THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

STUDENTS' ITEMS RESPONSE ANALYSIS REPORT ON FORM TWO NATIONAL ASSESSMENT (FTNA) 2023

CIVIL ENGINEERING SURVEYING

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073 CIVIL ENGINEERING SURVEYING

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FOREWORD

This report presents Students' Items Response Analysis (SIRA) on Form Two National Assessment on the subject of Civil Engineering Surveying conducted in November 2023. The report aims to provide feedback to all education stakeholders on the factors that contributed to the students' performance in Civil Engineering Surveying subject.

The Form Two National Assessment (FTNA) is a formative evaluation that intends to monitor students' learning outcomes and provide feedback that teachers, students and other education stakeholders can use to improve the teaching and learning process. This analysis shows justification for students' performance in the Civil Engineering Surveying subject. Students who attained high scores demonstrated their ability to understand the demands of the questions as well as enough knowledge, skills and competence in the subject matter. Students who scored low marks missed adequate knowledge of the concepts tested and failed to respond according to the demands of the questions.

This report identifies students' strengths and weaknesses, which, in return, will help to improve learning before sitting for their Certificate of Secondary Education Examination (CSEE). The report will also help teachers to identify the challenging areas and act appropriately during the teaching and learning process.

National Examinations Council of Tanzania (NECTA) expects that the feedback provided in this report will enable education stakeholders to take proper measures to improve the teaching and learning of the Civil Engineering Surveying subject. Consequently, students will be able to acquire knowledge, skills and competence indicated in the syllabus for better performance in future assessments and examinations.

The Council appreciates the contributions of all those who participated in preparing this report.

Dr. Said A. Mohamed
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report presents a detailed analysis of the students' performance on Form Two National Assessment (FTNA) 2023 in Civil Engineering Surveying. The assessment adequately covered the Form Two Syllabus for Technical Secondary School Education issued in 2019 and as per the Examination format issued in 2021.

The Civil Engineering Surveying assessment consisted of three sections namely A, B and C with a total of 10 questions. Section A comprised of two (2) questions (1 and 2) which weighed 10 and 5 marks respectively, to make a total of 15 marks. Question 1 consisted of ten multiple-choice items constructed from various topics namely: *Civil Engineering Surveyor*, *Surveying Practice, Surveying Tools and Equipment, Safety Management and Rules, Introduction to Surveying Methods, Chain Surveying and Linear Measurements, Compass Surveying, Surveying Techniques Practice*, and *Introduction to Surveying*. Question 2 had five matching items drawn from the topic of '*Chain Surveying and Linear Measurements*'.

Section B consisted of seven (7) questions (3 to 9). The questions required the student to provide short answers and were derived from various topics namely: *Civil Engineering Surveyor, Surveying Tools and Equipment, Introduction to Surveying Methods, Chain Surveying and Linear Measurements, Compass Surveying* and *Surveying Techniques for Small Areas (Practice).* Each question carried 10 marks, making a total of 70 marks. Section C, had one (1) structured question derived from the topic of *Chain Surveying and Linear Measurements.* This question had 15 marks. Therefore, the paper weighed 100 marks.

A total of 281 students sat for this assessment. The performance was generally average, where by 173 (61.57%) of the students passed with average and good performance while 108 (38.43%) of the students failed. The students' students' performance in Civil Engineering Surveying subject is shown in Figure 1.

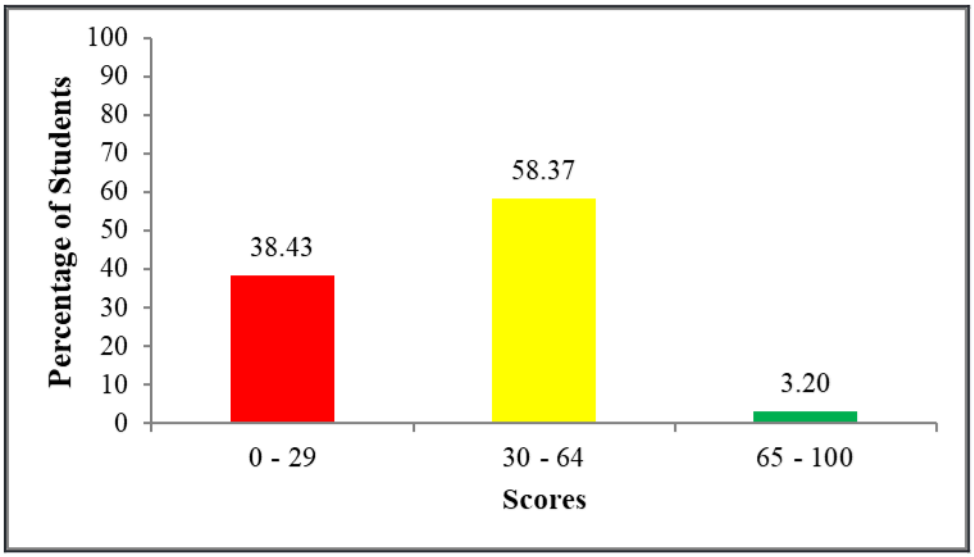


Figure 1: Students' Performance in Percentage.

Among the students who sat for Civil Engineering Surveying assessment in the year 2023, 03 (1.07%) students scored grade A, 06 (2.13%) scored grade B, 92 (32.74%) students scored grades C, 72 (25.63%) scored grade D and the remaining 108 (38.43%) students failed by scoring grade F. The range of the students' performance for each question was determined and the analysis of the strengths and weaknesses of students' responses was done. Sample extracts of students' good and poor responses are used to illustrate the cases presented. At the end of this report, conclusion and recommendations are made to help students, teachers, parents and other education stakeholders to take necessary measures to improve the teaching and learning process in the Civil Engineering Surveying subject.

2.0 ANALYSIS OF THE STUDENTS' RESPONSES IN EACH QUESTION

2.1 SECTION A: Multiple Choice and Matching Items

This section consisted of two questions, 1 and 2. Question 1 required the students to choose correct response from among the given alternatives and write its letter in the box provided. Question 2 required the students to match the survey signal listed in List A with the correct meaning of assistant movement described in List B by writing a letters of the correct response beside the item number in the table provided.

2.1.1 Question 1: Multiple Choice Items

The question consisted of ten multiple choice items (i) to (x), which carried one mark each, making a total of 10 marks for this question. The analysis of this question shows that 281 (100%) students attempted the question, where by 19 (6.76%) students scored from 0 to 2 marks, 175 (62.28%) students scored from 3 to 6 marks while 87 (30.96%) students scored from 7 to 10 marks. The score intervals used for grading students' performance in this question are shown in Table 1.

Table 1: Score Intervals of Students' Performance in Question 1

Scores Range	Remark	General Performance	
		Number of Students	Percentage
0 – 2	Weak	19	6.76
3 - 6	Average	175	62.28
7 - 10	Good	87	30.96
Total		**281**	**100**

The performance of students in this question was good as 262 (93.24%) students scored from 3 to 10 marks. The performance of students in this question is summarized as shown in Figure 2.

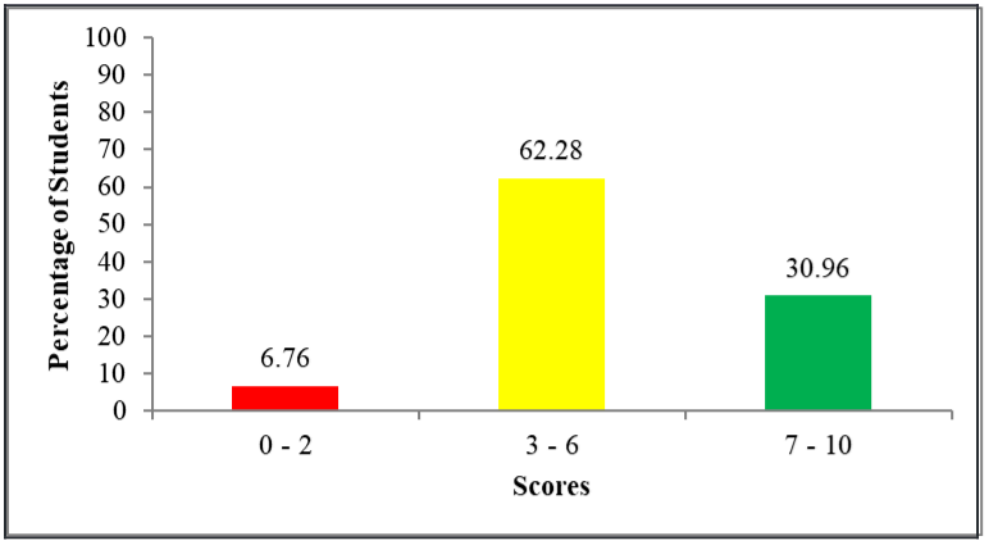


Figure 2: Students' Performance in Question 1

The students' strengths and weaknesses in choosing responses for individual items of question 1 are analyzed as follows:

Item (i) was developed from the topic of *Chain Surveying and Linear Measurements*. Students were required to select the type of sketch that would be prepared during the reconnaissance survey. The item is intended to measure students' ability to differentiate the types of sketches to be prepared or used before or after the reconnaissance exercise during the surveying process. The question was:

The school area was surveyed before the reconnaissance exercise is conducted. Select the type of sketch which is prepared during reconnaissance survey.

A	*Reference sketch*	*B*	*Offset sketch*
C	*Index sketch*	*D*	*Survey sketch*

The correct response for this item was C, '*Index sketch*'. The students who opted for this alternative were aware that an index sketch is a preliminary sketch prepared during the reconnaissance phase of a surveying activity showing landmarks, boundaries, trees, roads and other key features. Index sketch is often used as a reference during fieldwork, planning, and for further decision-making in construction projects. Students who opted for alternative A, '*Reference sketch*', were wrong because a reference sketch is a detailed map used by surveyors, which is used as a guide or reference during the surveying operation. Students who opted for alternative B, '*Offset sketch*', were also wrong because an offset sketch is a type of sketch used in surveying operations when conducting detailed surveys of linear features such as railways. It represents features or objects located adjacent to the surveyed linear feature, such features or objects include boundaries, farms, trees, or buildings. Students who opted for alternative D, '*Survey sketch'*, were incorrect because a survey sketch in surveying refers to a drawing or diagram that represents the layout, features, and measurements of a surveyed area. It serves as a visual representation of the data collected during the surveying operation and provides important information for planning, designing, construction and maintenance activities.

Item (ii) was set from the topic of *Compass Surveying*, whereby students were required to convert the given measurement in the whole circle bearing to the quadrantal bearing system. The item intended to measure both the students' understanding on the types of the bearing system and their ability to convert given measurement in the whole circle bearing system to the quadrantal bearing system. The question was:

The reading of $315^0 45'$ was recorded in the whole circle bearing when compass surveying was conducted. Convert the obtained data to the quadrantal bearing system.

A	*N 135^0 $45'$ W*	*B*	*N 44^0 $15'$ W*
C	*S 244^0 $15'$ E*	*D*	*N 135^0 $45'$ E*

The correct alternative was B, '*N 44^0 $15'$ W*'. The students who opted for alternative B were aware that the given measurement is located in the North -West direction as it falls between 270° to 360°. By considering the general formulae, Quadrantal Bearing = 90° - (Whole Circle Bearing - 270°), therefore N44°15'W is the correct response. Students who opted for alternatives A, '*N 135^0 $45'$ W*', C, '*S 244^0 $15'$ E*' or D, '*N 135^0 $45'$ E*', were not able to select the correct response. These students lacked sufficient knowledge and practical exercises from the topic of *Compass Surveying*.

Item (iii) was constructed from the topic of *Surveying Tools and Equipment*, whereby students were required to identify a reference point in which all elevation points would be related when carrying levelling operation. The item is intended to measure students' ability to identify a reference point in which all elevation points are related to, when carrying levelling procedure. The question was as follows:

When carrying out leveling operation, a reference point is chosen so that the elevation of all points is related. Which of the following do surveyors use to denote reference point in the field?

A	*Level line*	*B*	*Horizontal line*
C	*Datum*	*D*	*Reducing level*

The correct response was C, '*Datum*'. Students who opted for this alternative were aware that a datum is a level surface or point to which all elevation points are related to. Students who opted for alternative A, '*Level line*', were not aware that a level line is a line laying on a level surface and it is always perpendicular to the plumb line. On the other hand, students who opted for alternative B, '*Horizontal line*', made the incorrect choice because the horizontal line is a straight line that is parallel to the horizon and perpendicular to the vertical direction. Lastly, students who opted for alternative D, '*Reducing level*', were unable to select the correct response because reducing level is a vertical distance above or below the datum level.

Item (iv) was developed from the topic of *Safety Management and Rules*, whereby students were required to identify the category of safety regulation under the given circumstances. The item is intended to measure students' ability to evaluate the order in safety measures and to identify the correct response among the correct alternatives. The question was:

A supervisor warns you to handle with care tools, equipment and materials used in surveying works. In what category of safety does this regulation belong?

A	*Personal safety*	*B*	*Students safety*
C	*Workshop safety*	*D*	*Site safety*

The correct alternative was B, '*Students safety*'. Those students who opted for alternative B were aware that safety is more broadly concerned with anyone involved in the surveying activities, including staff, workers, and visitors. Students who opted for alternative A, '*Personal safety*', were incorrect because safety in surveying activities is also concerned with other people around. Those students who opted for alternative C, '*Workshop safety*', and D, '*Site safety*', were incorrect responses because workshop safety and site safety is less important as far as people's safety is concerned.

Item (v) was set from the topic of *Introduction to Surveying Methods*, whereby, students were required to identify the most important instrument used during setting out activities when a surveyor plans for the preliminary inspection. The item is intended to measure students' ability to differentiate the uses of different tools and equipment at all stages of the surveying process. The question stated was as follows:

A surveyor went to visit the site for preliminary inspection of the area to be surveyed for construction works. Which item is the most important to use during setting out works?

A	*Theodolite*	*B*	*Dump level*
C	*Compass*	*D*	*Note book*

The correct response was alternative A, '*Theodolite*'. Students who opted for this alternative were aware that theodolite is a precise instrument used for measuring angles in the horizontal and vertical planes. It is the most important instrument for accurate determination of angles and directions

during surveying tasks such as setting out. Students who opted for alternative B, '*Dump level*', made the incorrect selection because a Dump level is an instrument used in surveying and construction to measure height differences and establish the level of points or lines. Other students who opted for alternative C, '*Compass*', were unable to choose the correct response because compass surveying is a method of surveying in which directions, angles, and bearings are measured using a compass. This method is mostly used in larger and undulated areas where chain surveying fails. Students who opted for alternative D, '*Notebook*', were incorrect because a notebook sometimes known as a field notebook or field book is a tool used by surveyors to record field observations, measurements, and other required data during surveying activities.

Item (vi) was developed from the topic of *Compass Bearing*, whereby students were required to identify the type of bearing measurement when a surveyor stationed at point B observed the bearing of line BC from point B toward point C. This item is intended to measure students' ability to identify types of bearing as found in the concepts of compass surveying. The question was as follows:

A surveyor stationed at point B observed the bearing of line BC from point B towards point C. What bearing is the surveyor intend to measure?

A	*Fore bearing*	*B*	*Back bearing*
C	*BC bearing*	*D*	*CB bearing*

The correct response was alternative A, '*Fore bearing*'. Students who opted for this alternative were familiar with the concepts of forebearing and backbearing. Forebearing is the bearing of a line measured in the direction from the observer's location in point B to the target point C. Students who opted for B, '*Back bearing*', were not able to choose the correct response because back bearing is the bearing of a point measured in the opposite direction from point C to point B in the direction of BC. The students who selected alternative C, '*BC bearing*', and D, '*CB bearing*', were also not able to choose the correct response because Options C and D, "BC bearing" and "CB bearing" respectively, don't specify the direction from which the bearing is measured. They only refer to the line itself, without indicating the starting point of the measurement.

Item (vii) was constructed from the topic of *Chain Surveying and Linear Measurement*. Students were required to identify the type of measurements when measuring a distance on the ground with the help of a chain, tape, or any other instrument. The item is intended to measure students' skills in measuring linear distances using a chain, tape, or other surveying instruments that can be used to measure distances. The item was:

The distance measured on the ground with the help of a chain, tape or any other instruments, is known as

A	*Direct measurements*	*B*	*Indirect measurements*
C	*Computative measurements*	*D*	*Instrumental measurements*

The correct alternative was D, '*Instrumental measurements*'. Students who opted for this alternative were familiar with surveying instruments used for distance measurements. Students who opted for alternative A, '*Direct measurements*', were wrong because direct measurements refer to the process of acquiring quantitative data by direct observation or physical involvement. Students who opted for alternative B, '*Indirect measurements*', were also wrong as indirect measurements involve data collection without physical or direct use of measuring tools and equipment due to the presence of obstructions such as rivers or hills. Students who opted for alternative C, '*Computative measurements*', were incorrect because computative measurements use mathematical models or software to process raw data and derive meaningful results. Therefore, alternatives A, B and C were distractors.

Item (viii) was extracted from the topic of *Surveying Techniques (Practice)*, whereby students were required to identify the mathematical expression used for measuring perpendicular offsets by setting a right-angled triangle. The item is intended to measure students' ability to use the right-angled triangle technique to measure perpendicular offset measurements. The item was:

Students were measuring perpendicular offsets by setting right angled triangle. Identify the right mathematical expression used for that particular work.

A 1:2:5 B 1:4:5 C 3:4:5 D 3:4:8

The correct alternative was C, '*3:4:5*', obtained performing Pythagoras theorem, which states that the square of the length of the hypotenuse is

equal to the sum of the squares of the lengths of the other two sides. For those students who opted for alternative A, '*1:2:5*', B, '*1:4:5*' and D, '*3:4:8*' had no enough knowledge and skills in mathematical expression specifically in the application of Pythagoras theorem.

Item (ix) was developed from the topic of *Chain Surveying and Linear measurements*, whereby students were required to convert the given value into a representative fraction scale. This item intended to measure students' ability to convert scale to representative fractions. The question was as follows:

A surveyor used large scale to draw the map of 1cm = 1 m. Convert the value into RF scale.

A $\frac{1}{10}$ B $\frac{1}{100}$

C $\frac{1}{1,000}$ D $\frac{1}{10,000}$

Those students who opted for alternative B, '$\frac{1}{100}$', were able to choose the correct response from the given alternatives because 1 cm of a map represents 1m on the ground, the expression of 1m on the ground is equal to 100 cm and thus representative fraction scale is equal to map distance to ground distance. Students who opted for alternative A, '$\frac{1}{10}$', were incorrect because the actual distance is 100 cm, hence this alternative was a distractor. Those who opted for C, '$\frac{1}{1000}$', were incorrect because 1cm on the map represents 100 cm on the ground. Students who opted for alternative A, '$\frac{1}{10}$', were incorrect because the actual distance is 100 cm. Students who opted for D, '$\frac{1}{10000}$', were also wrong because 1cm on the map does not represent 10000 cm on the ground according to the given scale.

Item (x) was set from the topic of *Introduction surveying methods*, whereby students were required to identify principles to be used by a surveyor to determine the relative positions of different objects on the surface of the earth. The item is intended to measure students' ability to apply principles of surveying in the determination of the relative position of different objects. The question was:

A surveyor wishes to determine the relative position of different objects on the surface of the earth. Which principles are to be used by a surveyor to perform his work?

A *Working from the whole to the part and locate a new station by at least two measurements, from fixed reference points.*

B *Locating a new station by at least two measurements from fixed reference points and bench mark.*

C *Working from the whole to the part and determine the natural features of a country.*

D *Working from whole to the part and locate a new station by one measurement.*

The correct answer was A, '*Working from the whole to the part and locate a new station by at least two measurements, from fixed reference points*'. This is a common surveying approach that minimizes the occurrence of errors, the control points are established with a higher degree of precision within the area. Students who opted for alternative B, '*Locating a new station by at least two measurements from fixed reference points and bench mark.*', were unable to choose the correct response because using fixed reference points and benchmarks for tracing new stations, is not a basic principle in surveying, however alternative C, '*Working from the whole to the part and determine the natural features of a country*', was incorrect response because precise measurements require reference points. Furthermore, more alternative D, '*Working from whole to the part and locate a new station by one measurement*', is not recommended in surveying because relying on only one measurement for locating a new station can lead to inaccuracies and errors. Students who opted for alternative D were unable to select the correct response because the establishment of control points in working from whole to part is done from two reference points.

2.1.2 Question 2: Matching Items

The question required the students to match items (i - v) described in List A with responses in List B by writing the letter of the corresponding correct response beside the item number. Each item in this question carried 01 mark, making a total of 05 marks. The question was designed to test the students' ability to hand signals in *Chain Surveying and Linear Measurements.*

List A	*List B*
(i) Rapid sweep with right hand	*A Plumb the rod to the right*
(ii) Slow sweep with left hand	*B Continues to move to right*
(iii) Right arm up and move to right	*C Considerable to move to right*
(iv) Left arm extended	*D Continues to move to left*
(v) Both hand above head then move below down	*E Fix the rod*
	F Move slowly to left
	G Move slowly to the right
	H Correct position

The analysis of students' performance in this question shows that 153 (54.45%), students scored from 0 to 1 mark, 127 (45.19%) students scored from 2 to 3 marks and 01 (0.36%) student scored from 4 to 5 marks. The ranges of scores used to grade students' performance in this question are presented in Table 2.

Table 2: Score Intervals of Students' Performance in Question 2

Scores Range	Remark	General Performance	
		Number of Students	Percentage
0 – 1	Weak	153	54.45
2 - 3	Average	127	45.19
4 - 5	Good	01	0.36
Total		**281**	**100**

The general performance of students in this question was average as 128 (45.55%) students scored from 2 to 5 marks, and 153 (54.45%) scored from 0 to 1 mark. Figure 3 shows the overall students' performance in question 2.

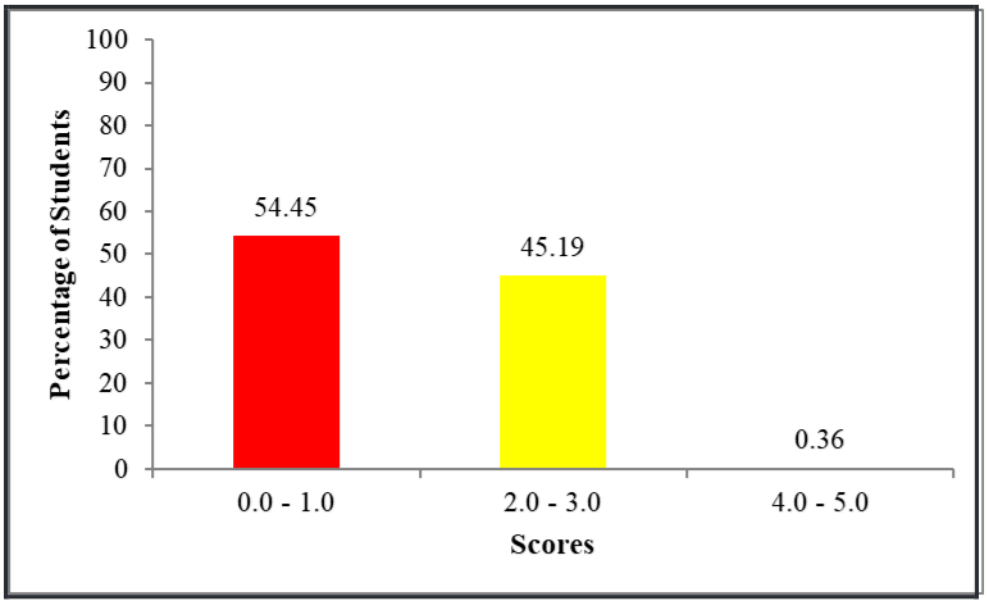


Figure 3: The Students' Performance in Question 2

The students' strengths and weaknesses in choosing responses for individual items of question 2 are analyzed as follows:

Item (i): Students were required to provide the correct response that matches the description "*Rapid sweep with right hand"*. The correct response was C "*Considerable to move to right".* Students who were able to select the response correctly understood clearly the significance of hand signals in the surveying process. On the other hand, students who selected other responses such as "*Continues to move to right*" had no sufficient knowledge and skills because this distractor was closely related to alternative C "*Considerable to move to right".*

Item (ii): The students were required to choose the correct match of the description "*Slow sweep with left hand*". The correct response was F, "*Move slowly to the left*". This indicates a slower and more deliberate movement with the left hand, signaling someone to proceed with caution or perform a task slowly toward the left side. Students who chose matches contrary to this response indicated to have inadequate knowledge of the nonverbal hand signals used in surveying processes.

Item (iii): The students were required to provide a suitable response that matches correctly with the statement "*Right arm up and move to right"*. The correct response was A, "*Plumb the rod to the right*". This means the

rod should be moved to the right and be inserted. Students who selected this option had a clear understanding of different signals and their meaning in the surveying processes. Some of the students opted for G, "*Move slowly to the right*", which was an incorrect response because of intended meaning is unclear and imprecise.

Item (iv): The students were required to choose the correct match of the description "*Left arm extended*". The correct response was D, "*Continues to move to left*". Students who selected this match understood that the signal indicates a continuous movement to the left. Other students who matched contrary to this response had inadequate knowledge of the nonverbal hand signals as applied in surveying activities.

Item (v): The students were asked to match correctly the statement "*Both hand above head then move below down*". The correct response was H, "*Correct position*". This signal means lowering or bringing something down or in a correct position. It might be used in scenarios where an object or equipment needs to be lowered or brought to the correct position. Students who opted for this match had a sufficient understanding of the hand signals as applied to the surveying. Some of the students confused the statement by matching with E, "*Fix the rod*" which is incorrect because its meaning is contrary to the intended gesture. Extracts 1.1 and 1.2 show samples of students' correct and incorrect responses respectively.

List A	(i)	(ii)	(iii)	(iv)	(v)
List B	D	F	C	B	H

Extract 1.1: A sample of the student's correct response to Question 2.

List A	(i)	(ii)	(iii)	(iv)	(v)
List B	C	D	B	F	E

Extract 1.2: A sample of the student's incorrect response to Question 2

2.2 SECTION B: Short Answer Questions

This section consisted of seven (7) questions from 3 to 9, each carrying 10 marks making a total of 70 marks. The students were considered to pass if they scored a grade of D and above. The score ranges used for grading students' performance in this section are indicated in Table 3.

Table 3: Score Intervals for Questions 3 to 9

Score Range (Marks)	Remarks	Grades
0 – 2.5	Weak	**F**
3 - 6	Average	**C - D**
6.5 - 10	Good	**A - B**

2.2.1 Question 3: Civil Engineering Surveyor

This question was extracted from the topic of *Civil Engineering Surveyor*. The question was intended to assess the awareness of the students on surveys' duties. It stated as follows:

'*Suppose you are among the students who are assigned to survey an area for the construction of a school library. What will be your three basic duties as a surveyor?*'.

The question was attempted by 281 students, where 100 (35.59%) students scored from 0 to 2.5 marks, 93 (33.09%) students scored from 3 to 6 marks and 88 (31.32%) students scored from 6.5 to 10 marks. This performance is average as 181 (64.41%) of all students scored from 3 to 10 marks while 100 (35.59%) students scored from 0 to 2.5 marks. Figure 4 represents the students' performance who attempted this question.

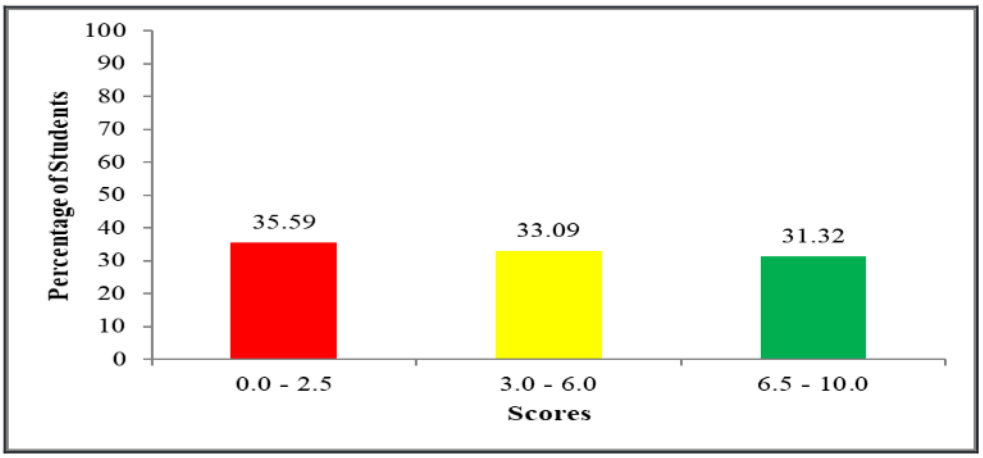
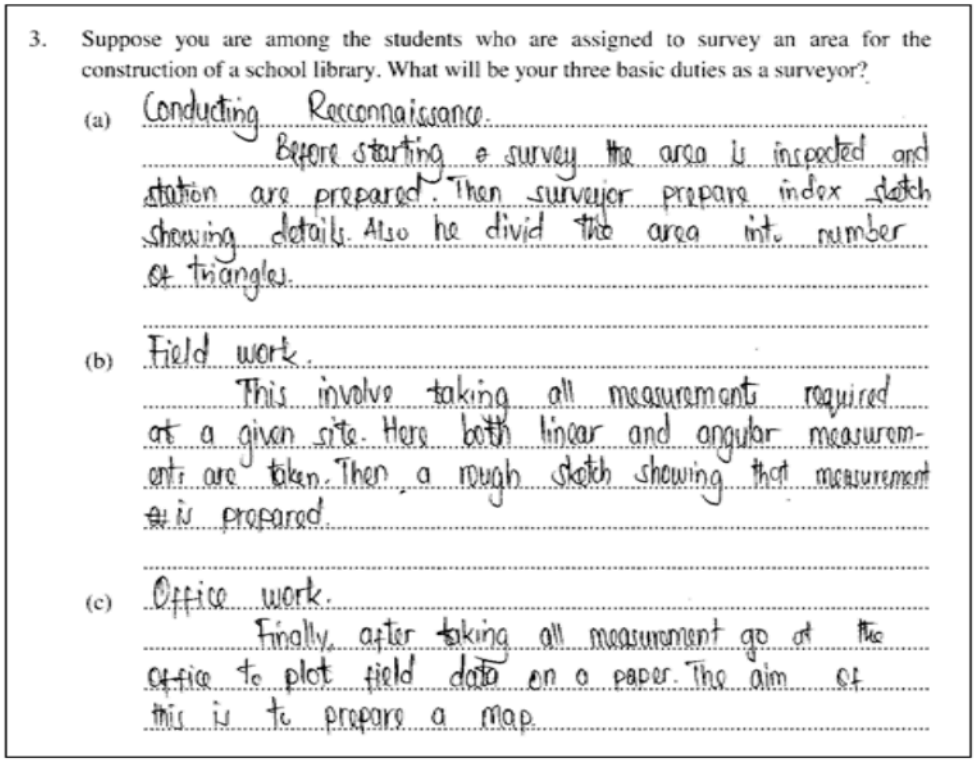


Figure 4: Students' Performance in Question 3.

Figure 4 indicates that 181 (64.41%) students who were able to respond correctly to the item had sufficient knowledge on the topic *Civil Engineering Surveyor*. These students were capable of understanding the requirements of the question. The students provided the three basic duties of the surveyor. They demonstrated their ability by describing the surveyor's duties such as field work which includes the measurements of angles, distances and keeping of records, office work which includes drafting, computing and design works by using the data collected from the field work. Moreover, surveyors have a duty to care and maintain all tools, equipment and materials. These duties require enough experience in handling tools and equipment, the field and office work. Extract 2.1 demonstrates a sample of student who was able to respond correctly than others.



3. Suppose you are among the students who are assigned to survey an area for the construction of a school library. What will be your three basic duties as a surveyor?

(a) Conducting Reccennaissance.
Before starting a survey the area is inspected and station are prepared. Then surveyor prepare index sketch showing details. Also he divid the area int. number of triangles.

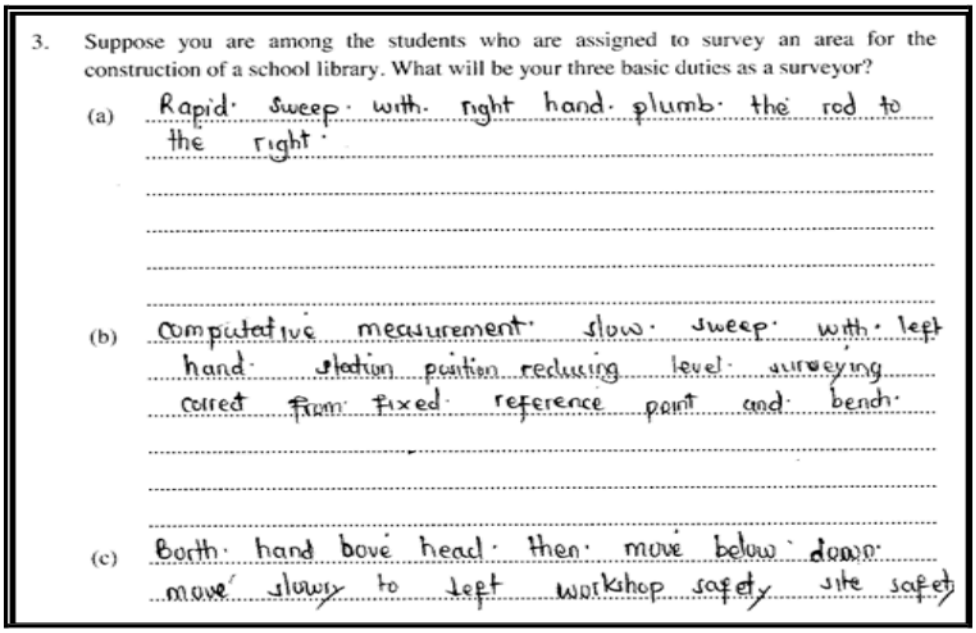
(b) Field work.
This involve taking all measurements required at a given site. Here both linear and angular measurements are taken. Then a rough sketch showing that measurement is prepared.

(c) Office work.
Finally, after taking all measurement go at the office to plot field data on a paper. The aim of this is to prepare a map.

Extract 2.1: A sample of the student's correct responses to Question 3.

On the other hand,100 (35.59%) students who scored from 0 to 2.5 marks demonstrated insufficient knowledge of the topic concerned, as they scored from 0 to 2.5 marks. The following were the reasons for their poor performance; inability to understand the requirements of the question because they provided irrelevant responses such as principles of surveying,

other students mentioned tools and equipment used in surveying, while others explained levelling procedures in the field. Also some of the students provided copies of phrases from the question paper for instance one student wrote "*rapid sweep, with right hand plumb the rod to the right*", the other one wrote "*computative measurement slow sweep with left hand station position reducing level surveying current from fixed reference point and bench*". These responses are the hand signals used in surveying process, the student responses extracted from question 2. The correct responses were "*field works involve measurements of angles and distance and the keeping of record, office works consisting of drafting, computing and designing* and *care and maintenance*" few students were not able to write anything on the answer sheet, Extract 2.2 demonstrated a sample of student who responded incorrectly to the question.


3. Suppose you are among the students who are assigned to survey an area for the construction of a school library. What will be your three basic duties as a surveyor?

(a) Rapid sweep with right hand plumb the rod to the right.

(b) computative measurement slow sweep with left hand station position reducing level surveying corret from fixed reference point and bench.

(c) Both hand bove head then move below down move slowly to left workshop safety site safety

Extract 2.2: A sample of the student's incorrect response to Question 3

2.2.2 Question 4: Surveying Tools and Equipment

The question consisted of two parts (a) and (b). In part (a), the students were required to explain two ways that can be used to check whether the prismatic compass is exactly centered. In part (b), the students were required to explain three reasons why linen tape is not always used in conducting chain surveying. The question was projected to measure the ability of students on some uses of surveying tools. The question stated that;

(a) *One of the temporary adjustments to the prismatic compass in the field is centering. Explain two ways that you can use to check whether the prismatic compass is exactly centered.*

(b) *A linen tape is not always used in conducting chain surveying. Support this statement by giving three reasons.*

This question was attempted by 281 (100%) students, where 216 (76.87%) students scored from 0 to 2.5 marks. The students who scored from 3 to 6 marks were 64 (22.77%) while 01 (0.36%) of the students scored from 6.5 to 10 marks. Generally, the students' performance in this question was weak as 216 (76.87%) of the students scored from 0 to 2.5 marks which is weak. 65 (23.13%) students scored from 3 to 10 marks. This data is summarized in Figure 5.

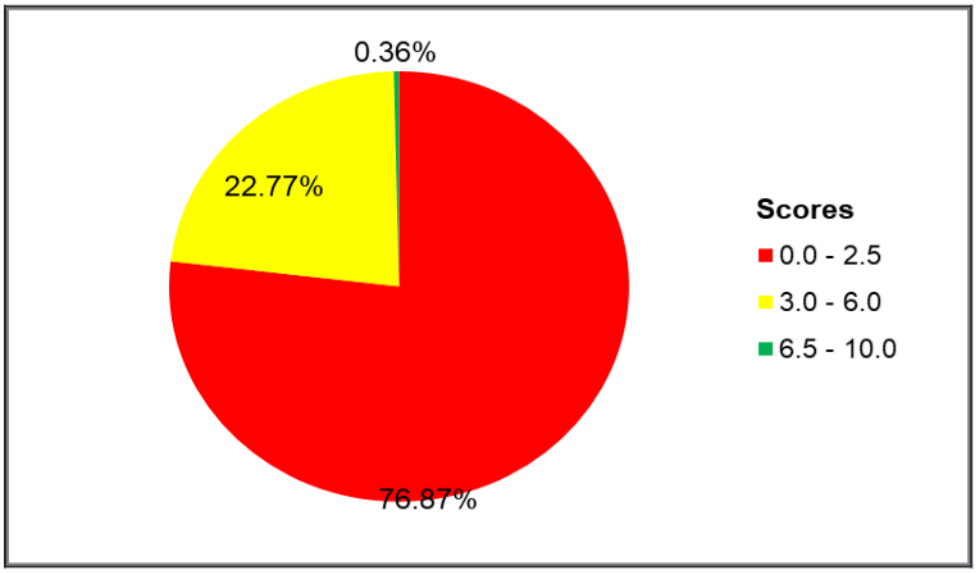


Figure 5: Students' Performance in Question 4

About 216 (76.87%) of the students failed in this question. Their failure is an indication that they had insufficient knowledge on the tested topic of *Surveying Tools and Equipment*. In part (a), most of the students in this category wrote irrelevant responses and some of them copied some words or phrases from other questions and wrote them as their responses. Other students failed to understand the requirements of the question by providing inappropriate responses such as writing procedures of the prismatic compass. For example, a student wrote "*By measuring bearings, when you need to can use to check whether the prismatic compass is exactly centered by measure bearing*", such responses indicates that the students had an

insufficient understanding about the topic. The correct response was "*a plumb bob which is suspended from the underside of the compass to fall exactly on the station*" and pebble is used in the absence of the plumb bob whereby "*centering by pebble is done by dropping it from the center of the bottom of that compass to the center of the station".*

In part (b), students were unable to provide the correct responses as per the requirements of the question. Such students were not able to understand what the linen tape looked like, while other students thought linen tapes must be of shorter length. Examples of such responses are "*by setting a staff with numbers and use a prismatic compass to check if the numbers are, if they are seen then it is exactly centered*" and "*the needle should be vertical. The magnetic need of prismatic compass should be vertical*". Some students repeated the same response more than once while others were not able to write anything on the answer spaces. Extract 3.1 demonstrated a sample of student's incorrect responses to the question.

4. (a) One of the temporary adjustments to the prismatic compass in the field is centering. Explain two ways that you can use to check whether the prismatic compass is exactly centered.

(i) By measuring bearings when you need to can use to check whether the prismatic compass is exactly centred by measure bearing.

(ii) By measuring declination. when you need to check whether the prismatic compass is exactly centred you should be use measure the bearing declination by using true ~~for~~ bearing.

(b) A linen tape is not always used in conducting chain surveying. Support this statement by giving three reasons.

(i) Because it is not cheap A linen tape is not always used in conducting chain surveying because it is not cheap I mean you can not get this instrument that is used to measure various structure easily.

(ii) Because it is ~~cost~~ high cost. A linen tape is not always used in conducting chain survey ing because it is require high cost to sell this tape. So, many people have not enough money to sell it.

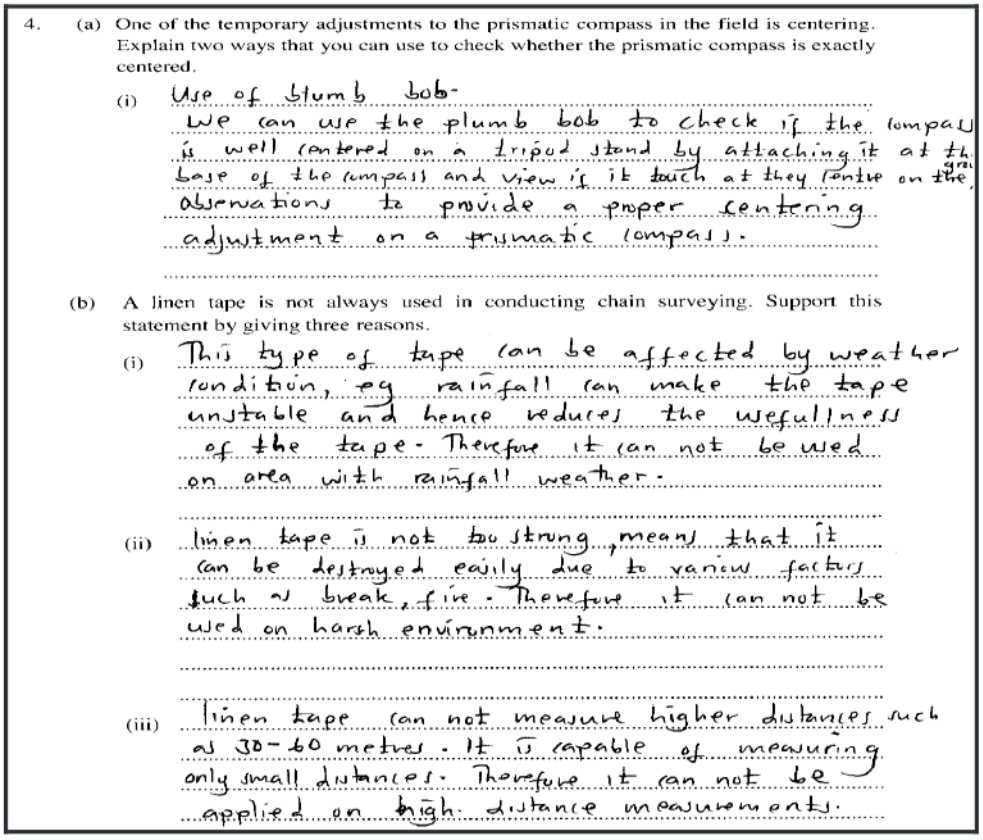
(iii) Because Users not use well A linen tape is not ~~a~~ always used in conducting chain surveying because users / worker are not know about / system to use that well during measuring.

Extract 3.1: A sample of student's incorrect response to Question 4

Moreover, 65 (23.13%) students managed to score average and good marks in this question. Such students were able to demonstrate a strong understanding of the topic. The good performance was triggered by their ability to understand the requirements of the question by providing appropriate responses. In part (a), centering of the prismatic compass as one of the temporary adjustments is done by using a plumb bob or pebble, "*a plumb bob is suspended from the underside of the compass to fall exactly on the station, otherwise the compass is not exactly centered*". Pebble is used in the absence of plumb bob, "*centering by pebble is done by dropping it from the center of the bottom of that compass to the center of the station*", otherwise the centering is not exact. Such students managed to

score good marks.

In part (b) of the question, linen tape is often not recommended in chain surveying because of the four reasons. Students who wrote the following responses proved to have understood clearly the demands of the question and had sufficient knowledge and skills. The responses were supposed to be; "*it is affected by moisture or dampness and thus shrinks, its length gets altered by stretching and can thus provide incorrect readings, it is likely to twist and tangle in the course of taking measurement and It is not strong as compared to steel tapes therefore it can break easily*". Extract 3.2 demonstrated samples of student's correct responses to the question.



4. (a) One of the temporary adjustments to the prismatic compass in the field is centering. Explain two ways that you can use to check whether the prismatic compass is exactly centered.

(i) Use of plumb bob-
We can use the plumb bob to check if the compass is well centered on a tripod stand by attaching it at the base of the compass and view if it touch at they centre on the ground. observations to provide a proper centering adjustment on a prismatic compass.

(b) A linen tape is not always used in conducting chain surveying. Support this statement by giving three reasons.

(i) This type of tape can be affected by weather condition, eg rainfall can make the tape unstable and hence reduces the usefullness of the tape. Therefore it can not be used on area with rainfall weather.

(ii) linen tape is not too strong, means that it can be destroyed easily due to various factors such as break, fire. Therefore it can not be used on harsh environment.

(iii) linen tape can not measure higher distances such as 30-60 metres. It is capable of measuring only small distances. Therefore it can not be applied on high distance measurements.

Extract 3.2: A sample of student's correct response to Question 4

2.2.3 Question 5: Introduction to Surveying Methods

In this question, the students were required to describe five common procedures to be taken when measuring the length of a line from point A to B by using a tape. The question was intended to measure the students'

skills of measuring of a distance by using tape measure. The question stated that;

'Describe five common procedures to be taken when measuring the length of a line from point A to B by using a tape'.

The analysis of students' performance in this question shows that 243 (86.48%) students out of 281 scored from 0 to 2.5 marks. The students who scored from 3 to 6 marks were 32 (11.03%), while 6 (2.49%) students scored from 6.5 to 10 marks. The general analysis of students' performance in this question was weak as 243 (86.48%) of the students scored from 0 to 2.5 marks. This analysis is illustrated in Figure 6.

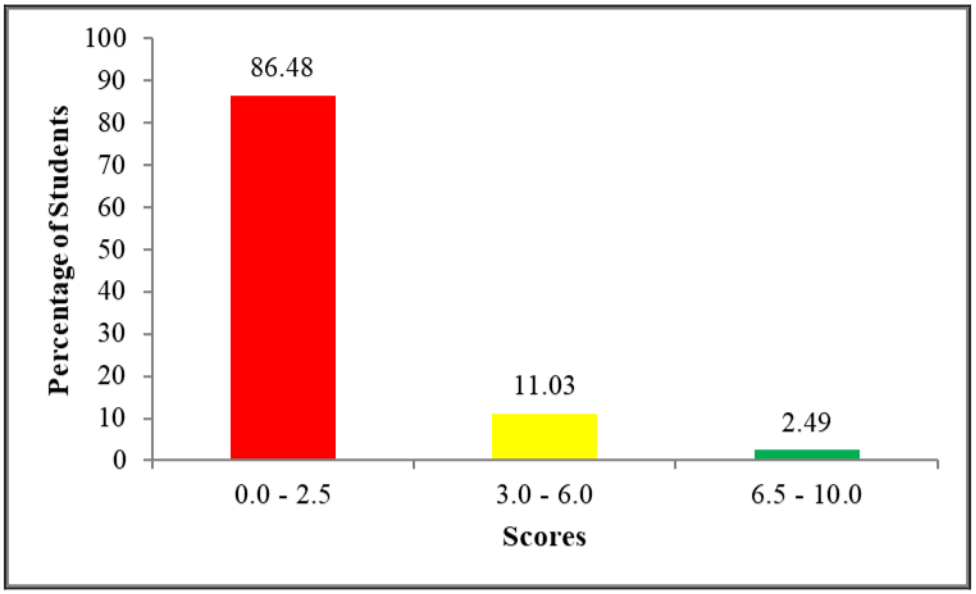


Figure 6: Students' Performance in Question 5

Further analysis reveals that 243 (86.48%) of the students scored below pass marks. The analysis reveals several reasons for the students' poor performance, such as; many students could not grasp the knowledge from the topic concerned and some were unable to understand the requirements of the question. In the first step, students were supposed to identify the line AB to be measured on the ground. Students' poor performance in this step was attributed to their inability to understand the question demands and lack of knowledge on the topic concerned, for instance, one of the students' responses was "*start to measure at zero point and not other points at any*

situation". This response was incorrect because the student mentioned second step instead of the first step.

The second step was "*The follower stands at point A holding one end of the tape while the leader moves ahead holding the zero end of the tape in one hand and a bundle of arrows in the other hand*." The students' failure to respond correctly to this step was due to insufficient knowledge and a lack of surveying practical skills. For example, one student who failed to explain the second step accurately wrote the principle of surveying such as *"working from the whole to the part and locate a new station at least measurement from two reference points survey station from"*.

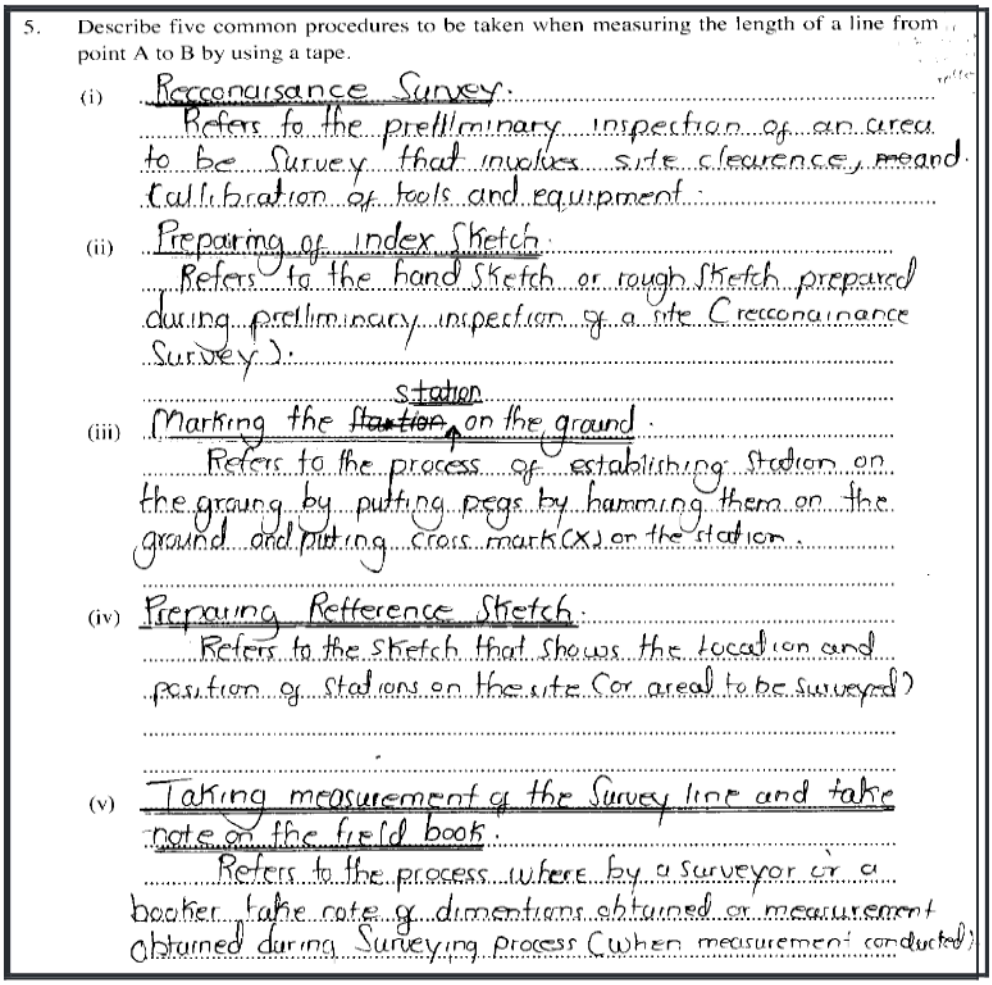
In the third step, "*The follower then releases his end of the tape and the two move forward along the line, the leader dragging the tape; when the end of the tape reaches the arrow just placed, follower calls out tape to stop. He then picks up the end of tape and lines the leader, and the procedure is repeated as in step two"* involves the leader and the follower moving forward to take the second, third, and subsequent measurements in the survey line. Many students struggled by providing unclear or mixed-up responses due to a lack of sufficient knowledge. For example, one student's response was: "*Mark the points (A and B), this involves marking of points (A and B) by either ranging rods or arrows*", this response was supposed to be the first step.

The fourth step was "*When the second arrow has been established by the leader, the follower picks up the first arrow and both persons move ahead as described in step ii. The procedure is repeated until ten tape lengths have been measured. When the leader moves further after the tape length has been measured and reaches the tape length ahead, the follower takes out the tenth arrow, erects a ranging rod or a nail in its place, and transfers ten arrows to the leader. The surveyor records the transfer of arrows in the field book*." In this step, the leader and the follower reach the end point B where the leader reads the final measurement and the follower removes the last arrow from the ground. Students were unable to accurately explain this step due to insufficient knowledge of conducting tape measure surveys. For instance, one student wrote "*preparing reference sketches that show the location and position of stations on the site area to be surveyed*." This answer was incorrect because the student described the use of a "reference sketch" which is utilized in detailed surveys. This response

indicates the student's lack of sufficient knowledge.

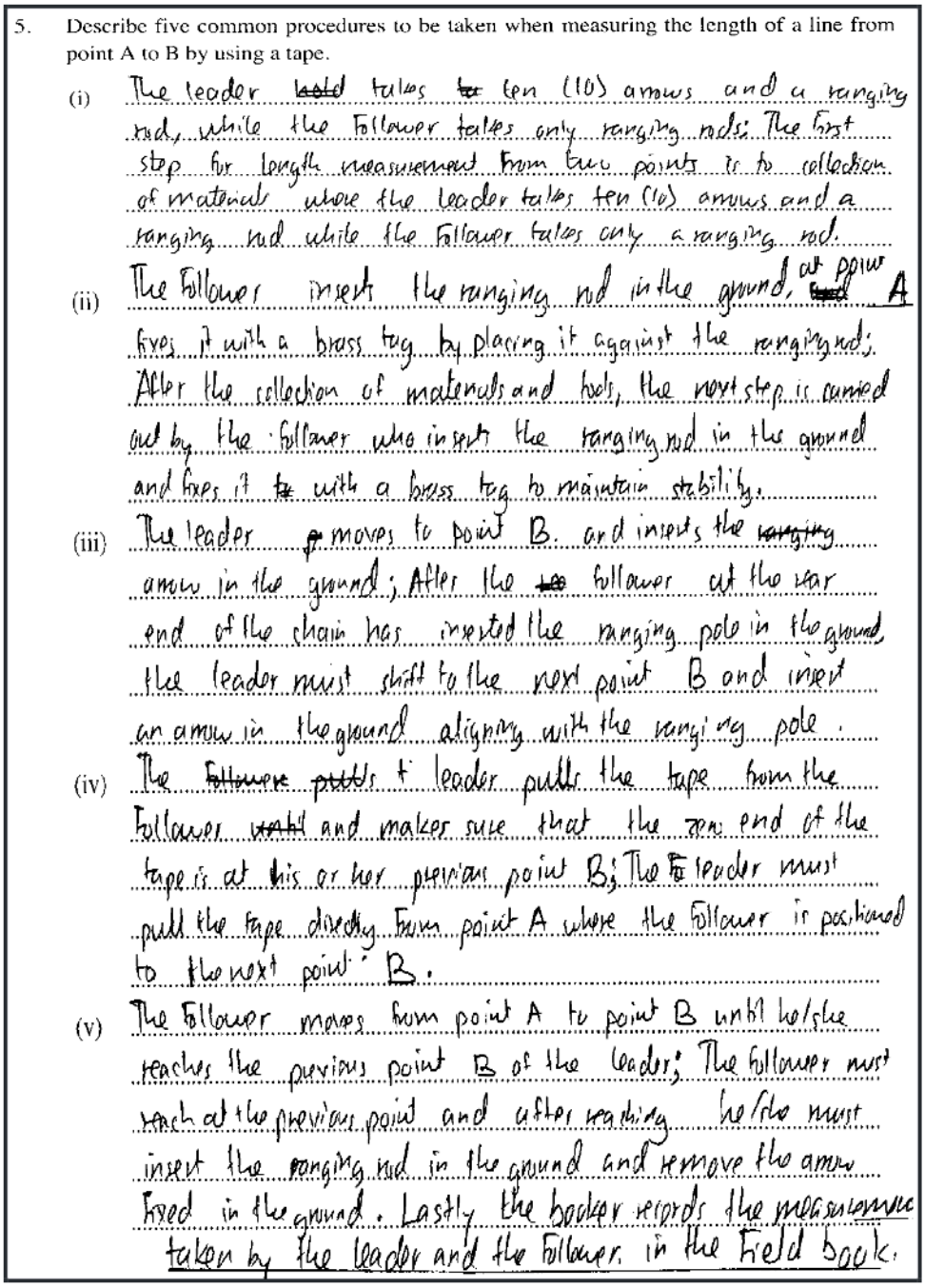
The fifth step was "*At the end of the line, at B, the last measurement will generally be a partial tape length from the last arrow set to the endpoint of the line. The leader holds the end of the tape at B while the follower pulls the tape back until it becomes taut, and then reads against the arrow*." In this step, the exercise concludes by taking the final measurements along the line AB survey line and recording all the initial data for office work. Some students did not explain the survey steps but instead described the use of the tape measure. For example, one student wrote "*tape measure is used in measure into the direct area/ stract area and the used errors to support in measured*" and "*tape measure used duties into the necessary into the length of the baseline.*" This response indicates that the student did not understand the question and lacked mastery of the subject matter. Extract 4.1 shows a sample of student's poor response to this question.

On the other hand, analysis shows that 38 (13.51%) students who scored from 3 to 10 marks had sufficient knowledge of the common five procedures to be taken when measuring the length of a line from one point to another. These students also demonstrated adequate skills on the team members of a surveying activity, number and the types of tools required at the site. They also stipulated specific tasks for both leader and follower. Other students were able to explain the criteria of tools selection in order to minimize errors during measurements. Extract 5.2 gives a sample of correct responses from one of the students who attempted this question.



Extract 4.1: A sample of student's incorrect response to Question 5

In Extract 4.1, students provided irrelevant responses to the question. The student wrote procedures of the preliminary steps when conducting fieldwork for chain surveying instead of writing the procedures for measuring the length of the line. As explained before, some students provided relevant responses. Extract 4.2 is a sample of the correct responses to question 5.



5. Describe five common procedures to be taken when measuring the length of a line from point A to B by using a tape.

(i) The leader ~~took~~ takes ~~to~~ ten (10) arrows and a ranging rod, while the Follower takes only ranging rods. The first step for length measurement from two points is to collection of materials where the leader takes ten (10) arrows and a ranging rod while the Follower takes only a ranging rod.

(ii) The Follower inserts the ranging rod in the ground, at point A fixes it with a brass tag by placing it against the ranging rod. After the collection of materials and tools, the next step is carried out by the follower who inserts the ranging rod in the ground and fixes it ~~to~~ with a brass tag to maintain stability.

(iii) The leader ~~p~~ moves to point B. and inserts the ~~ranging~~ arrow in the ground. After the ~~the~~ follower at the rear end of the chain has inserted the ranging pole in the ground, the leader must shift to the next point B and insert an arrow in the ground aligning with the ranging pole.

(iv) The ~~Follower pulls~~ t leader pulls the tape from the follower ~~with~~ and makes sure that the zero end of the tape is at his or her previous point B. The ~~Fo~~ leader must pull the tape directly from point A where the follower is positioned to the next point B.

(v) The follower moves from point A to point B until he/she reaches the previous point B of the leader. The follower must reach at the previous point and after reaching he/she must insert the ranging rod in the ground and remove the arrow fixed in the ground. Lastly the booker records the measurement taken by the leader and the follower in the field book.

Extract 4.2: A sample of student's correct response to Question 5.

In Extract 4.2, most of the students managed to provide the common procedures to be taken when measuring the length of the line from point A to point B by using a tape, indicating that they were conscious of the concept and understood the demand of the question.

2.2.4 Question 6: Chain Surveying and Linear Measurements

The question had three parts namely: (a), (b) and (c) where in (a), students were required to calculate the true length of line AC on a sloping area AB with 40.50 m at angle 30^0. In (b), students were required to mention three duties of the chainman before linear measurements are taken on the ground, while in (c), students were required to give reasons why a follower stays at the rear end position of the chain and hold zero end of the chain at the station during linear measurements. The question was intended to measure the awareness of the students on chainman either if in front or rear end position but also, how they can do in chaining on leveling ground. The question stated that;

(a) The surveyor is conducting a linear measurement on the sloping area. The length of the slope AB is 40.50 m and the angle measured is 30^0. Calculate the true length of line AC.

(b) Before linear measurements are taken on the ground the chainman is supposed to be at the forward end of the chain. What are the three duties of a chainman on that context?

(c) During linear measurements, a follower should be at the rear end of the chain and holds zero end of the chain at the station. Why the follower should stay on that position?

The analysis of students' performance in this question shows that 217 (77.22%) students out of 281 scored from 0 to 2.5 marks, 57 (20.29%) students scored from 3 to 6 marks and 7 (2.49%) students scored from 6.5 to 10 marks. The general performance of students for this question was poor as the majority 217 (77.22%) of the students who attempted this question scored below pass marks as illustrated in Figure 7.

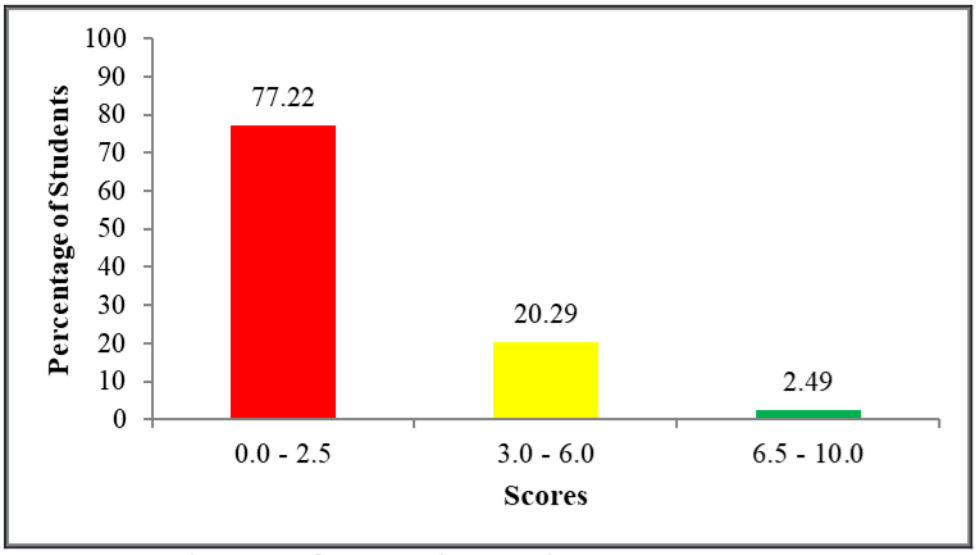


Figure 7: Students' Performance in Question 6

The data shows that 217 (77.22%) of the students scored below pass marks. These students did not comprehend the requirements of the question and also had insufficient knowledge in the concepts of *Chain Surveying and Linear Measurements*.

In part (a) Students were required to calculate the true length of line AC. They were supposed to use the trigonometrical cosine function since the length of the slope AB and the inclination were given. The majority of students were not able to provide correct answers as required by the question. This implies that students lacked enough knowledge to identify the right-angled triangle formed by lines AB and AC on the ground. Other students failed to identify the line AB and AC of the triangle formed which are the hypotenuse and adjacent sides respectively, as a result of failure to use the mathematical cosine function, AC = *AB x cos (α),* to calculate the true length AC on the ground. Some of them failed to provide the given data, while others used the sine function to compute the length AC.

Oppositely, while the majority answered incorrectly, some of the students were able to comprehend the demands of the question as they were able to use mathematical trigonometric function to calculate the true length of the line AC. Such students were able to identify the right-angled triangle formed by lines AB and AC on the ground. These students applied the formulae *AC = AB* x *cos (α),* where α = 30° to reach the correct response which was 35.073 m.

In part (b), the majority of students failed to provide three basic duties of a chainman when taking linear measurements in surveying. According to the question's demand, a chainman is supposed to drag the chain forward with some arrows and a ranging rod, to fix the arrows on the ground at the end of every chain and to follow the instructions of the follower. Students' poor performance in this part depicted a lack of knowledge of the topic and failure to understand the concepts of chaining in surveying. Other students provided unclear responses, for example, one of them wrote '*it help measurement to forward end of the chainman*'. This statement provided by one of the students does not give clear meaning.

However, few students could understand both the demands of the question and the topic concerned, as they managed to give the duties of the chainman like, dragging the chain forward with some arrows and a ranging rod, fixing the arrows on the ground at the end of every chain, helping in setting up and calibrating surveying equipment, obeying the instructions as given by the follower, in some cases, chainmen may help clear vegetation or obstacles that obstruct the surveying process, care and maintain the tools and equipment. Such students responded correctly to the question.

In part (c), students were required to provide three reasons for the follower to stay at the rear of the chain when taking linear measurements in surveying. According to the question's requirements a follower has the duties of directing the leader at the time of ranging, carrying the rear handle of the chain and picking up the arrows inserted by the leader. Students who failed to respond correctly lacked sufficient understanding of the concepts in chaining. For example, one student wrote "*Drags out the ranging rods*", this response was incorrect because such duty belongs to the chainman.

Inversely, some of the students were able to provide the correct responses as per the requirements of the question. Such students were capable of comprehending with duties of the follower in the *Chain Surveying and Linear Measurement.* Students who got high scores were able to provide correct responses such as "directing the leader at the time of ranging, carrying the rear handle of the chain and picking up the arrows inserted by the leader during taking linear measurements".

6. (a) The surveyor is conducting a linear measurement on the sloping area. The length of the slope AB is 40.50 m and the angle measured is 30^0. Calculate the true length of line AC.

Soln

True length = $\frac{\text{Length of AB} \times \text{angle measured}}{100}$

$= \frac{40.5\cancel{0} \times 3\cancel{0}\cancel{0}}{1\cancel{0}\cancel{0}} = 40.5 \times 3$

Length of $\overline{AC}$ = 121.5 m

(b) Before linear measurements are taken on the ground the chainman is supposed to be at the forward end of the chain. What are the three duties of a chainman on that context?

(i) To take linear measurement at the forward end of the chain.

(ii) To correct the incorrect data of the measurement.

(iii) To ensure take all correct measurement during measuring process are doing.

(c) During linear measurements, a follower should be at the rear end of the chain and holds zero end of the chain at the station. Why the follower should stay on that position?

(i) To take linear measurent at the rear end of the chain and hold zero end of the chain at the station.

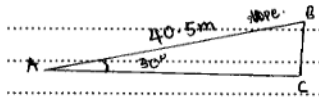
(ii) To correct the data of the measurement during measuring process if the measurement is not correct.

(iii) To ensure that take all correct measurement during do the linear measurement.

Extract 5.1: A sample of student's incorrect responses to Question 6

In Extract 5.1, the student provided irrelevant responses to all questions. In part (a) students failed to identify the right-angled triangle and use of formulae. In part (b) the students failed to understand the concepts of chaining in surveying, and in (c) he or she wrote measurement of distance instead of writing the importance of the follower staying at the rear end.

6. (a) The surveyor is conducting a linear measurement on the sloping area. The length of the slope AB is 40.50 m and the angle measured is 30^0. Calculate the true length of line AC.



Cos 30° = AC / 40·5m

From; Cos C = Adjacent / Hypotenus

AC = 40·5 m Cos 30° but Cos 30° = 0·8

= 40·5 m x 0·866

= 35·073m.

∴ The true length of line AC is 35·073m.

(b) Before linear measurements are taken on the ground the chainman is supposed to be at the forward end of the chain. What are the three duties of a chainman on that context?

(i) To drag the chain foward to prevent sagging of the chain while taking measurements.

(ii) To establish the chaining proces by unfolding the chain towards its chain line or survey line.

(iii) To hold the chain at the end of the chain on its station.

(c) During linear measurements, a follower should be at the rear end of the chain and holds zero end of the chain at the station. Why the follower should stay on that position?

(i) A follower should be at the rear end of the chain to direct the leader in order to make proper ranging.

(ii) A follower should zero end of the chain at the station to prevent accumulation of errors in the measurements.

(iii) The follower should stay on that position to enable the chainman (leader) to drag or unfold the chain so as to take measurements.

Extract 5.2: A sample of student's correct responses to Question 6

In Extract 5.2, the student provided relevant responses to all three items indicating adequate knowledge of the topic and understanding of the requirement of the question.

2.2.5 Question 7: Surveying Techniques for Small Areas Practice

The question had six parts (a) to (f) in which students were required to prepare a checklist of pieces of equipment used to establish the elevations of the buildings under the given guidelines. The question was intended to measure awareness of the students on surveying equipment and how can be relate the correct tools with specific works. It stated that;

Suppose you have been awarded a project to establish the elevations of all the buildings in Masoko town. Prepare a check list of pieces of equipment you will use to conduct this project basing on the following guidelines:

(a) Four equipment for measuring elevations

(b) Four self-leading staves for vertical measurement.

(c) Six tools for linear measurements.

(d) Two equipment for measuring angles.

(e) Two equipment for measuring bearings.

(f) One equipment for measuring area.

The analysis of students' performance in this question shows that 71 (25.27%) scored from 0 to 2.5 marks, 204 (72.59%) students scored from 3 to 6 marks, and 6 (2.14%) students scored from 6.5 to 10 marks. The general performance in this question was good as 210 (74.73%) students who attempted this question scored pass marks from 3-10 marks. The rest 71 (25.27%) students scored between 0 to 2.5 marks. This analysis is illustrated in Figure 8.

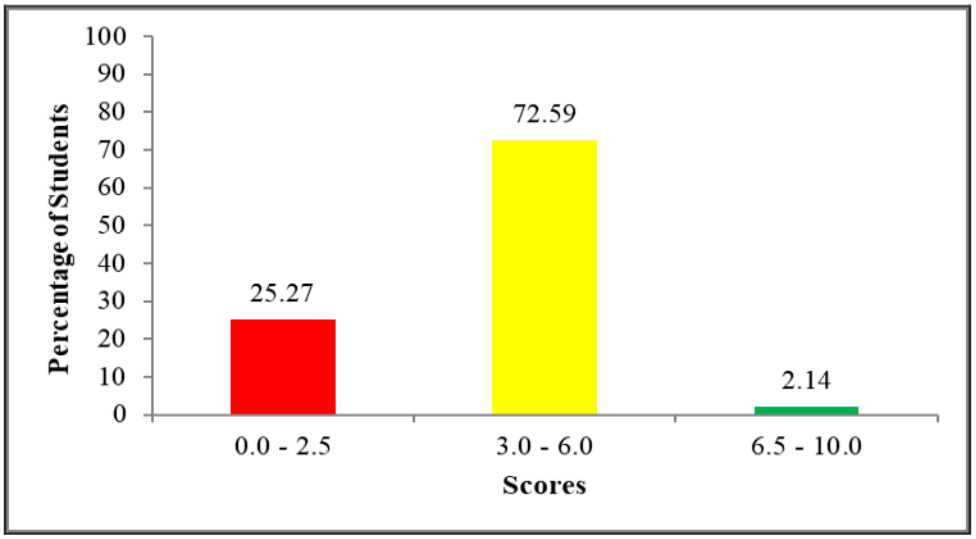
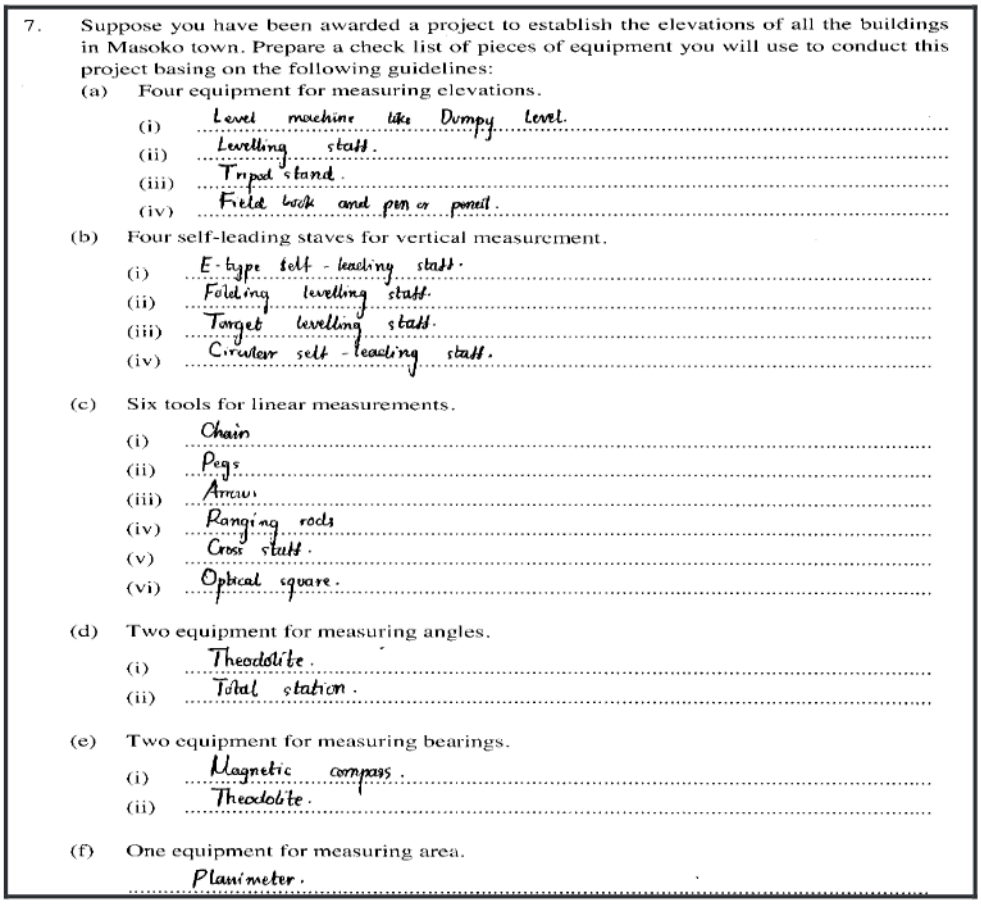


Figure 8: The Students' Performance in Question 7

Based on Figure 8, the general performance of students in this question was good as 210 (74.73%) of the students scored from 3 to 10 marks. The students' good performance on this question was contributed by their ability to meet the requirements of the question and sufficient knowledge of practical skills in the topic of *Surveying Techniques for Small Areas Practice*.

Majority of the students were able to mention tools that fall into these categories. For instance, a good number of students were able to name the following instruments "*Dumpy level, Automatic level, Tilting level and Wye level*" which fall under equipment for measuring elevations. Other students were able to mention the tools under self-leading staves for vertical measurement such as "sop with telescopic staff, folding metric staff, one-length staff and invar staff correctly". Some students went further to list six tools for linear measurements which are *tape, chain, ranging rod, arrows, peg and notebook.* Two pieces of equipment for measuring angles are *"theodolite and total station "while* two *pieces of* equipment for measuring bearings include "*prismatic compass and surveyor's compass*". On the other hand, students mentioned "*Planimeter*" which is an equipment for measuring area. Extract 6.1 shows a sample of students' correct responses to question 7.



7. Suppose you have been awarded a project to establish the elevations of all the buildings in Masoko town. Prepare a check list of pieces of equipment you will use to conduct this project basing on the following guidelines:

(a) Four equipment for measuring elevations.
- (i) Level machine like Dumpy level.
- (ii) Levelling staff.
- (iii) Tripod stand.
- (iv) Field book and pen or pencil.

(b) Four self-leading staves for vertical measurement.
- (i) E-type self-leveling staff.
- (ii) Folding levelling staff.
- (iii) Target levelling staff.
- (iv) Circular self-leveling staff.

(c) Six tools for linear measurements.
- (i) Chain
- (ii) Pegs
- (iii) Arrows
- (iv) Ranging rods
- (v) Cross staff.
- (vi) Optical square.

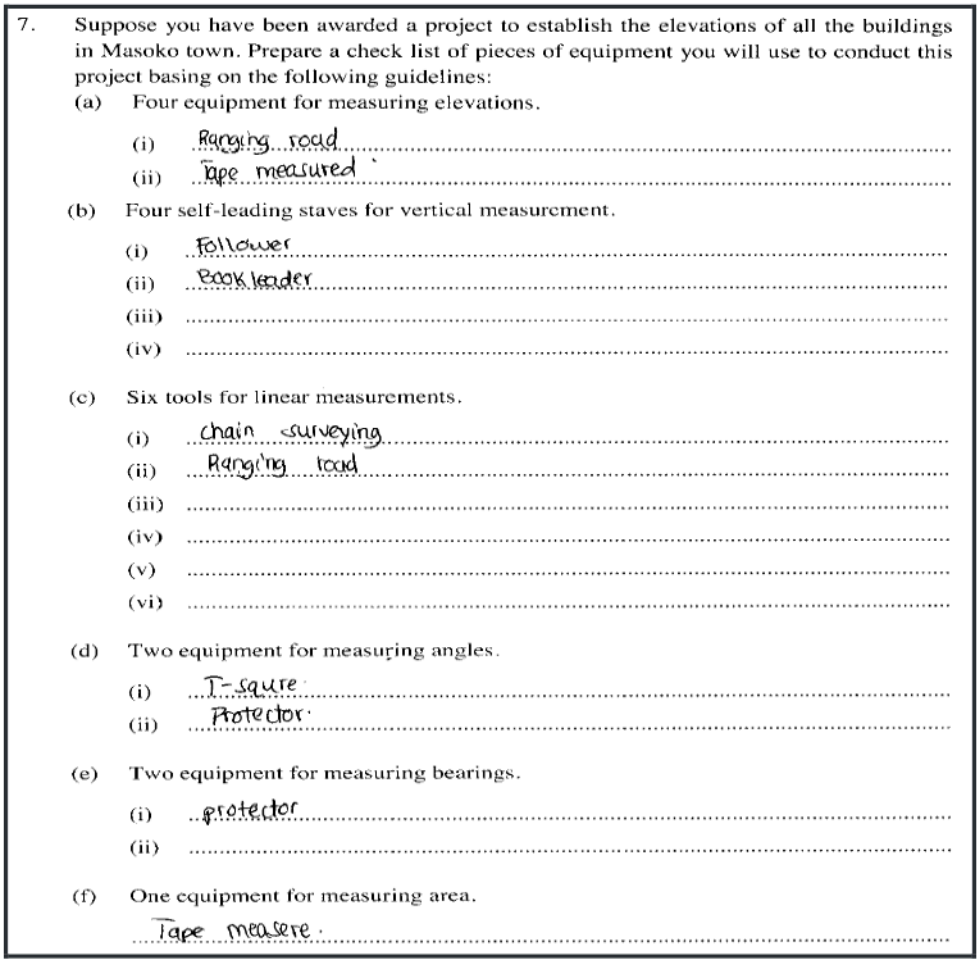
(d) Two equipment for measuring angles.
- (i) Theodolite.
- (ii) Total station.

(e) Two equipment for measuring bearings.
- (i) Magnetic compass.
- (ii) Theodolite.

(f) One equipment for measuring area.
Planimeter.

Extract 6.1: A sample of students' correct responses to Question 7

Further analysis shows that the majority of students had performed well, but other students were not able to score pass marks. Statistics show that 71 (25.27%) students in this question scored from 0 to 2.5 marks. Students' poor performance was attributed to irrelevant responses and lack of sufficient knowledge. Other students failed to meet the requirements of the question. These students also demonstrated that they had inadequate practical skills. For instance, in part (a) of the question one student mentioned "*Clinnometer, Cross staff, Compass and Clinometer*", the correct answer was "*Dumpy level, Automatic level, Tilting level and Wye level*". In part (b) of the questions a student wrote "*Total Station, and Theodolite*" instead of "*Sop with telescopic staff, Folding metric staff, One-length staff, Invar staff*". Other students were not able to provide any response in spaces provided, this indicates lack of knowledge to the topic concerned. Extract 6.2 shows a sample of incorrect responses to question 7.



7. Suppose you have been awarded a project to establish the elevations of all the buildings in Masoko town. Prepare a check list of pieces of equipment you will use to conduct this project basing on the following guidelines:

(a) Four equipment for measuring elevations.

(i) Ranging rood

(ii) Tape measured

(b) Four self-leading staves for vertical measurement.

(i) Follower

(ii) Book leader

(iii)

(iv)

(c) Six tools for linear measurements.

(i) chain surveying

(ii) Ranging rood

(iii)

(iv)

(v)

(vi)

(d) Two equipment for measuring angles.

(i) T-squre

(ii) Protector

(e) Two equipment for measuring bearings.

(i) protector

(ii)

(f) One equipment for measuring area.

Tape measere

Extract 6.2: A sample of student's incorrect responses to Question 7

2.2.6 Question 8: Surveying Techniques for Small Areas Practice

In this question, students were required to prepare and identify the uses of five equipment that would be needed to conduct chain surveying at a sisal farm and was intended to measure the ability of the students on performing surveying works in different places. It stated that;

"Prepare five equipment you would need for conducting chain surveying at a sisal farm and identify their uses".

The analysis of students' performance in this question shows that 54 (19.22%) students scored from 0 to 2.5 marks, 91 (32.38%) students scored from 3 to 6 marks and 136 (48.40%) students scored from 6.5 to 10 marks. The general performance in this question was good because 227 (80.78%) students who attempted this question scored pass marks. This analysis is illustrated in Figure 9.

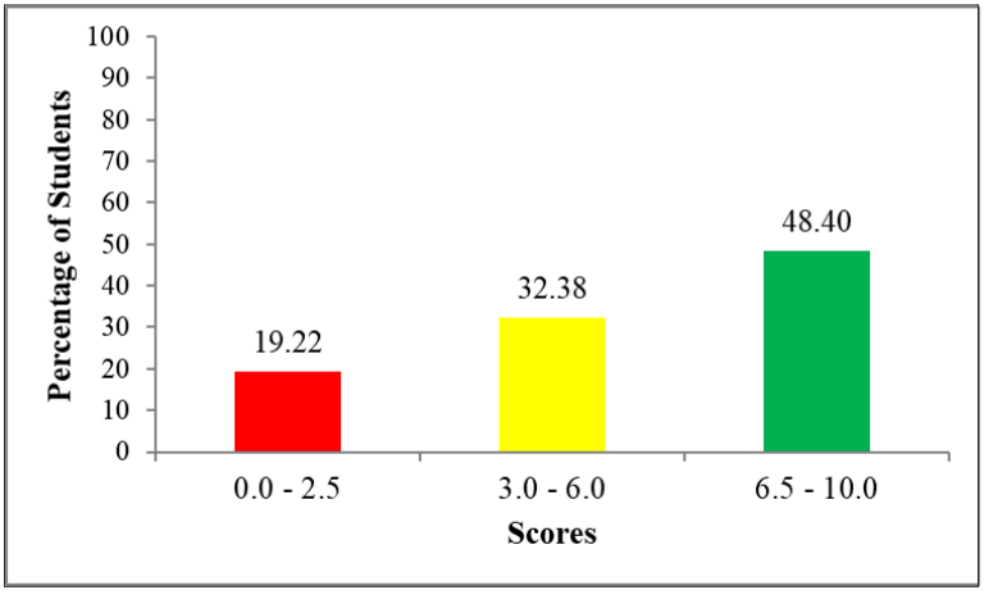
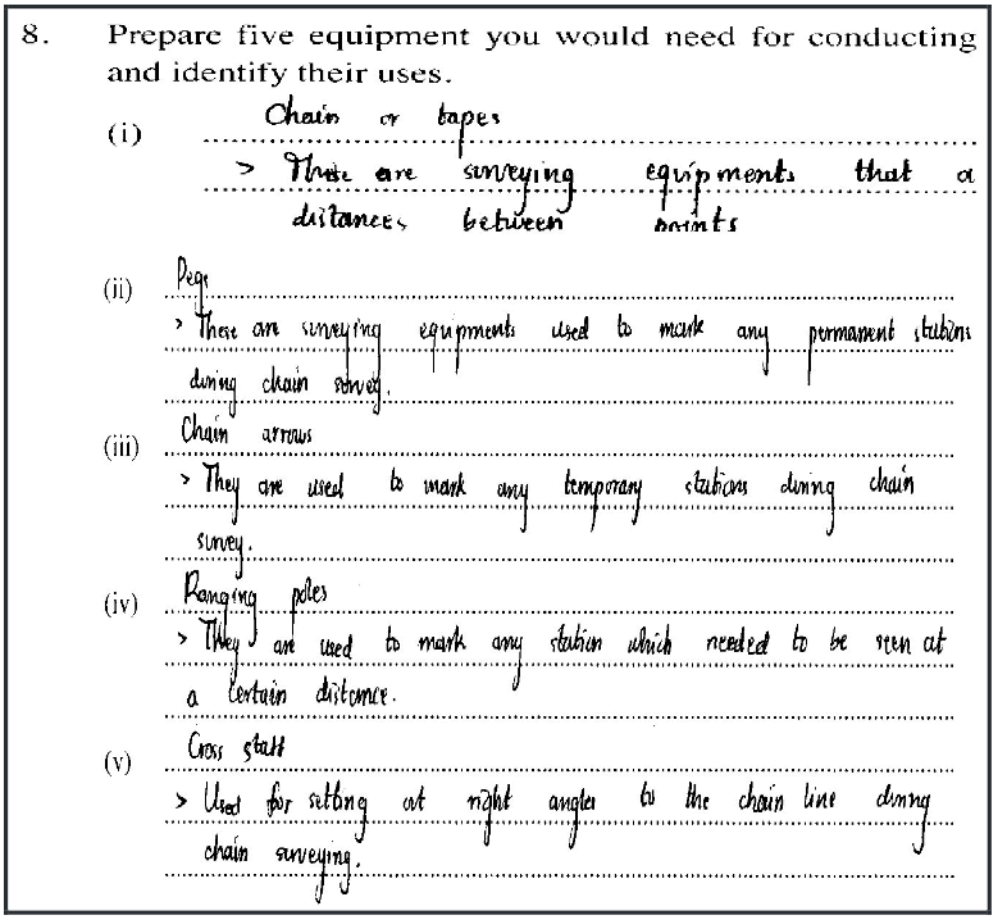


Figure 9: Students' Performance in Question 8

Based on Table 10 and Figure 9, the general performance of students in this question was good as 227 (80.78%) of the students scored from 3 to 10 marks. Students who answered this question correctly demonstrated a good understanding of the topic that assessed students' learning process. They were able to accurately mention equipment and its uses. A significant

number of students performed well in this question by correctly listing some of the equipment. For instance, one student wrote; *"Tape measure: is a tool used to take horizontal linear measurements from point A to point B". "Ranging rods: a tool used to range some intermediate points in the survey line". "Arrows: are tools used to insert at the end of each chain length on the ground". "Pegs: are tools used to mark the position of stations permanently". "Plumb bob: is a tool used to make ranging rod vertical and transfer point from line ranger to the ground".* Extract 7.1 shows a sample of correct responses to question 8.


8. Prepare five equipment you would need for conducting and identify their uses.

(i) Chain or tapes
> These are surveying equipments that a distances between points

(ii) Pegs
> These are surveying equipments used to mark any permanent stations during chain survey.

(iii) Chain arrows
> They are used to mark any temporary stations during chain survey.

(iv) Ranging poles
> They are used to mark any station which needed to be seen at a certain distance.

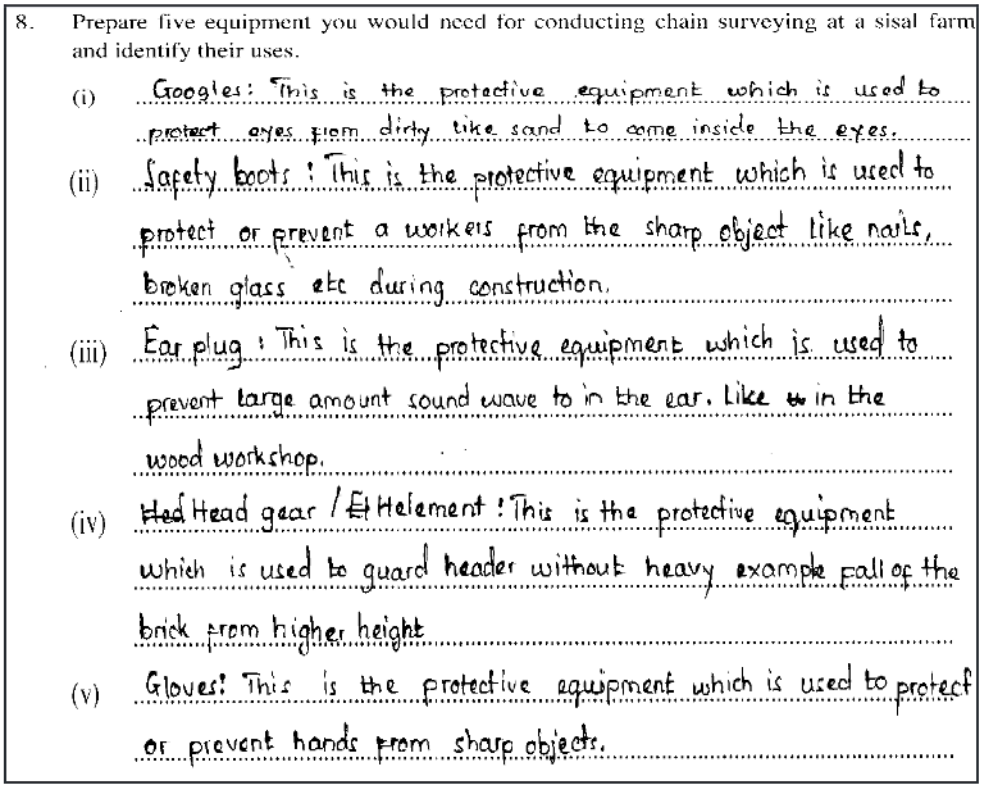
(v) Cross staff
> Used for setting out right angles to the chain line during chain surveying.

Extract 7.1: Sample of the student's correct responses to Question 8.

Extract 7.1, is an example of a student who provided relevant responses. This student demonstrated his or her full capacity both to understand the requirements of the question and sufficient mastery of the topic concerned.

As it was analyzed earlier there were 54 (19.22%) students who provided

incorrect responses, such students had inadequate knowledge and skills of the topic *Surveying Techniques for Small Areas Practice*. Another factor for their poor performance was contributed by insufficient knowledge and skills on equipment used in chain surveying. Examples of such responses are; "*chain survey; is used in help in measuring number of length*". Such student did not adhere to the requirement of the question because he or she was unable to understand the question demand. There was a student who wrote "*googles; this is the protective equipment which is used to protect eyes from dirty like sand to come inside the eyes*", "*safety boots, ear plugs, and gloves*" he/she provided personal protective equipment instead of providing equipment for chain surveying such as tape measure, ranging rods, arrows, pegs and plumb bob. This indicates the student lacked knowledge on the concepts tested. Some of the students wrote ambiguous statements, while others were unable to write anything in the spaces provided. Extract 7.2 shows a sample of students' incorrect responses to question 8.



8. Prepare five equipment you would need for conducting chain surveying at a sisal farm and identify their uses.

(i) Googles: This is the protective equipment which is used to protect eyes from dirty like sand to come inside the eyes.

(ii) Safety boots : This is the protective equipment which is used to protect or prevent a workers from the sharp object like nails, broken glass etc during construction.

(iii) Ear plug : This is the protective equipment which is used to prevent large amount sound wave to in the ear. Like ~~w~~ in the wood workshop.

(iv) ~~Hed~~ Head gear / ~~El~~ Helement : This is the protective equipment which is used to guard header without heavy example fall of the brick from higher height

(v) Gloves: This is the protective equipment which is used to protect or prevent hands from sharp objects.

Extract 7.2: A sample of the student's incorrect responses to Question 8

Extract 7.2 shows a student who provided irrelevant responses to all five

points in this question and he/she failed to score pass marks.

2.2.7 Question 9: Surveying Tools and Equipment

This question had two parts, (a) and (b) where in (a) students were supposed to write five causes of positive errors and in part (b) students were required to write the negative errors. The question was intended to measure the competence of the students on chain surveying, how it suffer from errors especially instrumental errors during measurement. The expansion or contraction of chain may cause either additional (positive) error or subtraction (negative) error. The question it stated that;

Readings recording during chain surveying suffers from series of different errors which can be either positive or negative. In each case, what are the five causes of errors that can be corrected before using the data?

(a) Positive errors.

(b) Negative errors.

The analysis of students' performance in this question shows that 133 (43.77%) students scored from 0 to 2.5 marks. As well as 133 (43.77%) students scored from 3 to 6 marks, and 15 (5.34%) students managed to score from 6.5 to 10 marks. General performance in this question was average as 148 (49.11%) students scored above the pass marks, as illustrated in Figure 10.

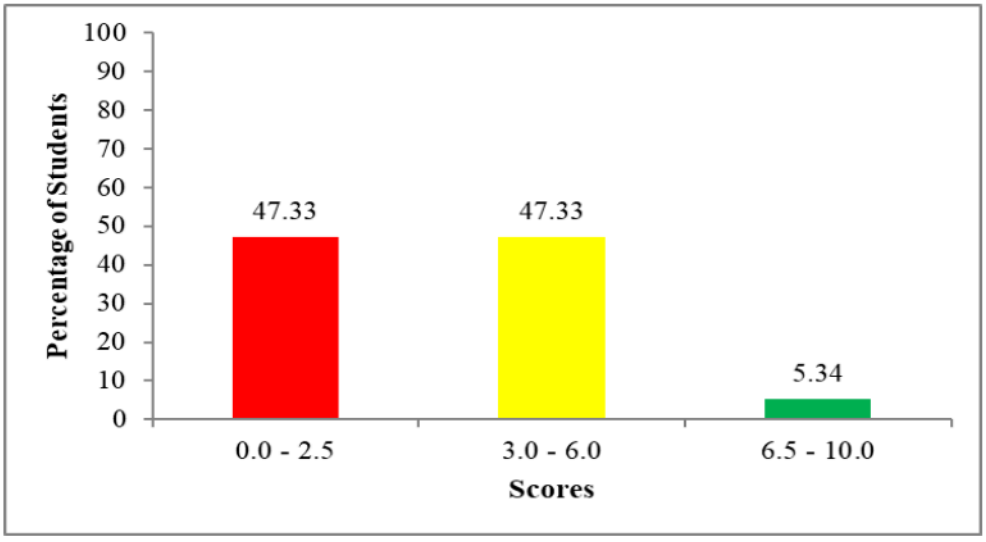


Figure 10: Students' Performance in Question 9

The general performance of students for this question was average as 148 (49.11%) out of 281 students scored from 3 to 10 marks. Such students were able to respond correctly to the question, as they showed to have adequate knowledge of the topic *Surveying Tools and Equipment*. The students who provided correct responses in part (a) positive errors and (b) negative errors, demonstrated the ability to describe the causes of errors in surveying. The students were able to mention causes of errors as in part (a) these are; the length of chain or tape being longer than standard length, ignoring slope correction, ignoring correction for sag, measurement being taken with faulty alignment and measurement being taken in high winds with tape in suspension. In part (b), the opening of the ring joint, the applied pull being much greater than the standard pull, the temperature during measurement being much higher than the standard temperature, wearing of connecting rings and elongation of the links due to heavy pull. Extract 8.1 is a sample of responses from students who provided correct responses.

9. Readings recording during chain surveying suffers from series of different errors which can be either positive or negative. In each case, what are the five causes of errors that can be corrected before using the data?

(a) Positive errors

(i) Wind; Wind can cause the bent of the tape. So we get positive error.

(ii) Sag; When follower and leader don't pull well at the tape as need. Tape bend at the.

(iii) Temperature; As the temperature increase the tape tend to exepand.

(iv) Elongation; As the tape increase in length we get positive error.

(v) Tension pull; As the pull reduced the error will occur.

(b) Negative errors

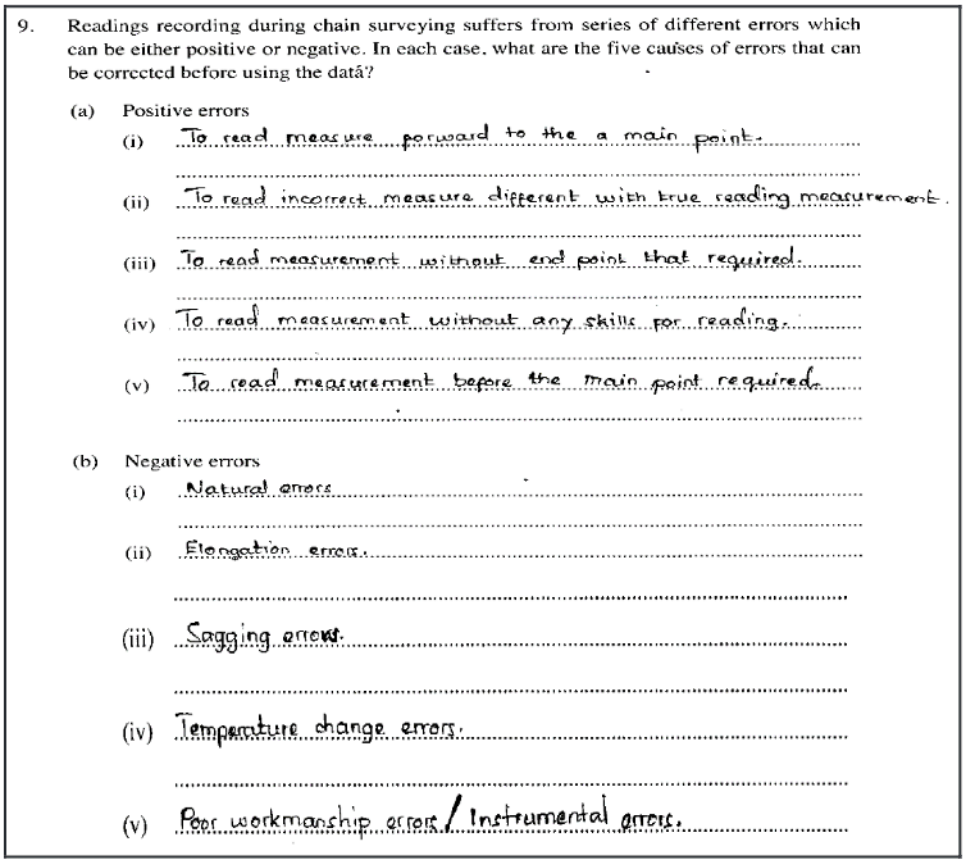
(i) When tape is pulled to the maximum

(ii) Doing measurement during cold season

Extract 8.1: A sample of the student's correct responses to Question 9

Furthermore, analysis shows that although the majority of the students had good performance, 133 (43.77%) students scored from 0 to 2.5 marks. Students' poor performance was indicated by irrelevant responses caused by lack of or insufficient knowledge and failure to meet the demands of the question. These students also demonstrated that they had inadequate practical skills. For instance, in part (a) different students had various incorrect responses such as "*using the chain which is the start, it is known as positive*", "*insufficient ranging*", "*insufficient straightening of the chain or tape*". These responses were incorrect because positive errors refer to errors that cause a measured value to be greater than the true value hence their causes should be "*the length of chain or tape being longer than standard length, ignoring slope correction, ignoring correction for sag, measurement being taken with faulty alignment and measurement being taken in high winds with tape in suspension*".

In part (b) some of the incorrect responses provided were "*sag, this is when the tape is not straight, it bends and cause*", "*incompetence of surveyors*", "*random errors, instrument errors, survey line to be large*". Such answers were not correct since negative errors in measurement are errors that cause a measured value to be less than the true value, instrument errors is a general term it can either be positive or negative. Causes of negative errors can either be *the opening of ring joint, the applied pull being much greater than the standard pull, the temperature during measurement being much higher than the standard temperature, wearing of connecting rings* or *elongation of the links due to heavy pull.* Extract 8.2 is an example of incorrect to question 9.



9. Readings recording during chain surveying suffers from series of different errors which can be either positive or negative. In each case, what are the five causes of errors that can be corrected before using the data?

(a) Positive errors

(i) To read measure forward to the a main point.

(ii) To read incorrect measure different with true reading measurement.

(iii) To read measurement without end point that required.

(iv) To read measurement without any skills for reading.

(v) To read measurement before the main point required.

(b) Negative errors

(i) Natural errors

(ii) Elongation errors.

(iii) Sagging errors.

(iv) Temperature change errors.

(v) Poor workmanship errors / Instrumental errors.

Extract 8.2: A sample of the student's incorrect responses to Question 9

Extract 8.2, demonstrates a sample of a student who was not able to provide correct responses. This student lacked adequate knowledge and skills.

2.3 SECTION C: Structured Question

This section consisted of one question, the students were required to attempt this question which carried 15 marks. The score ranges used for grading performance of the students for the question in this section is indicated in Table 4. The students with average to good performance were considered to have passed a particular question.

Table 4: Scores Range for Students' Performance in Question 10

Scores Range	General Performance	
	Remark	Grade
0 – 4	Weak	F
4.5 – 9.5	Average	C – D
10 – 15	Good	A - B

2.3.1 Question 10: Chain Surveying and Linear Measurement

This question had two parts: (a) and (b) where in (a) the students were required to describe three common survey stations obtained in the prepared index sketch. In part (b) the students were required to describe three obstacles and how each can be solved when chain surveying is taken at a detailed and crowded large area with too much rising and falling. The question was intended to measure skills of the students on the first step performing in chain survey but also, the ability of the students on performing chain survey in detailed and crowded area. The question stated that;

(a) Reconnaissance survey is done based on the thinking about the possible arrangement of the framework of survey and hence index sketch is prepared. Describe three common survey stations obtained in the prepared index sketch.

(b) In chain surveying when the area is large, too much rising and falling and crowded with many details, triangulation is not possible. Account for three obstacles and how can each one be solved for the process to become possible.

The analysis of students' performance in this question shows that 102 (36.30%) students scored from 0 to 4.5 marks, 22 (7.83%) students scored from 5 to 9.5 marks, and 157 (55.87%) students scored between 10 to 15 marks. The general performance of students in this question was average as 179 (63.7%) students achieved passing marks. This analysis is illustrated in Figure 11.

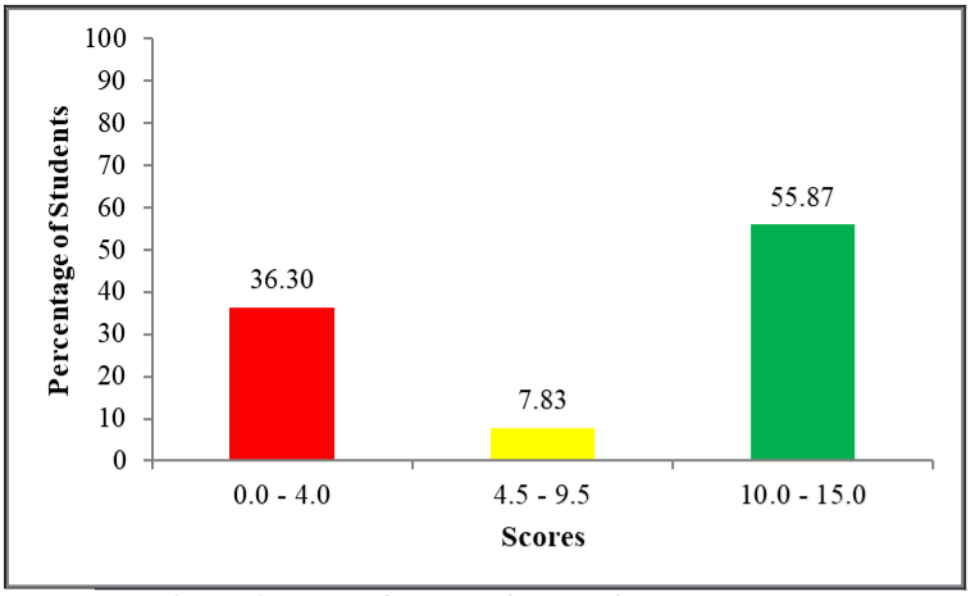
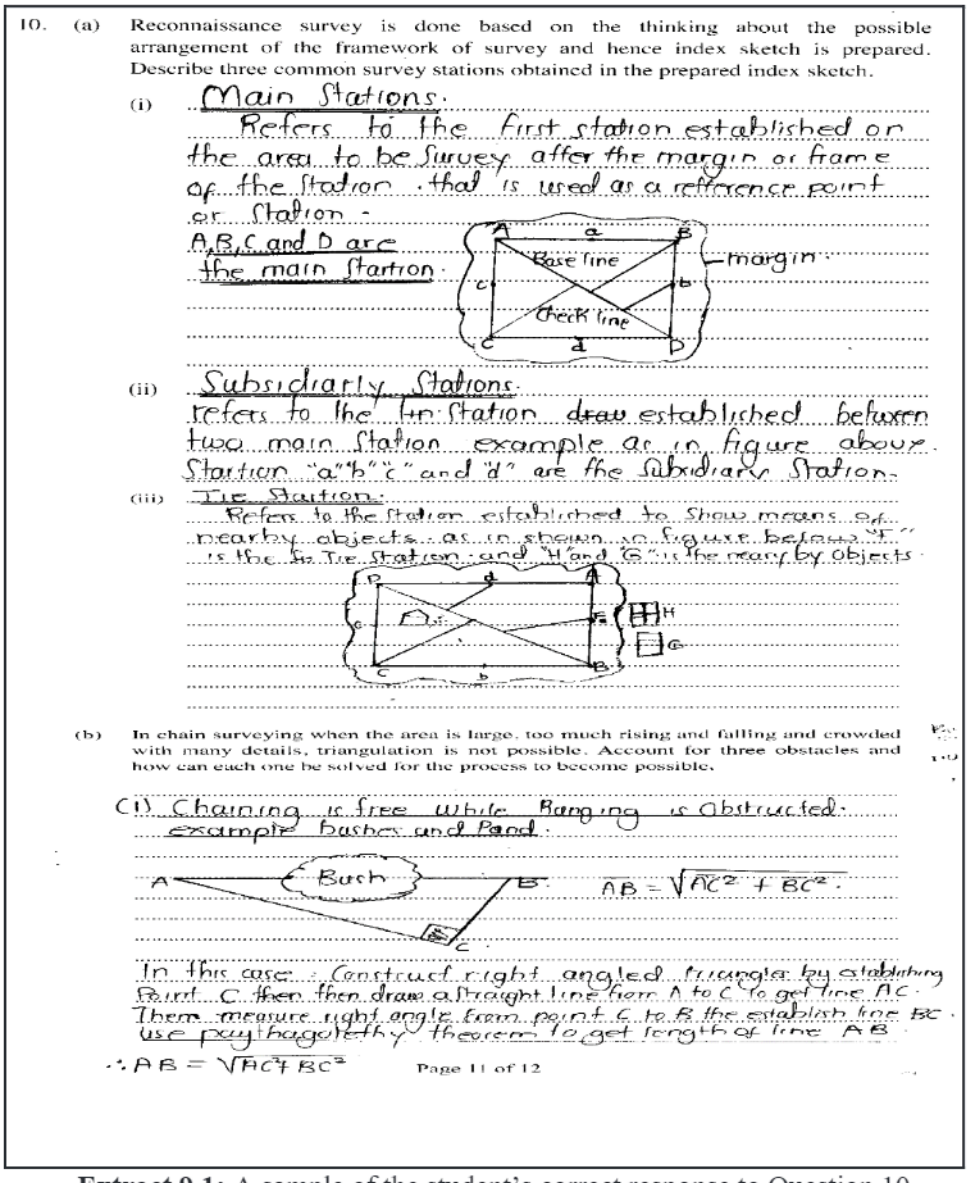


Figure 11: The students' Performance in Question 10

Figure 11 shows that students successfully answered the question and exhibited a mastery of the topic of *Chain Surveying and Linear Measurements*. The students accurately responded to both parts (a) and (b) and demonstrated their ability by describing three common survey stations obtained in the prepared index sketch and mentioning the obstacles and how each can be solved when chain surveying is taken at a detailed and crowded large area with too much rising and falling respectively. Analysis shows that sufficient knowledge and practical exercises helped students to provide correct responses. For example, in part (a) a student described stations as *"Main stations is a station taken along the boundary of an area as controlling points connecting the main survey lines*, *Subsidiary stations are lines for dividing the area into triangles for checking the accuracy of triangles and for locating interior details* while *Tie stations are stations taken on the main survey lines mainly to fix the directions of adjacent sides of the chain survey map*". This student was able to list three obstacles and ways to overcome. Extract 9.1 is an example of correct responses to question 10.



Extract 9.1: A sample of the student's correct response to Question 10

In Extract 9.1, the student correctly described three common survey stations obtained in the prepared index sketch. Also, she/he mentioned correctly the obstacles concern and how they can be overcome.

On the other hand, there were 102 (36.3%) students who failed to score pass marks. The analysis reveals that several reasons accounted for the students' poor performance, such as; many students could not master the knowledge from the topic concerned, and some students did not understand the demands of the question.

In part (a) more students provided incorrect responses contrary to the question demand. For instance, some of the students provided responses such as "*check line should be measured in the survey station because to check the accuracy of the area should be surveyed aimed to prepare index sketch*", and "*base line should measure in the survey station*". These responses are not survey stations students were required to explain that; *main stations are stations taken along the boundary or framework of an area as controlling points connecting the main survey lines. On the other hand, subsidiary stations are secondary or intermediate points established during a survey to provide additional reference located between the main station, and Tie stations are stations taken on the main survey lines mainly to fix the directions of adjacent sides of the chain survey area.*

In part (b), students failed to explain three obstacles for chain surveying, for instance few students wrote *"By divide survey station into triangle", "By during site reconnaissance"* and *"chain surveying to rising and falling to the measured in crowded into the ground and others"*. Such phrases were taken from the question paper. Students were expected to provide the following obstacles, "*Obstacles obstructing ranging but not chaining" especially when dense forest interrupts, its overcome by chaining by stepping method*, "*Obstacles obstructing chaining but not ranging" especially when a river interrupts, its overcome by two points selected, a perpendicular is erected, bisected and points are selected in the same straight line.* Lastly, *"Obstacles obstructing both ranging and chaining" especially when a building interrupts*, its overcome *by an extended line, two points are selected and then a perpendicular is erected so that it lays on the same straight line*. Other reasons for the poor performance were unclear statements, failure to write anything in the spaces provided, repetition of responses and poor sketching. Extract 9.2 is a sample of incorrect responses to question 10.

10. (a) Reconnaissance survey is done based on the thinking about the possible arrangement of the framework of survey and hence index sketch is prepared. Describe three common survey stations obtained in the prepared index sketch.

(i) offset sketch.
- offset sketch is the common survey station obtained in prepared index sketch to our survey work.

(ii) Survey Sketch.
- Survey sketch is the the common survey station obtained in the prepared index sketch to the frame work that frame work can be in survey work.

(iii) Refference sketch:
- Refference sketch is the sketch that contain the refference in the frame and this is the one of common survey station obtained in the prepared index sketch.

(b) In chain surveying when the area is large, too much rising and falling and crowded with many details, triangulation is not possible. Account for three obstacles and how can each one be solved for the process to become possible.

1. Will be have a 4 persond.
2. every one will be the one side
3. Then you can choose the point in order to make the triangulation
4. Make a triangulation to the every point which you want to choose.

Extract 9.2: A sample of the student's incorrect response to Question 10

3.0 ANALYSIS OF THE STUDENTS' PERFORMANCE PER TOPIC

The students' performance in FTNA 2023 was average as shown in the analysis of each question. The paper covered nine topics including *Civil Engineering Surveyor, Surveying Practice, Surveying Tools and Equipment, Safety Management and Rules, Introduction Surveying Methods, Chain Surveying and Linear Measurements, Compass Surveying, Surveying Techniques (Practice)* and *Surveying Techniques for Small Areas Practice.*

The analysis done indicates that students had good performance on the topic of *Surveying Techniques for Small Areas Practice* (77.76%). However, the students had an average performance on the topics of *Civil Engineering Surveyor* (64.41%), *Chain Surveying and Linear Measurements* (47.87%), and other topic of *Surveying Tools and Equipment* (36.12%). Though, other students had a weak performance on the topic of *Introduction Surveying Methods* (13.52%). A summary of performance in each question and per topic is appended at the end of this report as **Appendix A** and **B** respectively.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The general performance of students in the Civil Engineering Surveying subject in 2023 FTNA was average, given that only 173 (61.6%) students were able to score pass marks and above.

The students' performance in questions 1, 7 and 8 was good while the performance in questions 2, 3, 9 and 10 was average. The poorly performed questions were 4, 5 and 6 from the topics of *Surveying Tools and Equipment, Introduction to Surveying Methods* and *Chain Surveying and Linear Measurements* respectively.

Most students who performed poorly on those questions failed to understand the questions' requirements and had inadequate knowledge and skills on the topics tested. Moreover, they had partial practical experience, especially in the topics of *Introduction to Surveying Methods*, which hindered them from providing proper and correct answers. Therefore, students need to put more effort into studying Civil Engineering Surveying Subject to improve their competencies.

4.2 Recommendations

Based on the performance observed in this analysis, the following recommendations are worth noting for students and teachers:

(a) Recommendations for Students

(i) Students should read carefully the instructions before attempting the questions so as to understand the demands of the questions.

(ii) Students are encouraged to search and study relevant materials from books or internet sources to widen their knowledge. This will help them to grasp relevant and modern concepts and theories applied in Civil Engineering Surveying.

(iii) Students should be involved more in practical works and activities to practice. This will lead them to learn by doing.

(iv) Students should practice to draw different surveying sketches more often when they attend surveying practical sessions. This will help them to acquire appropriate skills of drawing, labeling, drafting and computing the collected data.

(v) Students should improve the English language by developing a passion of speaking and writing. This can be achieved by participating in debates, group discussions and presentations of various assignments to improve their ability to answer different questions correctly and fluently.

(b) Recommendations for Teachers

(i) In order to improve the students' performance, teachers should provide more exercises, homework and assignments and then provide feedback on time to their students before they sit for the National Assessment.

(ii) Teacher should ensure that practical exercise sessions are adequately attended and supervised.

(iii) Teachers are advised to read the Students Item Response Analysis (SIRA) more often to identify the challenging areas and be able to help the students appropriately

during the teaching and learning process at schools.

(iv) Teachers may use interactive projectors during teaching to make learning more active and productive. Through this, students can see visual aids, like colorful charts, diagrams and videos which will help them to acquire the expected skills of the subject matter.

Appendix A

Analysis of the Students' Performance in Each Question in FTNA 2023

S/N	Topic	Question Number	Percentage of Students who Scored 30% or More	Remarks
1	Civil Engineering Surveyor Surveying Practice Surveying Tools and Equipment Safety Management and Rules Introduction Surveying Methods Chain Surveying and Linear Measurements Compass Survey Surveying Techniques Practice Introduction to Surveying.	1	93.24	Good
2	Surveying Techniques for Small Areas Practice	8	80.78	Good
3	Surveying Techniques for Small Areas Practice	7	74.73	Good
4	Civil Engineering Surveyor	3	64.41	Average
5	Chain Surveying and Linear Measurements	10	63.7	Average
6	Surveying Tools and Equipment	9	49.11	Average
7	Chain Surveying and Linear Measurements	2	45.55	Average
8	Surveying Tools and Equipment	4	23.13	Weak
9	Chain Surveying and Linear measurements	6	22.78	Weak
10	Introduction to Surveying Methods	5	13.52	Weak

Appendix B

Analysis of the Students' Performance Per Topic in FTNA 2023

S/N	Topic	Question Number	Percentage of Students Who Scored 30% or More	Remarks
1	Civil Engineering Surveyor Surveying Practice Surveying Tools and Equipment Safety Management and Rules Introduction Surveying Methods Chain Surveying and Linear Measurements Compass Surveying Surveying Techniques Practice Introduction to Surveying.	1(Multiple Choice Items)	93.24	Good
2	Surveying Techniques for Small Areas Practice	7 & 8	77.76	Good
3	Civil Engineering Surveyor	3	64.41	Average
4	Chain Surveying and Linear Measurements	2, 6 & 10	47.87	Average
5	Surveying Tools and Equipment	4 & 9	36.12	Average
6	Introduction to Surveying Methods	5	13.52	Weak