two operations namely; manipulation and observation which in turn involves:

- methodical working
- correctness and safety experimental technique
- manual dexterity in the execution of the practical work
- orderliness and organization
- accuracy and precision of the instrument
• reliability of observations

• recording data and observations.

iii) **Interpretation of data**

This involves the reduction of data into tables and graphs, and using this data to draw conclusions regarding the experiment. It also involves the students’ ability to evaluate limitations and possible sources of errors associated with the experiment. This enables the student to account for failures of the experiment and for the improvement of instruments and procedure.

iv) **Communication of results**

The need to develop students’ ability to communicate scientific ideas in a clear and logical form and to write on matters of scientific interest has been indicated by the observations made on the role of Kenya National school science and technology congress (Agufana, 1995:24). However, little attempt has been made in the development of a suitable criterion to assess such skills.

L’Odiaga (1977) has suggested useful criteria to be considered in the assessment of communication skills:

i) the correctness of the scientific information presented by the student

ii) the relevance of this information to the issue or problem under consideration

iii) the logicality of the argument presented

iv) the organization or sequence of ideas

v) the clarity of expression in the student’s communication
Scientific communication can be in form of students' written reports presented to the teacher or in class, it could also be presented in seminars or in science congress.

3. The creative domain

In any definition of creativity the element of 'newness' or novelty is stressed as a criterion of a creative product, Brunner (1957), Flanagan (1957), and Ghiselin (1962) maintain that creativity consists of bringing something new into being and that creativity measures should emphasize newness and lack of previous existence of an idea or a product. Whichever the case, three aspects of creativity can be considered; creativity exists when a new idea is used in a new situation, or a new idea is used in an old situation or when an old idea is used in a new situation.

How can creativity development be measured? Okere (1986:22) points out five measures of creativity in physics education namely:

- sensitivity to problems
- recognition of relationships
- flexibility in reasoning
- planning for investigation and
- originality and fluency

He further points out that performance on creativity in physics basing on the above measures is quite low yet creativity development is central to science. This gives the impression that educational experiences in many institutions are not enhancing the development of creativity. In secondary school science, creativity can be measured more readily if students were
engaged in project work, which would stimulate the above measures. Assessment of projects then becomes central to determination of creativity. It is doubtful whether teachers use this useful approach for assessment in their school.

4. Affective and social domains

The affective domain of science learning relates to the development of students’ interests in and attitudes towards science and the study of science. The social domain involves the development of social skills in the learner. These enable the student to work with other scientists and appreciate the beliefs of others. The secondary school goals of physics are all stated in such a way that they demand the development for affective and social aspects in the learner (KIE 1992).

In these times of increasing complex social and political institutions and the changing role and impact of science and technology to there has been emphasis on the development of these affective and social characteristics in students (Clarke, 1985:43). But despite the emphasis, research shows that the assessment in these domains has been rare (Engel-clough et al, 1984:71; Yager and McCormack, 1989:49) due to:

i) the technical and methodological difficulties and

ii) ethical issues that arise in connection with the assessment of certain affective characteristics.

However, assessment is still carried out using interviews, written tests and direct observation. Attitudinal scales such as the likert scale, sematic differential and situational cases are used. This study determines the extend of awareness and use of these methods by the teachers.
Local research in motivational orientation in science, which relates to affective domain show a low performance in orientation in general and is gender specific (Twoli 1986; Magiri, 1996). On the overall girls tend to have a lower level of liking for Science and Physics in particular.

2.3 METHODS OF ASSESSMENT

Many methods of assessment have been in use (Frith and Macintosh, 1984:47) but only a few are appropriate to science and physics. The following methods of assessment are common to assessment in science as suggested by Kempa (1986:20).

- Written tests
- Practical assessment
- Oral assessment
- Projects and field work

2.3.1 Written assessment

This method includes objective items to which there is only one predetermined answer, structured questions and essay questions. These types of questions are suitable for testing a wide range of knowledge and comprehension tasks. High level abilities such as reasoning and problem solving can also be assessed adequately by this method.

2.3.2 Practical assessment

In physics, practical work tends to be laboratory-based and experimental in nature. This method is used in the assessment of practical skills. To assess practical skills, some form of a
scale is necessary in order to record information about this kind of assessment. Macintosh and Hale (1976) cite Duffey, who, in an unpublished paper, suggests that practical skills in science can be assessed globally in relation to the following five-point scale:

i) Ability to plan practical work and techniques for solving particular problems.

ii) Manipulative skills

iii) Skills in observation and recording of observations

iv) Ability to interpret the results of practical work

v) Ability to communicate or report findings

In each of the above, the assessor has specific qualities to assess or measure as the student progresses through the practical session. The following are the qualities that one needs to look for at each stage or level. During planning the student should demonstrate knowledge of apparatus, procedures, ways of using apparatus, and ability to identify variables. At the level of manipulation, the skills required are; ability to use apparatus, ability to implement procedures, ability to select appropriate procedures for a particular problem and ability to control variables.

During observation, the student should demonstrate the ability to observe the material under investigation and ability to record appropriately the observed changes (Whittaker, 1974:83) When interpreting results, the student should be able to work out or reconstruct measured data, draw graphs of interrelationships between variables and draw meanings out of the reduced data.
Finally the student should be able to account for choices made, observations made and conclusions drawn. He/she must be able to offer suggestions for continuity of inquiry, improvements to the experiment and give a comprehensive report (written or oral) of the experiment.

2.3.3 Project work

Project work as an assessment technique is a very powerful tool since it has the ability to assess unique domains on which other methods fail. It can be used to assess the student's attainment in the creative domain, process science domain and attitudes of science domain. (Yager and McCormik 1989:43).

Despite its strength, assessment by project work has various limitations (Deere, 1974:102). It is difficult to measure the contribution of the individual student where a project is carried out by various students or when the teacher provides some guidance to the student. In addition, the assessment of 'how' the final product was produced posses a challenge to the teacher since there are a number of students who may work together and some students may as well work on their projects outside the school time.

It is, therefore, important that as the teacher engages in assessment using project work as the method, he/she must be clear of the criterion of assessment in each domain.

2.4 MODERN TRENDS IN ASSESSMENT

Trends in assessment over the past several years have been clear and apparently inexorable. Sutton (1991:18) observes that norm-referenced assessment has given way to criterion-
referenced assessment in all but a few areas of internal and external assessment. The range and specificity of the criterion has increased to include assessment of the process of knowledge acquisition rather than the knowledge itself (Sumner 1991:96). Assessment has become more diagnostic and informative in purpose to have a greater impact on the teachers’ planning of children’s’ learning. As a result, and especially in developed countries, teacher-based assessment is taking over from the external examinations which are more often terminal (Macintosh, 1974:102) Engel-Clough, et al, 1984:60). Trends in assessment are therefore threefold:

i)    criterion referenced assessment

ii)   process assessment

iii)  Teacher-based assessment

2.4.1 Criterion referenced assessment

The Kenya National Examinations have tended to be norm-referenced. This means that the student’s performance is based on the distribution of performance within the examination population and on the performance of the candidates relative to one another, rather than in the evaluation of a candidate’s absolute attainments and abilities. This is a shortcoming of the national examinations since the grades awarded to candidates only show the relative abilities of the candidates.

There is need, therefore, to develop and adopt criterion-referenced assessment procedures, which measure the student’s performance against his/her abilities. This requires a change in the assessment programme so that the process rather than the product is assessed. One way is to consider making use of teacher assessment scores.
2.4.2 Teacher-based assessment

In one of the very useful reports on assessment, Macintosh, (1974:223) states:

"The teacher as an assessor is nothing new; all teachers are assessors and spend a large part of their time evaluating their pupils, themselves and the courses of study. What is new is the opportunity to participate directly in the assessment of examinations which are nationally recognized”

This statement points towards the new trend of using teachers in national assessment. This is a situation, which has not been attained in Kenya yet. The national examinations have remained external with little of the teachers' involvement. This is coupled with the monopoly of examining since there is only one national examination body, the Kenya National Examination Council (KNEC).

There is a need to adopt the trend of involving teachers in national examinations. The issue limiting this is the status of the assessment reports from the teachers.

2.4.3 Process assessment

A number of studies carried out in recent years have shown low correlation between the results on performance of students on laboratory exercises and that based upon the direct observation of students' performance on the same exercises (Kempa, 1979:29; Ward, 1981:84). This has led to a shift from the traditional 'outcome' based assessment to the process assessment. This is characterized by high involvement of teachers in the assessment of the processes that students go through particularly in practical work. This has since then become a new trend in the assessment of science.
2.5 CONCLUSION

This literature review indicates that the reasons for assessment, the domains of science learning, which can be assessed, and the methods of assessment are numerous. There are chances, therefore, that teachers may be inclined towards certain aspects of assessment at the expense of others. But since the quality of an assessment depends on these numerous aspects, such a stance can affect the quality of assessment. It is calling, therefore, for a judgment to be made on the quality of an assessment, the various factors considered during the assessment.
CHAPTER THREE: METHODOLOGY

3.0 INTRODUCTION

This chapter outlines the strategy through which data was collected and used in answering the research questions. The strategy involved; population identification, sampling procedure, description of research instruments; data collection procedure, piloting and data analysis procedure.

3.1 RESEARCH DESIGN

This was a descriptive study aimed at describing the assessment situation in secondary schools. Descriptive statistics such as means and percentages were used in data analysis. The research design followed the flow chart guide in figure 3.1
Figure 3.1 Descriptive research design as used in this study.

- Research population: Secondary schools of Kakamega District
- Stratified random sampling technique
- Sample
- Subjects: Physics teachers
- Data collection: Data on methods and aspects of assessment in Physics
- Data analysis: - Percentages - Tables - Notes
- Summary and Conclusion
- Recommendations
- Research instruments for data collection:
  - Questionnaire
  - Checklist for document analysis
3.2 SAMPLING

The study was conducted on secondary school physics teachers in public schools in Kakamega District. At the time of the study there were 80 public schools in the district (according to the Ministry of Education, Kakamega District). These schools were stratified according to the school type and sampled as follows:

Table 3.1: Sampling Grid for Schools

<table>
<thead>
<tr>
<th>School Type</th>
<th>Number</th>
<th>Sample Size (75%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys' Schools</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>Girls' Schools</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Mixed Schools</td>
<td>47</td>
<td>35</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80</strong></td>
<td><strong>60</strong></td>
</tr>
</tbody>
</table>

From the schools sampled, one form three class was selected for the study. The form three physics teacher was chosen because the content taught in this class covered most of the aspects, which are stated in the objectives of the secondary school physics. This gives the teachers a wider opportunity to assess most of the domains of science learning.

Although the form four syllabus covers as much of the objectives as the form three one, the form four classes were preparing for the national examinations, a factor thought likely to affect the school best assessment procedures and related aspects.
3.3 RESEARCH INSTRUMENTS

Two instruments were used in this study; a teacher’s questionnaire (Appendix A), to the form three secondary school physics teachers, and a document analysis of the test papers used by the teachers in the assessment of their students in physics (Appendix B).

A questionnaire was preferred because it is more objective and thus effective for providing the comprehensive required data for the study. In addition, it makes data scoring easy and requires less time to administer (Oppenheim, 1982:84).

Analysis of the tests was expected to provide information about the aspects that teachers assess and the methods used. In addition, it was expected to be a reinforcement to the information obtained through the questionnaire.

3.4 PILOTING

Six schools were selected for piloting. These schools were selected from the same district but not among the ones sampled for the study. From each school type - boys’ schools, girls’ schools and mixed schools - two schools were selected and the physics teachers from these schools picked for the pilot study. The questionnaire was administered to these teachers and two sample test papers collected from each teacher.

a) to check the suitability of the instruments

b) to test the reliability of the instruments

c) to gain basic administrative experience in conducting the research in preparation for the larger group survey.
Each teacher responded to all the questions in the questionnaire. The teachers helped in clarifying some of their responses and as a result those question items which elicited ambiguous responses were adjusted.

After piloting the results were analysed and the reliability co-efficient was calculated using the Spearman Brown formula

\[ \alpha = \frac{2r}{1 + r} \]

where \( \alpha \) = reliability coefficient
\( r \) = actual correlation between halves of the instruments

and 'r' was calculated using the Pearson Product moment formula

\[ r = \frac{XY}{\sqrt{\sum X \sum Y}} \]

where \( X = x - \bar{x} \)
\( Y = y - \bar{y} \)

Where X stood for scores from first half and y stood for the scores from the second half of the pilot sample. \( x \) and \( y \) were their respective means. The reliability co-efficient was 0.84 and this was felt to be good enough.
3.5 ADMINISTRATION OF INSTRUMENTS AND DATA COLLECTION

PROCEDURE

The questionnaire was administered to the form three physics teachers in each of the sampled schools. The copies of the questionnaire were hand delivered to these schools since each school had to be visited so as to collect samples of the assessment test papers used by the teacher.

A brief explanation of the purpose of the study was given at the beginning of the questionnaire. This served the purpose of limiting the chances of the respondents giving irrelevant responses.

Two different test papers of previously written tests were collected from the teachers while delivering the questionnaire. The test papers were collected for analysis to establish which aspects of the physics curriculum the teachers assessed their students in. This was done by looking at the test items one by one and noting what aspect each item was expected to assess.

After a period of one month, the test papers were returned to the teachers while the questionnaire, completed by the teachers was collected for analysis.

3.6 DATA ANALYSIS PROCEDURE

This study aimed at describing the situation as it regards to school based assessment in secondary schools. Hence, being a descriptive study, the existing results were reported in raw form. One of the commonly used methods in reporting descriptive surveys is the use of frequency distribution, calculating the percentages and tabulating them appropriately (Gay,
This was done to the responses given by the teachers guided by the research questions.

For reasons of assessment, the responses given by the teachers were tallied showing the number of teachers in boys', girls' and mixed schools who either agreed, were not sure or disagreed with the given statements. Their mean averages were calculated according to the Likert scale to show the strength of agreement. A score of three (3) implied that the respondents were not sure, $3 < X \leq 5$ showed the strength of agreement while $1 \leq X < 3$ indicated the strength of disagreement. The corresponding percentage scores were then calculated.

For each of the remaining research questions the number of respondents was determined and the corresponding percentages calculated. These results were then tabulated for interpretation.
CHAPTER FOUR: DATA ANALYSIS AND ITS INTERPRETATION

4.0 INTRODUCTION

The chapter analyses and discusses the assessment practices in secondary schools. The discussion is focused on the need for school based assessment, the methods of assessment in use at the secondary school; aspects assessed in science at school level and the need for a national policy to govern assessment at school level.

This chapter is divided into five sections, each section focusing on an aspect of assessment in science. Section 4.1 focuses on the reasons why teachers engage their students in assessment. Section 4.2 focuses on the various methods of assessment that are used by physics teachers to assess their students. It further discusses the methods used for assessing various aspects of science and various domains of science learning. Section 4.3 analyses the domains of science that are frequently assessed by teachers while section 4.4 focuses on the existing policies on school based assessment. Section 4.5 focuses on the modern trends in assessment and the teachers' views towards these trends.

In each section the percentage of teachers responding to various aspects of assessment are given in tables, which are followed by discussions.

4.1 NEED FOR ASSESSMENT

The teachers were asked to give the reasons for assessing their students in science. Table 4.1.1 gives a summary of the reasons for assessment as indicated by the teachers. It gives the
mean scores for every reason based on a five point Likert scale (appendix A). A score below three (3) was viewed as an indication of disagreement with the stated reason while a score above three (3) was viewed as an agreement with the same reason. A score of three (3) was therefore viewed as the mean score. The equivalent percentage scores are also given.

The scores are grouped according to the school type; boys’ schools, girls’ schools and mixed schools. The overall score from a combination of all the sampled schools is also given.
Table 4.1.1. Mean scores and percentage scores for reasons of assessment

<table>
<thead>
<tr>
<th>Reasons for assessment</th>
<th>Boys' schools</th>
<th>Girls' schools</th>
<th>Mixed schools</th>
<th>Overall sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\bar{X}$</td>
<td>$%$</td>
<td>$\bar{X}$</td>
<td>$%$</td>
</tr>
<tr>
<td>1. To measure learners' understanding of a given task</td>
<td>5.00</td>
<td>100</td>
<td>5.00</td>
<td>100</td>
</tr>
<tr>
<td>2. To measure learners' achievement at the end of a course</td>
<td>4.27</td>
<td>85.4</td>
<td>4.57</td>
<td>91.4</td>
</tr>
<tr>
<td>3. As part of teaching learning process</td>
<td>4.00</td>
<td>80.0</td>
<td>4.43</td>
<td>88.6</td>
</tr>
<tr>
<td>4. To measure teaching effectiveness</td>
<td>4.27</td>
<td>85.5</td>
<td>4.43</td>
<td>88.6</td>
</tr>
<tr>
<td>5. To encourage students to work hard (motivation)</td>
<td>4.00</td>
<td>80.0</td>
<td>4.43</td>
<td>88.6</td>
</tr>
<tr>
<td>6. To prepare students for external examinations</td>
<td>3.73</td>
<td>74.6</td>
<td>4.00</td>
<td>80.0</td>
</tr>
<tr>
<td>7. To provide feedback to students</td>
<td>3.55</td>
<td>70.9</td>
<td>4.00</td>
<td>80.0</td>
</tr>
<tr>
<td>8. For career choice and placement</td>
<td>3.00</td>
<td>60.0</td>
<td>3.07</td>
<td>61.4</td>
</tr>
<tr>
<td>9. To determine learners' readiness for topic or course</td>
<td>3.55</td>
<td>70.9</td>
<td>2.71</td>
<td>54.3</td>
</tr>
<tr>
<td>10. To group students</td>
<td>2.73</td>
<td>54.5</td>
<td>3.00</td>
<td>60.0</td>
</tr>
</tbody>
</table>

N=60
In all the three school types (boys, girls and mixed) the reasons for assessment are similar with measuring understanding being the overall reason. What differs is the preference given to various reasons.

In boys' schools, all the teachers showed that they assessed to measure the extent to which a learner understood a given task. They gave the preference for assessment in the order of reasons numbered 1, 2, 4, 3, 5, 6 and 7 (table 4.1.1). They however indicated that they do not assess with the purpose of grouping students nor for career choices (reasons 8 and 10 table 4.1.1).

According to the teachers in girls' schools the order of preference of the reasons for assessment is similar to that of the teachers in boys' schools. On the other hand, while the teachers in boys' schools assess students to determine their readiness for a topic or course, teachers in girls' schools do not assess for this purpose.

Teachers in mixed schools gave more preference to assessment as part of teaching and learning compared to assessing for the purpose of measuring teaching effectiveness. For the overall sample the order of preference for the reasons of assessment was given in the order of the reasons numbered 1, 2, 3, 4, 5, 6, 7 (table 4.1.1.). However, the teachers in the sample did not assess for determining learners' readiness for a topic or course nor for the purpose of grouping students (reasons 9 and 10 table 4.1.1).
The reasons presented for assessing can be grouped into three categories depending on when the assessment is done, either before the instructional process takes place, during the instructional process or after the instructional process (Kempa 1986:1)

Table 4.1.2: Scores and percentages for reasons based on the time of assessment

<table>
<thead>
<tr>
<th>Time of Assessment</th>
<th>$\bar{X}$</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment before the instructional process (Diagnostic)</td>
<td>2.77</td>
<td>55.4</td>
</tr>
<tr>
<td>Assessment during the instructional process (Formative)</td>
<td>4.29</td>
<td>85.8</td>
</tr>
<tr>
<td>Assessment after the instructional process (Summative)</td>
<td>4.04</td>
<td>80.8</td>
</tr>
</tbody>
</table>

These results (table 4.1.2) show the mean scores and percentage for the reasons based on when the assessment was done. With three (3) as the mean score, these results indicated that the teachers do not assess students prior to the instructional process. Assessment is done during the instructional process and after the instructional process. This points to the view that the teachers perceive assessment as part of teaching and learning and as a measure of learning outcome. However, the teachers consider diagnostic assessment as unnecessary. On the contrary assessment of prior learning is important in determining what the learner brings to the classroom. Constructivism theory of learning states that the learner usually has his/her own perception of science (Driver, 1983). This perception may differ from the true facts of science or may coincide with these facts. It is the role of the teacher to determine the kind of knowledge the learner brings to the classroom before engaging him/her in an instructional process. Lack of assessment to determine prior learning can therefore affect the learning achievement of the learner. The teacher therefore needs to perform assessment at the three levels.
It is possible however, that lack of assessment for prior knowledge may be attributed to the Kenyan education structure. The structure is uniform and structured such that as students move from one level to the next competence is assumed. The teachers assume that students must have learnt specific things before being promoted to the next class. Even though, this does not negate the need for assessment at the three levels.

4.2 METHODS OF ASSESSMENT

4.2.1 Methods for general assessment

The teachers were provided with a variety of methods commonly used in the assessment of science learning. They were required to indicate the frequency of use for each method in assessment.

Table 4.2.1 Methods of assessment per term

<table>
<thead>
<tr>
<th>Method</th>
<th>Once a Term</th>
<th>Twice a Term</th>
<th>Thrice a Term</th>
<th>More Often</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Written tests</td>
<td></td>
<td></td>
<td>09</td>
<td>15</td>
<td>42</td>
</tr>
<tr>
<td>Practical work</td>
<td>09</td>
<td>15</td>
<td>04</td>
<td>6.7</td>
<td>07</td>
</tr>
<tr>
<td>Project work</td>
<td>41</td>
<td>68.3</td>
<td>04</td>
<td>6.7</td>
<td>-</td>
</tr>
<tr>
<td>Home work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Oral tests</td>
<td>4</td>
<td>6.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Observation</td>
<td>4</td>
<td>6.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

N=60
The table gives the number and percentage of teachers who used a given method either once, twice, three times or more than three times a term (table 4.2.1). The total percentage of teachers who at least used a given method is also given.

These results (table 4.2.1) show that all the teachers sampled at least used written tests, practical work and homework in the assessment of their students. The most frequently used methods, however, were homework (96.7%), observation of students in class (81.8%), oral tests (71.7%) and practical work (66.7%).

Although all the teachers used written tests for assessment, only 15% used it more than three times a term. Seventy percent (70%) used this method three times a term.

Only 6.7% used project work more than three times a term. Most teachers (68.3%) used it once a term.

It was observed however, that it was for those methods, which were most frequently used that assessment records were not kept. The teachers were asked to state the methods for which they kept assessment records of their students' performance.
Table 4.2.2. Assessment records from various methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written tests</td>
<td>59</td>
<td>98.3</td>
</tr>
<tr>
<td>Project work</td>
<td>47</td>
<td>78.3</td>
</tr>
<tr>
<td>Practical work</td>
<td>36</td>
<td>60.0</td>
</tr>
<tr>
<td>Home work</td>
<td>07</td>
<td>11.7</td>
</tr>
<tr>
<td>Observation of students</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>Oral tests</td>
<td>00</td>
<td>00</td>
</tr>
</tbody>
</table>

N=60

The table (4.2.2.) gives the number and percentage of teachers who kept assessment records for the corresponding method of assessment. These results indicate that for the most frequently used methods of assessment (home work, observation of students, oral tests and practical work), assessment records were rarely kept. On the other hand, for the methods, which were used not more than three times a term, most teachers kept assessment records.

This observation can be attributed to the fact that assessment methods such as observation of students, oral testing, homework and practical work are used by the teachers on a daily basis either to facilitate instruction or as informal evaluation approach. This is in agreement with Frith and Macintosh (1984:52) who cite these as formative evaluation methods. It is most likely then that it was because of this reason that no records were kept from these forms of assessment. Other methods of assessment such as written tests, project work and to some extent practical work consume a lot of time and require time out of the usual instructional period. They cannot, therefore, be done on a daily basis. In addition, results from these
methods of assessment may serve purposes beyond the interest of the teacher e.g. as a school requirement. As a result, the teachers kept assessment records from them possibly to form part of end of term examination record.

4.2.2. Methods for assessing aspects of science learning

The teachers were asked to indicate against each aspect of science learning the methods they used to assess the aspect. The results were grouped according to the school type; boys’ schools, girls’ schools and mixed schools. The results are shown in the table 4.2.3.

Table: 4.2.3 Methods used to assess various aspects of science learning in Boys’ Schools

<table>
<thead>
<tr>
<th>Method/Aspects</th>
<th>Written Tests</th>
<th>Practical Work</th>
<th>Project Work</th>
<th>Oral Tests</th>
<th>Home Work</th>
<th>Observation of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>1. Knowledge</td>
<td>11</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2. Understanding</td>
<td>8</td>
<td>72.7</td>
<td>3</td>
<td>27.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3. Application</td>
<td>3</td>
<td>27.3</td>
<td>8</td>
<td>72.7</td>
<td>8</td>
<td>72.7</td>
</tr>
<tr>
<td>4. Creativity</td>
<td>5</td>
<td>45.5</td>
<td>5</td>
<td>45.5</td>
<td>5</td>
<td>45.5</td>
</tr>
<tr>
<td>5. Planning for experiments</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>45.5</td>
<td>3</td>
<td>27.5</td>
</tr>
<tr>
<td>6. Manipulation</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>45.5</td>
<td>3</td>
<td>27.5</td>
</tr>
<tr>
<td>7. Interpretation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8. Communication</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>72.7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9. Feelings and Values</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

N=11

The table (4.2.3) shows the number and percentage of teachers using a given method to assess given aspects of science learning in boys’ schools.

These results show that the teachers used certain methods to assess some aspects of science and not others. Written tests were used to assess knowledge, understanding, application of
scientific knowledge and creativity. Project work, on the other hand was used to assess application of scientific knowledge, creativity, investigation and manipulation. Practical work came out as the most versatile method as it was used to assess all the aspects except knowledge, feelings and values towards science. The other methods of assessment were mainly used to assess the acquisition of knowledge and facts.

When the aspects are classified into the domains of science learning as described by Bloom (1956) Krathwohl, (1964); and Yager and McComack (1989) written test were found to be used for the assessment in the cognitive domain (aspects numbered 1, 2, 3, table 4.2.3). Practical work was mostly used to assess the process science domain (aspects 5, 6, 7 and 8) while project work was used to assess the creative domain (aspect number 4). Assessment in the affective domain was however very minimal.
These results (Table 4.2.4) show the methods used for the assessment of various aspects of Science in girls' schools. The results indicate that written tests were used to assess knowledge and facts, understanding and application of scientific knowledge. All these are aspects within the cognitive domain of science learning.

Practical work was used to assess the application of scientific knowledge, planning for experiments, interpretation of findings and communication of findings from experiments. These aspects fall within the domain of process science. Practical work was, therefore, used to assess the process science skills acquired by the learners.
Project work was used by less than half of the sampled teachers to assess the creativity in science. This method was rarely used by the teachers in assessing any other aspect of science learning. Creativity in science is a domain of its own science learning (Yager and McComick 1989). Project work was used for assessment in this domain.

Oral tests and observation of students in class were used by an equal number of teachers in the assessment of feelings and values towards science. The affective domain was therefore assessed by use of oral tests and observation of students. These findings are in agreement with Yager and McComick (1989) who indicate these methods as appropriate for assessment in these particular domains.
The results (Table 4.2.5) show the number and percentage of teachers who used a given method to assess the indicated aspect of science learning in mixed schools. It can be observed that written tests were used to assess all the aspects of science learning. Most teachers (over 20%) used this method to assess knowledge and facts, understanding, interpretation of scientific data and communication of findings from experiments. Over seventy percent (70%) of the teachers used this method to assess knowledge and facts, and understanding, which are key aspects in the cognitive domain.
Practical work as an assessment method was used to assess application of knowledge, planning for experiments, manipulative skills and interpretation of scientific data. Most of these aspects fall within the process science domain.

Project work was used to assess creativity in science, application of scientific knowledge and manipulative skills. These aspects fall in the creative domain and the process science domain.

Oral tests were used mostly in the assessment of understanding, communication of finding from experiments and feelings and values towards science.

On the overall assessment in various domains in the three school types, (boys' schools, girls' schools and mixed schools) was similar although more teachers in mixed and girls' schools assessed their students in the affective domain than in boys' schools. The methods used in assessment at various domains of science learning are similar in the three school types.

### 4.3 ASPECTS OF SCIENCE LEARNING

Two test papers, one theory and one practical test paper, previously used by the teachers to assess their students in physics were collected for analysis. The number of question items in the theory papers and the practical test papers were counted. The number and percentage of the items testing on an aspect of science learning was then determined and presented in tabular form (table 4.3.1). The results show the number and percentage of items out of the total number of question items assessing a given aspect of science learning. Some items tested for more than one aspect of science learning.
Table: 4.3.1  Aspects assessed in theory and practical tests by number and percentage

<table>
<thead>
<tr>
<th>Aspects of Science</th>
<th>Theory paper</th>
<th>Practical Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Knowledge and facts</td>
<td>428</td>
<td>28.5%</td>
</tr>
<tr>
<td>Understanding</td>
<td>279</td>
<td>18.6%</td>
</tr>
<tr>
<td>Application of Science knowledge</td>
<td>348</td>
<td>23.2%</td>
</tr>
<tr>
<td>Creativity &amp; Imagination</td>
<td>164</td>
<td>10.9%</td>
</tr>
<tr>
<td>Investigation</td>
<td>28</td>
<td>1.9%</td>
</tr>
<tr>
<td>Manipulative skills</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Interpretation of Data</td>
<td>203</td>
<td>13.5%</td>
</tr>
<tr>
<td>Communication of findings</td>
<td>60</td>
<td>4.0%</td>
</tr>
<tr>
<td>Feelings and Values</td>
<td>18</td>
<td>1.2%</td>
</tr>
</tbody>
</table>

N=1500       N=600

These results (table 4.3.1) show that for the theory test papers most of the question items centred around assessment of the learners’ acquisition of knowledge and facts, understanding of science and the application of scientific knowledge with 28.5%, 18.6% and 23.2% respectively of the question items testing these aspects. Creativity and imagination, and interpretation of data are also assessed by the theory paper with 10.9% and 13.5% respectively of the items assessing these aspects.

The aspects accounting for most of the test items, knowledge and facts, understanding and application of scientific knowledge, are all aspects within the cognitive domain. It can be
observed that the cognitive domain accounted for 70.3% of the question items in the theory test papers.

Aspects that fall within the process science domain accounted for 19.4% of the question items in these papers while the creative domain and the affective domain accounted for 10.9% and 1.2% respectively.

For the practical tests papers, the aspects within the cognitive domain; knowledge and facts, understanding, and interpretation of data; accounted for 8.0%, 5.7% and 8.2% respectively. This is 21.9% of the question items in the practical test papers.

The aspects within the process science domain; investigation, manipulative skills, interpretation of data and communication of findings; accounted for 66.0% of the question items in the practical test papers. The creative domain and the affective domain accounted for 11.3% and 1.5% of the test items.

It can be observed that while the theory papers test more on the cognitive aspects, the practical paper tests more on the process science domain. The two types of tests are therefore necessary in science for the assessment of these two domains. However, these two papers are not sufficient since the creative and affective domains are assessed less by these two methods of assessment. As observed earlier, creative domain is mostly assessed by use of project work (tables 4.2.3, 4.2.4 and 4.2.5). Project work should therefore be emphasized for the purpose of assessing the learners' development in the creative domain. This is in line with Macintosh and Hale (1976) who suggest the use of multiple methods in assessment.
4.4 SCHOOLS' POLICY ON ASSESSMENT

4.1.1 Policy on setting and marking

The teachers were asked to indicate who does the setting of the examinations used internally in their schools, who prepares the marking scheme and who does the marking of these examinations. Their responses are represented in the tables that follow (tables 4.4.1, 4.4.2, 4.4.3, and 4.4.4). The data was organized according to the school type.

Table 4.4.1: Examination setting, marking preparation and marking in Boys' Schools.

<table>
<thead>
<tr>
<th>Persons Involved</th>
<th>Setting</th>
<th>Marking Scheme Preparation</th>
<th>Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Subject Teacher</td>
<td>7</td>
<td>63.6</td>
<td>4</td>
</tr>
<tr>
<td>Team of Teachers</td>
<td>2</td>
<td>18.2</td>
<td>4</td>
</tr>
<tr>
<td>Head of Department</td>
<td>1</td>
<td>9.1</td>
<td>1</td>
</tr>
<tr>
<td>External Teachers</td>
<td>1</td>
<td>9.1</td>
<td>2</td>
</tr>
</tbody>
</table>

N=11
Table 4.4.2: Examination setting, marking preparation and marking in Girls’ Schools

<table>
<thead>
<tr>
<th>Persons Involved</th>
<th>Setting</th>
<th>Marking Scheme Preparation</th>
<th>Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Subject Teacher</td>
<td>9</td>
<td>64.3</td>
<td>8</td>
</tr>
<tr>
<td>Team of Teachers</td>
<td>2</td>
<td>14.3</td>
<td>2</td>
</tr>
<tr>
<td>Head of Department</td>
<td>0</td>
<td>0.0</td>
<td>1</td>
</tr>
<tr>
<td>External Teachers</td>
<td>3</td>
<td>21.4</td>
<td>3</td>
</tr>
</tbody>
</table>

N=14

Table 4.4.3: Examination setting, marking preparation and marking in Mixed Schools

<table>
<thead>
<tr>
<th>Persons Involved</th>
<th>Setting</th>
<th>Marking Scheme Preparation</th>
<th>Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Subject Teacher</td>
<td>30</td>
<td>85.7</td>
<td>29</td>
</tr>
<tr>
<td>Team of Teachers</td>
<td>4</td>
<td>11.4</td>
<td>5</td>
</tr>
<tr>
<td>Head of Department</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>External Teachers</td>
<td>1</td>
<td>2.9</td>
<td>1</td>
</tr>
</tbody>
</table>

N=35
Table 4.4.4.: Examination setting, marking preparation and marking for the sample

<table>
<thead>
<tr>
<th>Persons Involved</th>
<th>Setting</th>
<th>Marking Scheme Preparation</th>
<th>Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Subject Teacher</td>
<td>46</td>
<td>76.7</td>
<td>41</td>
</tr>
<tr>
<td>Team of Teachers</td>
<td>8</td>
<td>13.3</td>
<td>11</td>
</tr>
<tr>
<td>Head of Department</td>
<td>1</td>
<td>1.7</td>
<td>2</td>
</tr>
<tr>
<td>External Teachers</td>
<td>5</td>
<td>8.3</td>
<td>6</td>
</tr>
</tbody>
</table>

N=60

These results (table 4.4.1, 4.4.2, 4.4.3 and 4.4.5) show that in all the three school types, over 60% of the respondents indicated that the subject teachers are the ones who set the tests that they use in the assessment of their students. At the same time over 70% of the teachers do mark the tests themselves. There is a variation however, in the preparation of the marking schemes used to mark the tests. In boys’ schools the marking scheme is either prepared by the teacher (36.4%), a team of teachers from the same department (36.4%) or external teachers (18.2%). Only 9.1% indicated that the head of department was responsible for the preparation of the marking scheme.

There is no indication however that the decision on who sets, marks or prepares the marking scheme is a matter of school policy. Most of the teachers indicated that the decisions are either made departmentally or personally by the teacher (many schools had only one teacher in the physics department). Although the role of the teacher in assessment has been over emphasized, it is worth noting that assessment results from one teacher have higher chances.
of bias (Macintosh 1974:231). There is need for teachers to work as team and a need for school policies to govern assessment.

### 4.4.2 Policy on grading system:

The teachers were asked to indicate the grading system they used in describing the scores that students attained. They indicated that they used either grades such as A., B, C etc. or marks out of a predetermined total (e.g. out of 100), or both grades and marks as follows:

<table>
<thead>
<tr>
<th>Grading System</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades such as A, B, C etc.</td>
<td>6</td>
<td>10.0</td>
</tr>
<tr>
<td>Marks out of a predetermined total</td>
<td>10</td>
<td>16.7</td>
</tr>
<tr>
<td>Both Grades and marks</td>
<td>44</td>
<td>73.3</td>
</tr>
</tbody>
</table>

The majority of teachers (73.3%) indicated that they used both grades and marks to grade the students. Sixteen percent (16.7%) indicated that they only used marks alone to describe the students' performance while only ten percent (10) indicated that they used grades to describe the students' performance.

When asked which grading system the teachers preferred all the teachers indicated that they preferred the methods, which they used to grade their students. This implies that the teachers chose the preferred method for use and not because there is a school policy determining the grading system used. Seventy nine percent (79%) of the teachers stated that they chose this
grading system personally. Only three percent (3%) indicated that the grading system is predetermined by the school policy.

These results therefore point to the conclusion that in most of the schools, there is no school policy on the grading system that the teacher uses. Each school and in fact each teacher decides on which grading system to use to organize the students' scores.

If school based assessment has to have any significant meaning to the general grading of the students at the end of the school course, then there is need to have a national policy to govern assessment in schools. The teachers strongly agreed to the need to have a national policy on assessment in schools.

4.5 TRENDS IN ASSESSMENT

The teachers were provided with a variety of general views on assessment. They were required to state whether they agreed or disagreed with the stated view.
Table 4.5.1: Teachers scores on various views about assessment

<table>
<thead>
<tr>
<th>View about assessment</th>
<th>Agreed</th>
<th>Disagreed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Scarcity of apparatus hinders some forms of assessment</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>The curriculum does not provide time for assessment</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>There is need to have a national policy on assessment in schools</td>
<td>41</td>
<td>68.3</td>
</tr>
<tr>
<td>CATs' scores should be included in the final grading of candidates</td>
<td>42</td>
<td>70</td>
</tr>
<tr>
<td>Frequent assessment improves students performance</td>
<td>12</td>
<td>20</td>
</tr>
</tbody>
</table>

N= 60

4.5.1 Criterion Vs Norm referenced evaluation

Some reasons could be classified as those aimed at measuring the student’s performance against his/her academic achievement while others aim at discriminating one student from another. The teachers preferred assessing to measure student achievement (reason 2 table 4.1.1) to assessing with the aim of discriminating students (reasons 5, 7 and 8, table 4.1.1). However, the teachers accepted that assessment for both purposes was necessary.

4.5.2 School based assessment

Teachers were asked to state whether or not school based assessment results should be included in the final grading of candidates at the end of the secondary school course. Seventy percent (70%) of the teachers (table 4.5.1) accepted that this was necessary. However, an
equally large percentage (68%) stated that it was necessary to have a national policy on assessment if this was to be made a reality.

It is evident here then that teachers realize the need for a wider spectrum form of assessment, which is designed in such a way as to ensure proper discrimination so that candidates across the ability range are given opportunities to demonstrate their knowledge, abilities and achievements. What seems to emerge is the fact that single sets of papers that are taken by the candidates at the end of a school course may not produce the desired discrimination. There arises need therefore, to draw judgment of students’ achievement based on a variety of assessment. School-based assessment results need then to be considered. However, before such a decision is taken other aspects of teacher assessment discussed in the previous sections of the chapter need to be put into consideration.
CHAPTER FIVE: SUMMARY AND RECOMMENDATIONS

5.0 INTRODUCTION

This chapter ties up the study by outlining the major findings that resulted from data analysis and interpretations in the previous chapter. Recommendations on the major aspects of science assessment are also made in line with the findings. The chapter ends with a list of suggestions for further study, which addresses the areas the study could not address within its limits.

5.1 SUMMARY

5.1.1. Need for assessment

It was noted that the need for assessment was based on the following reasons and order of preference.

a) to measure the learners understanding and academic achievement

b) as an evaluation of the teaching effectiveness

c) as an instructional strategy

d) to motivate the learners

Assessment was done as part of formative and summative evaluation but rarely for diagnostic purposes. There is need however, for the teachers to engage in diagnostic assessment in order to understand the shortcomings of their students before subjecting the learners to learning materials (Briggs 1977:21). Since different students enter the class situation with varied entry
behaviour, it is the role of the teacher to harmonize the entry behaviour of the learners with the scientific facts.

5.1.2 Methods of assessment

The study found that teachers use a variety of methods in their assessment of the students. The most commonly used methods are the written tests and practical work. However, these two methods also assess quite a variety of science aspects. Project work, though is very vital in measuring creativity of the learner was rarely used.

Other methods of assessment such as homework, oral assessment and observation of students were used on a day to day basis by the teachers as part of formative evaluation of the learners. The teachers therefore do not keep assessment records of the results obtained from the use of these methods. It may be assumed that these results however are used by the teachers in the learning process and informal evaluation of the learner.

Assessment records from the methods, which are used regularly, are necessary. Engel Clough (1984) argues that other than providing the teacher with formal evaluation of the learner and decision making, they also provide records for reference by any person who may want some information regarding the learner. This practice of record keeping also need to be emphasized if the teachers assessment scores are to play any role in national examinations.

5.1.3 Domains of Science Learning

It was also found that the most frequently assessed domains of science learning were the cognitive and process skills domain. This is impressive since the emphasis placed on process
skills domain has only developed in the recent times. Teachers are aware of the need to develop the process skills in the learner and are thus engaged in the assessment of the development of these skills. The cognitive domain is equally central in acquisition of knowledge and facts about science. Its assessment thus need not be overemphasized.

Assessment of the creative and affective domains of science is however very low. Teachers recognize the need for the learners to develop creative insights but little is done in the assessment of the development of these insights. It had been already observed that "evaluational experiences in many institutions are not enhancing the development of creativity" (Okere 1986:23). It is surprising that despite the time stretch not much change has been acquired towards assessment of creativity. Teachers may not be engaging in rigorous assessment of this domain because the national examinations do not test it directly.

Low assessment in the creative domain can be attributed to two factors:

a) lack of appropriate assessment tools and methods

b) the inability to immediately realize the development or undevelopment of positive affective aspects in the learner.

There is need to device ways of ensuring assessment and development of affective and social aspects of the learner towards science. This is necessary because the goals of teaching science at secondary school level emphasize the development of social aspects of Science (K.I.E. 1992).
5.1.4 Assessment policy

The study found that assessment practices in schools are teacher determined. The teachers decide individually on what to assess and how to treat the assessment results. The grading system used to describe the students' performance was based on the teacher's preference.

In some cases individual schools develop policies on assessment to govern the assessment practice in the school. The teachers however indicated that there is need to have a national policy to govern assessment practices in schools so as to make the practice similar. This would also create uniformity in the assessment records kept by the teachers. As a result it would be possible to reliably make reference to the teacher's records and make judgment on the student beyond the school level.

5.1.5 Trends in assessment

Teachers' assessment practices were found to be in line with the international trends in assessment as discussed by Kempa (1986:106). They recognized the need to emphasize process skills. They preferred criterion referenced assessment to norm-referenced assessment and stressed the need for the involvement of teachers in examinations, which are nationally recognized.

5.1.6 General Issues

It was observed that most of the physics teachers were not trained. In fact some had just high school level academic qualifications with very little experience in teaching. This can impact a great deal on the assessment practices in schools particularly given that many decisions on
assessment are made by the teachers. There is need to improve staffing in secondary schools and to train the teachers in the service.

It was also noted that over ninety eight percent (98%) of the teachers were male teachers. This is bound to have a demotivating effect on female learners. It could create the impression that physics is a male domain, a factor already identified to affect girls' performance (Twoli 1986).

5.2 RECOMMENDATIONS FOR ACTION

In view of the issues summarized in section 5.1 and basing on the data analysis results, the following recommendations need to be addressed:

a) It was observed that teachers emphasized formative and summative forms of evaluation. However diagnostic evaluation was found to be low. The education inspectorate needs to advice teachers on other forms of evaluation such as diagnostic evaluation. This could be done through seminars and workshops designed to update the teachers on new trends in assessment.

b) It was found that though vital tool in Science assessment, project work was rarely used. It is recommended that project work as an assessment method should be emphasized. It is the most appropriate method that can be used in the assessment of creativity. Teachers need to give students at least two projects a term so that the learners can develop creative insights. Because of the effect of national examinations on school assessments there is need to introduce project work as part of the national examinations.
c) There is need to educate teachers on the variety of assessment methods. This will enable the teachers to develop assessment tools that will enable assessment in all the domains of science learning and all the aspects that fall in these domains. Creative domain and the affective domain indicated low assessment. Teachers need to be made to recognize the need for assessing the development of the affective and social values that relate to science in general and physics in particular.

d) Schools tend to emulate the Kenya National Examination Council style of evaluation by emphasizing theory and practical papers. The National Examinations Council needs to develop a national policy that will govern assessment practices in schools. Such a policy needs to address issues such as:

- frequency of assessment
- methods of assessment
- setting and marking of the tests
- record keeping of the assessment results
- utilization of these records at the national level.

It is only when such a policy is in place that the examinations council can consider using teachers records of students' performance in determining the final grade of the student. Otherwise the records are diverse and reflect the information that an individual teacher deems necessary.
5.3  SUGGESTIONS FOR FURTHER STUDY

This study focused on the existing situation as relates to assessment of physics in Kenyan Secondary Schools. It considered the methods in use and the frequency of assessment. The results of this study do not describe the nature of the tests in terms of their reliability and validity. If the assessment results from schools are to be used in national examinations, there is need to carry out an evaluation of the teacher made tests with the aim of establishing their reliability and validity.

There is need to carry out a similar study in other parts of the country. This would enable a higher generalisation if the findings are similar. Since this study was conducted in only one district and the district being of rural setting, it is necessary to have a comparison study between rural and urban settings.

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Brunner, J.S. (1957): "Ongoing beyond the information given", in Contemporary Approaches to cognition, Massachusetts. Harvard University Press.


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Engel-Clough, E. Davies, P. and Sumer, R (1984):
Assessing Pupils: A study of policy and practice Windsor: NFER-NELSON


Gipps, C., Steadman, S., Blackstone, T. and Stiever, B. (1983):


Examination of Examinations. London: Macmillan.


Kenya Institute of Education. (1992):


Kenya National Examination Council, (1990):


London. Longmans.

Lee, C.E. (1967):  


*Assessing Attainment in the classroom,* London: Hadder and Stoughton.


Woolnough, B. And Alsopp, T. (1985):


INTRODUCTION

As a physics educator, I am interested in finding out the characteristics of the tests made and used by physics teachers in the assessment of physics and physical science (Physics) at secondary school level. Below are statements related to this subject. Please answer all the questions by either ticking the option, which applies to your situation, or writing an explanation in the spaces provided or according to the instructions after each statement.

Note that this is not a test and that there are no right or wrong answers. State the situation as it applies to you or your school.

Your responses will be treated as confidential information and, therefore, no other person will gain access to them.

Thanks in advance

Moses Keya Ochanji
SECTION 1: PERSONAL AND GENERAL INFORMATION

1. Type of school (Tick one)
   Boys [ ]   Girls [ ]   Mixed [ ]

2. Gender: Tick whether you are male or female
   Male [ ]   Female [ ]

3. Professional qualifications
   B.Ed.(Sc.) [ ]   B.Sc. [ ]
   S1 [ ]   P.G.D.E. [ ]
   Others (specify)........................................................................................................
   .................................................................................................................................
   .................................................................................................................................

4. Teaching Experience ...............years

5. Your Employer
   T.S.C. [ ]   B.O.G. [ ]
   Others (specify)........................................................................................................
   .................................................................................................................................
   .................................................................................................................................

6. What other subject(s) do you teach other than physics? (Name them)
   i) .................................................................................................................................
   ii) .................................................................................................................................
   iii) .................................................................................................................................
SECTION II: REASONS FOR ASSESSMENT

Below are ten statements regarding to why we assess students in physics. Please indicate against each statement the extent to which you agree or disagree with the statement. Answer the questions by ticking in the appropriate box.

SA = Strongly Agree: A=Agree N=Neutral
D= Disagree SD= Strongly disagree

1. Assessment is done to determine the learner’s readiness for a topic, unit, or course
   SD [ ] D [ ] N [ ] SA [ ]

2. Assessment has the purpose of measuring the extent to which the learners have understood a given task
   SD [ ] D [ ] N [ ] A [ ] SA [ ]

3. Assessment is done to measure the student’s achievement at the end of a course
   SD [ ] D [ ] N [ ] A [ ] SA [ ]

4. Assessment is done so as to provide feedback to students
   SD [ ] D [ ] N [ ] A [ ] SA [ ]

5. Regular assessment serves the purpose of encouraging students to work hard

69
6. Assessment is used to judge teaching effectiveness.

7. Assessment is done to prepare students for external examinations.

8. Assessment is done so as to group students.

9. Assessment is done to predict the courses that the students will take.

10. Assessment is done as part of teaching and learning.
SECTION III: ASSESSMENT PROCEDURES

11. (a) In the table below are various methods of assessment used in physics. Please indicate by ticking in the relevant position the frequency of assessment made of each method per term in your class. If there are other methods that you may have used which are not indicated please write them down and state their frequency.

Table 1:

<table>
<thead>
<tr>
<th>Method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Once a term</td>
</tr>
<tr>
<td>Written test</td>
<td></td>
</tr>
<tr>
<td>Use of Practical work</td>
<td></td>
</tr>
<tr>
<td>Project work</td>
<td></td>
</tr>
<tr>
<td>Oral tests</td>
<td></td>
</tr>
<tr>
<td>Home work</td>
<td></td>
</tr>
<tr>
<td>Observation of students</td>
<td></td>
</tr>
<tr>
<td>Others (Name them and give frequency)</td>
<td></td>
</tr>
</tbody>
</table>

b) From the methods indicated above name those from which you keep assessment records.
12. The next table below (table 2) shows various aspects of physics learning. Please indicate in the table the method that you have used to assess any of these aspects and against each method indicate the frequency of use for that method. You may give more than one method for a given aspect. You can refer to the methods in table 1.

Table 2:

<table>
<thead>
<tr>
<th>Aspects of Physics</th>
<th>Method of Assessment (as in 1)</th>
<th>Number of Times Assessed in the assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Knowledge and facts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application of scientific knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creativity and imagination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning for experiments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manipulative skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpretation of data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication of findings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feelings and values towards science</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
13. Are there any aspects of physics learning which you find inherently difficult to assess? If yes please name them.

14. Please indicate who does the setting of the tests that you use in your assessment (Tick as appropriate)
   a) The teacher (myself) [ ]
   b) A team of teachers [ ]
   c) Head of department [ ]
   d) External persons [ ]
   e) Others (specify) ..........................................................

15. Some teachers prefer to moderate tests before giving them to students. Explain briefly how your school moderates tests
   a) Before administration .............................................
   b) During marking .................................................
1.6 Indicate who prepares the marking scheme and who does the marking of the tests (tick as appropriate)

<table>
<thead>
<tr>
<th>Marking scheme</th>
<th>Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Class teacher</td>
<td>[ ]</td>
</tr>
<tr>
<td>b) Team of teachers</td>
<td>[ ]</td>
</tr>
<tr>
<td>c) Head of department</td>
<td>[ ]</td>
</tr>
<tr>
<td>d) External persons</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

17. Indicate by ticking out the appropriate option the marking or grading system (s) that you use in your assessment

<table>
<thead>
<tr>
<th>Marking system</th>
<th>[ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Comment with neither marks nor grades</td>
<td>[ ]</td>
</tr>
<tr>
<td>b) Use of grades such as A, B, C, etc.</td>
<td>[ ]</td>
</tr>
<tr>
<td>c) Marks out of a pre-determined total (e.g. out of 100)</td>
<td>[ ]</td>
</tr>
<tr>
<td>d) Others (specify)</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

18. Indicate whether the grades or marks used in assessment as mentioned in (17) above are chosen:

<table>
<thead>
<tr>
<th>Marking system</th>
<th>[ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Individually by teachers</td>
<td>[ ]</td>
</tr>
<tr>
<td>b) Departmentally</td>
<td>[ ]</td>
</tr>
<tr>
<td>c) As part of school policy</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

19. Do you have preference for any of the grading systems used? Please indicate which ones with reasons where possible
20. Do you have a school policy relating to assessment in your school?

Yes [ ] No [ ]

If yes,

a) What aspects of assessment does the policy concern? (Can tick more than one)

- system of grading [ ]
- system of setting [ ]
- system of marking [ ]
- system of record keeping [ ]

b) Do you have any difficulty in coping with the policy on assessment? Please indicate how?

......................................................................................................................

......................................................................................................................

Below are general statements on assessment. Again indicate the extent to which you agree or disagree with the statements by ticking in the appropriate box

SD    D    N    A    SA
21. Scarcity of apparatus hinders some forms of assessment

22. The curriculum does not provide time for assessment

23. There is need to have a national policy on assessment in schools so as to make assessment practices similar in schools

24. Continuous assessment tests scores should be included in the final grading of form four candidates

25. Frequent assessment improves students performance in physics

- END -

Thank you.
## APPENDIX B

### CHECKLIST FOR ANALYSIS OF TESTS (TO BE TALLIED BY THE RESEARCHER)

<table>
<thead>
<tr>
<th>Type of Test</th>
<th>Tally Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly tests</td>
<td></td>
</tr>
<tr>
<td>Monthly tests</td>
<td></td>
</tr>
<tr>
<td>Termly tests</td>
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<td>Mid year exams</td>
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<td>End year exams</td>
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<td>Other</td>
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<table>
<thead>
<tr>
<th>Method of Assessment</th>
<th>Tally Marks</th>
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<tbody>
<tr>
<td>Fixed time tests</td>
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<tr>
<td>Open ended test</td>
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<tr>
<td>Project work</td>
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<td>Home work</td>
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<tr>
<td>Laboratory work</td>
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<td>Aspects of Physics Learning</td>
<td>Tally Marks</td>
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<tr>
<td>--------------------------------------------</td>
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<tr>
<td>Knowledge and facts</td>
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<tr>
<td>Understanding</td>
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</tr>
<tr>
<td>Application of scientific knowledge</td>
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<tr>
<td>Creativity and imagination</td>
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<tr>
<td>Investigation</td>
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<td>Manipulative skills</td>
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<tr>
<td>Interpretation of data</td>
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<tr>
<td>Communication of findings</td>
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<td>Feeling and values towards science</td>
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# APPENDIX C

## BUDGET ESTIMATES

<table>
<thead>
<tr>
<th>Item</th>
<th>Kshs.</th>
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<tbody>
<tr>
<td>Secretarial work</td>
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<tr>
<td>Stationery</td>
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<tr>
<td>Travel</td>
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<td>Subsistence and Accommodation</td>
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<td>Binding</td>
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<td>Miscellaneous</td>
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**Total** = **30,000.00**
## APPENDIX D

### RESEARCH: TIME FRAME

<table>
<thead>
<tr>
<th>Activity</th>
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<tr>
<td>Departmental presentation</td>
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<tr>
<td>Faculty presentation</td>
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<tr>
<td>Piloting</td>
<td>March 1998</td>
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<td>Data collection</td>
<td>April - June 1998</td>
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<td>Data analysis</td>
<td>July - November 1998</td>
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<tr>
<td>Writing</td>
<td>December - January 1999</td>
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<tr>
<td>Presentation</td>
<td>February 1999</td>
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</tbody>
</table>
This is to certify that

Moses Keya

OCHAIJ

of (Address) P.O. Box 13844

NAIROBI

has been permitted to conduct research in

KAKAMEGA

District

WESTERN

Province,

on the topic ANALYSIS OF TESTS MADE AND USED BY PHYSICS TEACHERS IN THE ASSESSMENT OF PHYSICS IN SECONDARY SCHOOLS IN KAKAMEGA DISTRICT

for a period ending DECEMBER 19 1998

APPENDIX E: RESEARCH PERMIT.