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Refining geography teaching : an error analysis.

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4.7 Common errors in Geographical knowledge

Commonly made errors in respect to Geographical knowledge derive from the seven types of errors identified and these were made in the three broad categories: Physical Geography followed by Human Geography and then Map Reading. However, not all the three broad categories of errors appeared in all the seven types. Common errors will be discussed with respect to the three broad categories as they apply.

4.7.1 Error in Content Knowledge

Error in content knowledge had by far the greatest number of errors and commonly made errors commenced with Physical Geography (330) followed by Human Geography (160).

4.7.1.1 Errors - Physical Geography

Physical Geography covered errors mostly in river processes followed by weather, climate, folding and faulting, weathering and lastly marine erosion.

River Processes

- Students did not state the methods by which the river transports its load like suspension, traction, saltation and solution (Most Common Error (MCE) 30, Question (Q) 1).
- They did not explain how a delta may be formed. A delta forms at the river mouth and the river divides itself into distributaries due to a heavy load deposited into the sea to find alternative routes into the sea (MCE 39, Q 1).
- They did not name the wearing down of rock particles by colliding with other during transport by a river and this happens through traction (MCE 28, Q 1).
- They did not describe the physical features of a delta like it has a greater number of distributaries, triangular in shape and forms at the river mouth where the river is usually wide and flat (MCE 30, Q 1).
- Students did not answer the question which asked them to name one large river in Africa south of the Sahara which enters the sea by a delta like Nile (MCE 15, Q 1).

Weather and Climate

- Students did not name the cloud that forms low in the sky and which brings light rain like cumulo-nimbus (MCE 31, Multiple Choice Question (MCQ) 22).

- They did not state where an instrument should be cited to obtain accurate readings. An instrument like a rain gauge should be place 30cm above ground level to avoid splashes, in the open space away from trees and buildings (MCE 27, Q 3).
- They did not define Relative Humidity which refers to the amount of water vapour in the atmosphere compared to the amount of moisture air could hold at a particular temperature (MCE 23, Q 3).

Folding and Faulting

- Students did not describe the physical features of the relief and drainage of a volcano. Volcanoes have a dome on top called a crater. A crater is a basin like hole on top of a volcano which accumulates water with time. Radial drainage occurs when rivers originate from a crater and when they take different directions they form an oval shape as they go down. The relief and drainage of a volcano also results in parasitic cones, lakes, basic gentle sides, concave profile basic, convex profile acid *etc* (MCE 25, Q 5).
- They did not name the ranges of young fold mountains either in North or South America or in one of either Europe or Asia like Sierra in North America, Andes in South America, Rocky Alps in Europe and Himalayas in Asia (MCE 21, Q 5).

Weathering

- Students did not answer the question that asked them to name and describe in detail the processes of mechanical weathering which cause rock weathering like changes in temperature, frost action and freezing and thawing. With changes in temperature rocks get heated and expand during the day but cool and contract at night. With repeated expansion and contraction the outer layers of the rock peel off in thin sheets. While freezing and thawing occurs in areas with temperatures around freezing point. When water freezes in rocks it increases in size as a result weaken the rocks which break up in time. On the other hand, frost action occurs when water in cracks and joints of rocks freeze and expand and so cracks and joints expand. Due to pressure that water exerts on the rocks which is often higher than the resistance of most rocks it causes rocks to shatter (MCE 36, Q 2).
- They did not explain how climate, rock composition, relief and pollution of the atmosphere may influence the rate of rock weathering. With climate, hot temperatures contribute to the weathering of rocks in that when temperatures are hot they cause rocks to expand and when it cools down rocks contract. Rocks peel off due to repeated

expansion and contraction. Cold temperature causes water to freeze in rocks and increase the size of cracks. When it warms up the ice melts due to repeated freezing and thawing the rocks end up breaking into small pieces (MCE 22, Q 1).

- They did not differentiate between chemical and physical weathering. Chemical weathering involves breaking down of rocks through a chemical reaction e.g. a reaction between water and the minerals of a rock while physical weathering involves the breaking down of rocks by physical means e.g. by changes in temperature (MCE 17, Q 2).

Marine Erosion

- Students did not answer the question that asked them to name and describe in detail the processes of marine erosion like Hydraulic action, Attrition, Solution and Abrasion. Hydraulic action occurs when waves hit the cliff base and the air compresses inside the cracks and crevices. When the breaking waves retreat air expands violently causing the rocks to shatter. Attrition occurs when waves cause rocks and pebbles to bump into each other and break up. Solution is when certain types of cliff erode as a result of weak acid in the sea while abrasion is when waves pick up and hurl beach material like pebbles against the base of a cliff (MCE 35, Q 4).

4.7.1.2 Errors - Human Geography

Human Geography covered errors mainly in settlement and population.

Settlement

- Students did not state the problems which might be experienced by people living in the squatter settlement, like they are inhabited by people who are very poor with no access to their own tenured land and that infrastructure and services are usually inadequate (MCE 32, Q 10).
- They did not give the examples to show how towns in Africa south of the Sahara excluding Botswana, Lesotho and Swaziland differ in their functions like towns such as Cape Town and Durban in South Africa which function as sea ports (MCE 27, Q 10).
- They did not state the three pieces of information that could be used to make a settlement hierarchy like status, site and economy (MCE 24, Q 10).

- They did not state the problems experienced by people in modern residential areas of large urban settlements like traffic congestion (MCE 22, Q 5).
- They did not state the factor which most influences the location of the huts in a valley like roads and tracks which attracted the location of huts in the valley (MCE 17, MCQ 26).

Population

- Candidates did not state the population characteristics for a typical developing country like there is a rapid fall in each upward age group, more females than males, high dependency ratio, expanding population *etc* (MCE 38, MCQ 40).

4.7.2 Error in Interpreting Diagrams

Commonly made errors in interpreting diagrams were in Human Geography (159) followed by Physical Geography (92).

4.7.2.1 Errors - Human Geography

Human Geography covered errors mostly in population and a few in settlements.

Population

- Students did not identify the most important future priority for the government like the government should reduce unemployment (MCE 40, MCQ 37).
- They did not explain why education, contraception and jobs may help reduce birth rates. Education helps people understand the importance of having small families that they can afford. With contraceptives people are able to plan pregnancies while jobs keep partners apart for some time as a result chances of birth rate are reduced (MCE 27, Q 11)
- They did not show the statement that was true of the population pyramid that there is a lower death rate in the city than there is in the country (MCE 21, MCQ 36).
- They did not identify a diagram illustrating over-population. Such a diagram illustrates that the country has more resources than the total population (MCE 10, MCQ 39)

Settlement

- Candidates did not explain the relatively high rent value. It is expensive because it is a shopping mall found within the Central Business District (CBD) (MCE 31, MCQ 30).
- They did not say what is true of settlements **X** and **Y** shown on the photograph on the question paper provided. They both have a high density (MCE 18, MCQ 28).
- They did not describe the main features of the squatter settlement like they are inhabited by the poor with no access to their own tenured land and that infrastructure and services are usually inadequate (MCE 12, Q 10).

4.7.2.2 Errors - Physical Geography

Physical Geography covered errors to do with weather and climate, folding and faulting, river processes and weathering.

Weather and Climate

- Students did not interpret a photograph given in the question paper to describe the main features of a hot desert like the vegetation is exceedingly sparse, has sand dunes and rock pavements (MCE 26, Q 5).

Folding and Faulting

- Students did not interpret a diagram showing a contour map of a volcano to show the landforms marked **X, Y** and **Z. X** was a Secondary cone, **Y** a crater rim and **Y** the main vent respectively (MCE 25, MCQ 15).

River Processes

- Students did not interpret a figure to describe the physical features of a river and its valley in its mountain course like the river has a v-shaped valley, interlocking spurs, narrow valley, and pot holes and pebbles (MCE 21, Q 1).

Weathering

- Students did not interpret a figure to explain how chemical and mechanical processes may work together to weather rocks. Chemical weathering and Physical weathering can work together like in water where cracks of rocks absorb water which freezes and increase in size as a result put more pressure on the rock. In due time the rock breaks

(physical). With chemical weathering, water reacts with the minerals found in the rock and together process is called Physio-Chemical weathering (MCE 20, Q 2).

4.7.3 Error in Calculations

Commonly made errors were in Physical Geography (96) followed by Human Geography (47) and then Map reading (37).

4.7.3.1 Errors - Physical Geography

Physical Geography covered errors to do with weather and climate and river processes.

Weather and Climate

- Students did not calculate a range of temperature for a day. Range is calculated by finding the difference between the maximum and minimum temperature which was 6 degrees (MCE 36, Q 3).
- They did not show what relative humidity was when the readings were taken. Relative Humidity is calculated by finding the difference between the dry and the wet bulb thermometer and converting the product into a percentage, which was 61% (MCE 29, MCQ 23).

River Processes

- Students did not calculate the gradient which is calculated by finding the ratio between the vertical interval (height) and the horizontal interval (distance), which was 1:70 (MCE 31, Q 10).

4.7.3.2 Errors - Human Geography

Human Geography involved errors in population studies.

Population Studies

- Students did not calculate the population of Africa south of the Sahara in 1900 from the population graph which was 250 millions. (MCE 27, Q 11).
- They did not calculate the highest rate of natural population growth which is calculated by finding the difference between birth and death rates. It was 2000 (MCE 20, MCQ 33).

4.7.3.3 Errors - Map reading

Map reading covered errors in scales and measurements.

- Candidates did not calculate the distance between the road and the bridge, which was 4250 meters (MCE 37, MCQ 3).

4.7.4 Error in applying acquired knowledge

Commonly made errors in applying acquired knowledge were in Map Reading (82), followed by Physical Geography (75).

4.7.4.1 Errors - Map reading

Map reading covered errors in scales and measurements and grid references.

Scales and Measurements

- Students did not show the upper limit of sugar cultivation on the south side of Tamarin Mountain which was 40 meters (MCE 42, MCQ 6).

Grid Reference

- Students did not identify the grid square on the map provided. The rule is to start with the north number and then south one and the grid square is 8682 (MCE 40, MCQ 8).

4.7.4.2 Errors - Physical Geography

Physical Geography covered errors in weathering and river processes.

Weathering

- Students did not apply the concept of freezing and thawing on the graph to show the period in which frost action was shattering likely to be most active like in warmth and temperatures below zero degrees with precipitation (MCE 39, MCQ 18).

River Processes

- Students did not apply the concept of velocity in graphs to show the cross-section of the river channel the graph related to like the one that had a deep valley more to the left bank than to the right bank (MCE 36, MCQ 20)

4.7.5 Error in reading maps

Commonly made errors in 'Error in reading Maps' were in Map reading (81), followed by Human Geography (43) and a few in Physical Geography (6).

4.7.5.1 Errors - Map reading

Map reading covered errors commonly in grid reference.

Grid reference

- Students did not find the feature located within the grid square 875817 in the map provided and that feature was a Trigonometrical station (MCE 42, MCQ 2).
- They did not find the grid reference. The rule is to start with the north and then the south grid reading and the grid reference was 824827 (MCE 39, MCQ 1).

4.7.5.2 Errors - Human Geography

Human Geography covered errors made only in Population.

Population

- Students did not identify the transport policy which is most likely to reduce atmospheric pollution in a city from a diagram showing land use in a town like the government should encourage the use of public transport (MCE 43, MCQ 32).

4.7.5.3 Errors - Physical Geography

Physical Geography covered errors made only in Weather and Climate.

Weather and Climate

- Students did not say why the Stevenson's Screen should be placed on the grass which was basically to avoid heat from the ground (MCE 6, Q 3).

4.7.6 Error in drawing and labeling diagrams

Commonly made errors were in Physical Geography (83).

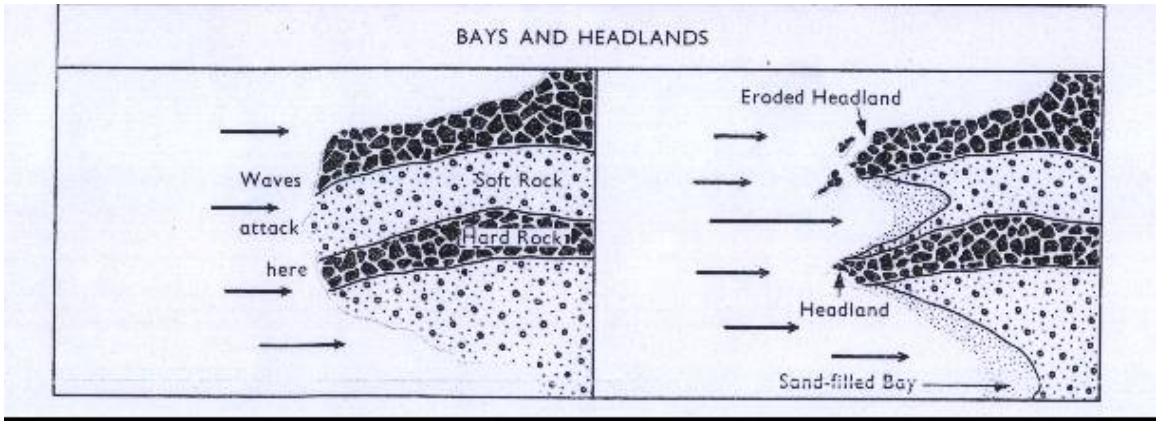
4.7.6.1 Errors - Physical Geography

Physical Geography covered errors in marine erosion followed by folding and faulting and then weather and climate.

Marine Erosion

- Students did not draw a well-labeled diagram to show the effects of marine erosion on a coast line which has alternating bands of soft and hard rock lying at right angles to the coast such as the one shown below MCE 34, Q 4).

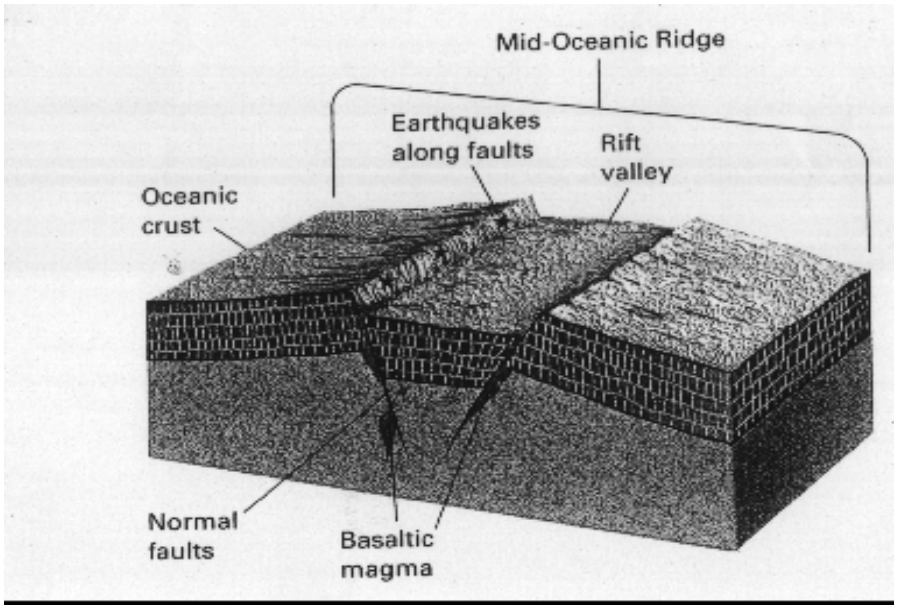
Diagram 1 - The effects of marine erosion on a coast line



Folding and Faulting

- Students did not describe with the aid of a well-labeled diagram how a rift valley may have formed (MCE 28, Q 4). A diagram showing how a rift valley may have formed is shown below.

Diagram 2 – How a rift valley may have formed



Weather and Climate

- Students did not label the features of a wet and dry bulb thermometer (MCE 21, Q 3). These were P – Mercury and S – Water.

4.7.7 Error in reasoning

Commonly made errors in "Error in reasoning" were in Physical Geography (68) and less in Human Geography (10).

4.7.7.1 Errors - Physical Geography

Physical Geography covered errors to do with weather and climate, river processes and folding and faulting.

Weather and Climate

- Students did not state why one thermometer gives a lower reading than the other. A wet bulb thermometer measures humidity while a dry bulb thermometer measures temperature. When it is hot temperature goes up while the amount of moisture in the air goes down, that is why thermometers read differently (MCE 20, Q 3).
- They did not account for the features of a Stevenson's Screen like it is painted white to reflect heat, insulated to reflect heat and 1.2 meters above ground level to avoid ground temperatures and louvered for free movement of air (MCE 6, Q 3).

- They did not answer the question that asked them to show why a Stevenson's Screen should be placed on a grass surface like to avoid ground temperatures (MCE 8, Q 3).

River Processes

- Students did not state why the volume and speed of water in a river change from place to place and from time to time. The river goes through three different stages namely young, mature and old and so in the young stage the valley is very narrow due to vertical erosion and the speed is high due to steep gradient. In the mature stage, the valley widens due to lateral erosion and so the speed decreases while the volume increases because it is joined by the tributaries. When reaching the old age stage the volume reaches maximum height and the valley widens further while the speed slows down even more (MCE 19, Q 1).

Folding and Faulting

- Students did not give reasons to show why there are no young fold mountains in certain parts of the world because they are filled with water (MCE 15, Q 5).

4.7.7.2 Errors - Human Geography

Human Geography covered mainly population.

Population

- Students did not say why many countries in Africa south of the Sahara have a high birth rate. The majority of African population is not educated and so people do not understand the importance of using contraceptives to control birth rate and in the past they used to take their pride in having large families so this value still holds (MCE 29, Q11).

4.8 Conclusion

In response to the second Research Question 'What errors students make in COSC Geography examinations?' findings revealed that errors were commonly made in Physical more than they were in Human Geography and then Map Reading. Commonly made errors in Physical Geography derived from river processes particularly to do with deltas, weather and climate particularly with regard to relative humidity and the Stevenson's Screen. This implies that

students have a serious problem understanding some of the concepts in Physical Geography. Human Geography on the other hand, comprised commonly of errors in population and settlement while Map Reading revealed that students did not know how to measure distances and read a grid square.

4.9 Common Non-Geographical Errors

Commonly made errors with respect to Non-Geographical errors derived from Physical Geography followed by Human Geography and then Map Reading. Errors within the two types will be discussed with respect to these three broad categories as they apply.

4.9.1 Error in interpreting examination questions

Students misinterpreted questions to do with Map work, Physical and Human Geography.

4.9.1.1 Errors - Map reading

Map reading involved errors to do with grid reference.

Grid Reference

- Students misinterpreted the question which asked them to show land uses shown in a grid square like scrub, cultivation and sugar plantation and other plantation (MCE 32, MCQ 5).

4.9.1.2 Errors - Physical Geography

Physical Geography covered errors to do with folding and faulting.

Folding and Faulting

- Students misinterpreted the question which asked them to show how young fold mountains are formed. They are formed when two plates move together. This can be where two continental plates move towards each other forcing sedimentary rocks upwards into a series of folds. Fold mountains are usually found along the edges of continents because the thickest deposits of sedimentary rocks generally accumulate along them. The collision of plates and continents riding on the edges compile the accumulated layers of rock crumple and fold like a table cloth pushed across a table (MCE 27, Q 4).

4.9.3.3 Errors - Human Geography

Human Geography covered errors to do with settlement.

Settlement

- Students misinterpreted the question that asked them to give examples to show how countries in Africa south of the Sahara differ in their functions excluding Botswana, Lesotho and Swaziland in towns like Durban and Cape Town in South Africa which serve as sea ports (MCE 27, Q 10).

4.9.4 Problems with English as medium of instruction

Problems with English as a medium have to do with Physical Geography.

4.9.4.1 Errors - Physical Geography

Physical Geography covered errors to do with weathering.

Weathering

- Students struggled with the question that asked them to explain how climate, rock composition, relief and pollution level of the atmosphere may influence the rate of weathering. They made grammatical errors and their sentence construction was not proper (MCE 10, Q 2).

4.10 Conclusion

In response to the second Research Question, findings have shown that within the two categories, errors were commonly made in Physical Geography particularly in Weathering and Folding and Faulting. Errors were also commonly made in Human Geography particularly in Settlement and Map Reading especially in Grid References.

4.11 Correction of Errors

Having shown that common Geographical errors exceed Non-Geographical errors, I will focus on the correction of errors in response to the third Research Question ‘How can errors be corrected to improve students’ performance in COSC Geography examinations?’ It will be recollected that seven key informants were interviewed and that they argued mainly for pedagogical strategies to correct errors. Apart from the usual lecturing, they suggested

strategies such as teaching aids, excursions, giving students practice with past examination papers and definition of concepts to be integrated in Geography teaching. They believe that students understand better when they can associate words with the real object being explained, that definition of concepts makes it easier for students to grasp concepts and that practice helps prepare students well ahead for examination. Errors were classified into four of the six categories of cognitive behaviour namely Knowledge, Comprehension, Application and Analysis (Bloom et al. 1956). The corrective strategies are similar for most errors but correction would be done differently; for knowledge, the correction is meant to help students know, for comprehension, to help them understand, for application, so that they can apply the knowledge they have gained, and finally for analysis is to help them analyse concepts. The correction of errors will be discussed with respect to errors made in Physical Geography, Human Geography and Map Reading as they apply.

4.11.1 Knowledge

Knowledge according to Breen et al. (1992) requires the specifics of terminology and facts, knowledge of ways and means of dealing with specifics of knowledge of conventions, classification and categories, criteria and methodology. Although knowledge represents a lower level of performance, it is indispensable to higher level categories which it is to be a prerequisite to successful learning. The corrective strategies and frequency within the three broad categories of errors are shown in Table 10 below.

Table 10 Corrective Strategies for errors within the Cognitive Category of Knowledge

Corrective Strategy	Physical Geography	Human Geography	Map Reading	Frequency
Practice	❖	❖	❖	15
Teaching aids	❖	❖	❖	11
Excursions	❖	❖	❖	10
Definition	❖	❖	❖	05
Interpretational Skills	❖	❖	❖	03
Thorough Explanation	❖	❖		02
Experiment	❖			01
Teach Drawing & Labeling	❖			01
Classification & Meaning	❖			01
Step by step	❖			01
Demonstration	❖			01
Thorough Teaching	❖			01
Comparison	❖			01
Examples		❖		01

4.11.1.1 Corrections - Physical Geography

Errors were made in river processes, folding and faulting, weathering, weather and climate and marine erosion.

Weather and Climate

Questions required students to provide knowledge on weather and climate concepts which they did not seem to know as much as they should. To start with, *they did not define relative humidity*. Three key informants suggested that concepts should be clearly defined to make it easier for students to access the terminology and hence assist in the acquisition of knowledge. The other three indicated that performing an experiment would be the best way either by pouring water in a bottle or blowing air into a balloon to facilitate acquisition of knowledge. When the bottle is half filled or the balloon is half blown, the teacher asks if there is more space for water or air. If yes then it is done. This experiment reinforces the definition because it illustrates the “relative” part where the amount of water vapour present in the air is compared to the amount of moisture air could hold at a particular temperature. In addition, one key informant suggested giving students practice with weather instruments for instance, a

wet and dry bulb thermometer. She argued that when they are able to read them and calculate relative humidity, they will know how to define it. The same question was left unanswered by some students. In this regard five key informants strongly believed that students left it unanswered because they did not know and they recommended definition as well to clarify concepts. The other two suggested a follow up with regular exercises to see if they have grasped the concepts. Definition, experiment and regular exercises are essential because they speed up the acquisition of knowledge. While definition provides clarity to concepts, carrying out experiment brings them to reality and regular exercises leads to successful learning because students get a chance to practice with the concepts as a result knowing the concepts becomes easier.

Secondly, *students did not label the features of a wet and dry bulb thermometer.* One key informant suggested teaching students how to draw and label diagrams without looking in their text books and then compare afterwards. This strategy may work with regular practice to perfect students' drawing skills however, it requires close supervision to ensure that students do not copy. As a follow up, the other six said that students need practice with questions that require them to draw to be in a position to draw and label diagrams correctly. The more students will practice drawing different diagrams the better they will get at it and ultimately they will know how to draw and label without copying.

Thirdly, *students did not state where an instrument should be placed to obtain accurate readings.* All the key informants were confident that taking students out to the weather station is the best way to correct this error because it would give them a clear picture of how they look like and where they are located. Integrating field work into teaching weather concepts is imperative because it provides firsthand experience to the weather instruments some of which students have never seen. Having seen the instruments, students will identify between different types of instruments and know why they are positioned the way they are becomes easier.

Lastly, *students did not name the cloud that forms low in the sky and brings light rain.* Five key informants said that students need to be taken out especially on a cloudy day for observation because observing the development of different types of clouds will assist in identifying with them. One key informant argued that more emphasis should be placed on the classification and meaning of clouds to facilitate acquisition of knowledge for instance, Nimbus is a Greek word meaning rain. Knowing what the cloud's name means is essential

because students will know how to differentiate between types of clouds. The last one suggested that students need to be given practice to check whether they have grasped the concepts. These teaching strategies seem to compliment each other well because through observation and meaning making, students will know what different types of clouds mean and giving them practice with different questions will help concretise the knowledge students would have gained.

River Processes

Firstly, *students did not describe the physical features of a delta.* One key informant argued that since deltas are very abstract and difficult to understand, teachers need to describe step by step what happens in their formation. The other four felt that this should be followed up by the use of teaching aids such as video tapes, pictures, diagrams to reinforce their knowledge. Morris (1968: 96) confirms that it is almost impossible to describe a physical feature so that the class can understand what it looks like and how it was formed. If a student is shown pictures of the landform as its various features are being explained, his interest will be aroused and his comprehension is improved. Thus, pictures will help facilitate the acquisition of knowledge because students get to see in reality what has been explained in words. The other two stated that teaching will become even more effective if excursions are incorporated because students will see what deltas look like in the real world. Thus, teachers need to make use of teaching aids to communicate effectively more especially because sometimes words alone cannot convey a convincing message.

Secondly, *students did not describe the physical features of a river and its valley in its mountain course.* Three key informants suggested correction through the use of teaching aids such as diagrams and photographs to assist students identify the features. The other two felt that field work is essential because students get to see the features in the real world. Field work and teaching aids are important to integrate into teaching because they give students a chance to see what the features look like, and so it is only when students know what the features look like that they can describe them. The last two suggested that interpretational skills be instilled in students because questions do not always come in statement forms. Interpretational skills are essential especially for diagrammatic, graphic or picturesque questions because students will know how to convert what they see into meaningful information only when they have the skill.

Thirdly, *students did not state the methods by which the river transports its load and did not name the wearing down of rock particles by colliding with other during transport by a river.* Three key informants said that describing the methods alone may not clarify concepts fully but coupled with demonstration, students get to see the different ways in which the river transports its load. Fieldwork according to the other two is the most important because river processes require one to be very practical. Students' acquisition of knowledge gets delayed if teachers only teach without showing. It is even more important to take students out on a rainy day so that they see exactly what happens. Demonstration and field work speed up the learning rate as students can associate content with what they see and knowing the methods becomes easier when they have seen how each of them occurs. The remaining two suggested giving students practice with past examination questions to check whether they understood. With practice students get familiarity with concepts and the more practice is administered the better are students' chances of knowing the concepts. Practice has a positive impact but it remains a challenge for teachers to mark and revise questions especially because classes in most schools are over-crowded. If students do not get feedback, practice can be demotivating.

Lastly, *students left unanswered, a question which asked them to name one large river in Africa south of the Sahara which enters the sea by a delta.* All the key informants indicated that students leave questions unanswered only when they do not know so giving them enough practice with past examination questions will help them prepare for examination. Practice with concepts is essential because the more students practice with them the better are their chances of knowing them. Regarding the question they left incomplete which asked them to *state the main physical features of a delta,* four key informants suggested that concepts should be taught thoroughly because students answer questions partially only when they do not know the remaining part. Teachers need to be aware that superficial teaching may impact negatively on student performance as a result there is a need to make sure that they get to the bottom of things. Students also need to take the responsibility to prepare well ahead of examination so that they answer questions fully. The other three recommended teaching aids because they believe abstract concepts like deltas are better illustrated with the use of diagrams and pictures *etc.* Teaching aids are essential especially in a case where words alone cannot convey the message that teaching aids would and ultimately the acquisition of knowledge is sped up.

Folding and Faulting

Firstly, *students did not describe the main features of the relief and drainage of a volcano.* Three key informants suggested a definition of the key words to enable students know what a volcano is. As a follow up the other four suggested the use of teaching aids such as video cassettes and bright coloured pictures which show the whole process of relief and drainage of a volcano. Teaching aids play a very important role in facilitating the acquisition of knowledge because students can make sense of the words when they see what is being explained as a result they will know how to describe the features since they would have seen them and have a clear memory of what they look like.

Secondly, *students did not describe the physical features of one of the ranges.* Two key informants suggested using teaching aids such as atlases for students to observe the local areas where the layers of sedimentary rocks can be seen. Letting students see the features will assist in identifying with them as a result learning becomes meaningful and successful. However, students in most schools do not have books so it is a problem to access some of the teaching aids. The other five recommended excursions arguing that Lesotho mountains are young fold mountains and so students will be able to identify the physical features as they see them and this will reinforce their knowledge. Effective as excursions may be, it is not always practical to take students out because teachers are constrained by the fact that they are time consuming, need prior arrangement, expensive and that they have to finish the syllabus within the given time frame.

Thirdly, *students misinterpreted a question which asked them to describe how young fold mountains are formed.* Three key informants suggested a thorough explanation of the formation of fold mountains. The other four suggested teaching aids such as atlases, text books, maps or a globe as students will get to see how fold mountains look like. Clear explanations and teaching aids assist the acquisition of knowledge because they provide concrete foundations for abstract ideas as a result students will be able to connect difficult material to concepts.

Weathering

Students did not describe the main features of a hot desert. Five key informants argued that since deserts are far from Lesotho, a normal lecture should be accompanied by the use of teaching aids like pictures to give students an idea of what they look like. Teaching aids are

essential because it is only when students know what a hot desert looks like that they will know its features. The other two suggested that a normal lecture should be followed up with exercises to help students practice and build on the knowledge they have already gained. Regular exercises are also essential in reinforcing the knowledge students would have acquired because the more students do the exercises the better are their chances of knowing the concepts.

Marine Erosion

Firstly, *students did not describe in detail the processes involved in one of the Marine erosion.* Three key informants suggested teaching aids such as video tapes which will show marine erosion processes because as the tape runs the teacher will be explaining. When students have seen the processes happening they will be in a position to connect what they saw with the explanations. The other four suggested excursions because students get will get to see exactly what happens as the teacher explains. Teaching aids and excursions contribute to successful learning because what students get to see stays long into memory and ultimately they will know how each of the processes occurs.

Secondly, *students did not draw a well-labeled diagram with bands of alternating soft and hard rock lying at right angles to the coast to show the effects of marine erosion.* All the key informants confidently suggested giving students practice with different questions that require them to draw and label diagrams. The more students engage in drawing and labeling diagrams the better will be their chances of knowing how to draw and label diagrams correctly. *Students also left a question that asked them to show on the diagram how the stack may be formed.* All the key informants also showed that it is through letting students practice drawing different diagrams that they will master the skill. Balderstone and Lambert (2000: 155) confirm that it is important that pupils gain experience of using a very wide range of diagrams, not least because they are sure to encounter such resources in assessment tasks and examination questions.

I have discussed the key informants' perspectives on teaching strategies to correct errors in Physical Geography. Findings argued for teaching aids, excursions, practice, defining concepts, demonstration and interpretational skills to help reinforce students' knowledge of concepts.

4.11.1.2 Corrections - Human Geography

Human Geography covered errors from settlement and population studies and teaching strategies suggested for the correction of errors in Human Geography are indicated in Table 10.

Settlement Studies

Firstly, *students did not state the problems which might be faced by people who live in the squatter settlement* and *did not describe the main features of the squatter settlement.* Three key informants suggested defining the term 'squatter settlement' to give students an idea of what it means. The other two suggested teaching aids such as photographs which they argued will help students see what it looks like and the remaining two suggested excursions to help students identify the problems as this gives them access to the conditions of living. Similarly, in the second question, four key informants suggested teaching aids because they give an insight into the squatter settlements as a result students will identify the features. The other three also suggested excursions to make them see the squatter settlement first other than when they see it for the first time in the examination. It is a general feeling that excursions and teaching aids will facilitate the acquisition of knowledge because what students would have seen during a field trip or when teaching aids were used would stay long into memory so they will know the problems and the features of the squatter settlement.

Secondly, *students did not state the problems experienced by people in modern residential areas of large urban settlements.* Five key informants suggested definition of concepts to make language accessible. Defining concepts clearly is always imperative as it speeds up knowledge acquisition when students can access the meaning of concepts. The remaining two suggested an excursion to a well planned town where students will be able to see the different functional zones of a town; the CBD, Residential and Industrial zones. Eventually students will be able to identify the problems that are likely to arise when they have seen them.

Thirdly, *students did not say what is true of both settlements X and Y in part of a city in a tropical country.* Five key informants suggested that students should be exposed to interpretational skills because diagrammatic questions require them. This implies that without interpretational skills students will not be able to address diagrammatic, graphic, picturesque questions. The other two suggested that students should be given enough practice with different structures of questions before examination so that they get used to interpreting graphs. Intensive practice is necessary to develop graph interpretation skills. Cave (1971)

believes that students need to have as much experience as possible with a wide variety of graphs and teachers need to teach students how to interpret graphs not just ‘create them’. The integration of interpretational skills does not only assist students to acquire the skill but it also helps them grasp the concepts.

Lastly, *students did not state the three pieces of information that they could use to make a settlement hierarchy.* Three key informants suggested that teachers should make sure that concepts are explained thoroughly to show the classification of settlement hierarchy to enable students acquire knowledge. The other two suggested that this can be supplemented by giving examples showing hierarchy from their local environment to other places so that they can differentiate between them. Examples can be very helpful because they help illustrate the point one is making as a result make it easy for one to acquire knowledge.

I have discussed key informants’ perspectives on teaching strategies suggested for the correction of errors in Human Geography. For most questions key informants showed the need to use teaching aids, excursions, definition of concepts and examples to facilitate the acquisition of knowledge.

4.11.1.3 Correction - Map Reading

Map reading covered errors in interpretation of maps and grid reference.

Interpretation of Maps

Students did not name the factor which most influences the location of the huts in a valley. Two key informants suggested introducing interpretational skills to students to help them interpret the key. Interpretational skills are essential in map reading because when students have the skill they will know how to interpret the key and the maps. Similarly, the other five, suggested giving students practice with different questions because with more practice they will know how to differentiate between symbols that the key shows. Giving out exercises to students is also important because it gives students an opportunity to interpret different questions and eventually they get to know how to interpret the key or the map.

Grid reference

Firstly, *students did not find the grid reference.* Four key informants said that after introducing the rule, that is, starting with the North and then the South grid reading, students

need to be engaged in a lot of exercises. A clear introduction of the rule is important for teaching grid reference because students will know how to read it. Giving students is even more important because it gives students an opportunity to put into practice the principles learnt. With more exercises they will know the rule and how to find the grid squares on their own. The other three suggested the use of teaching aids like maps and graphs because they will help students make sense not only of what a grid reading is but also know how to read it. So teaching aids are essential because they help convey the message that words alone would not for instance, seeing what a grid square looks like makes the material presented more clearer hence speed up the acquisition of knowledge. Similarly, *students did not find the grid reference given the information from the map.* Five key informants suggested defining what the term 'grid reference' means because students need to know what it means to work with it. Definition makes the language accessible and so it is this access that helps students know the concepts. As a follow up, the other two suggested practice after teaching so that students can grasp the procedure to grid reading and know how to locate grid squares. Also on the other question, *students did not show the upper limit of sugar cultivation on the south side of Tamarin mountain.* All the key informants suggested giving practice with local maps to reinforce their map reading skills. Generally the responses reveal confidence in integrating practice into grid teaching because it will help reinforce the knowledge students would have acquired.

I have discussed strategies such as interpretational skills, practice with different exercises, teaching aids like maps and graphs and definition of concepts that key informants have argued for as corrective strategies in errors made in map reading. They strongly believe that integration of these corrective measures into teaching will facilitate the acquisition of knowledge in map reading concepts.

4.11.2 Comprehension

Comprehension requires the ability to translate, interpret and extrapolate concepts. Translation (Bloom et al. 1956) means giving accurate meaning by paraphrase or rendering one language or form of communication to another while interpretation requires a recording, rearrangement or new view of the material; for example, in considering a programme as a configuration of ideas which may require a reordering into in the mind of the student and extrapolation refers to making estimates or predictions based on the extension of trends or tendencies beyond the given data. Students did not show their understanding of geographical

concepts as errors made in Physical and Human Geography indicated. Corrective strategies for these errors are shown in Table 11 below in order of frequency.

Table 11 Corrective Strategies for errors within the Cognitive Category of Comprehension

Corrective Strategy	Physical Geography	Human Geography	Map Reading	Frequency
Practice	▪	▪		06
Teaching Aids	▪	▪		04
Examples		▪		02
Interpretational Skills		▪		01
Question-answering skills	▪			01
Question-choice skills	▪			01
Explanation	▪			01
Thorough Teaching	▪			01
Excursions	▪			01
Help from Science Dept	▪			01

4.11.2.1 Correction - Physical Geography

Physical Geography covered errors in river processes and weathering.

River processes

Firstly, s*tudents did not say why the volume and speed of a river change from place to place and from time to time.* Six key informants suggested that besides normal teaching, students need to be taught how to answer questions for instance, by teaching them how to break questions down into smaller parts especially those that carry words like **and, account for, why** *etc* to help them give a step by step answer that includes everything there is to include. Although this strategy does not say much about concept understanding, its importance lies with the fact that students will understand the question and be in a position to provide a detailed answer. One key informant also suggested that students should be taught how to choose questions in an examination because they make wrong choices. Although the strategy does not correct the error made, its incorporation into teaching becomes essential because students need to know how to choose questions they can answer completely and correctly. However, it would also be of great importance to provide clear explanations to show why the volume and speed vary in the three courses of the river namely the upper, the middle and the

lower. Clear explanations are important because they help students understand the individual thoughts and ideas being presented and they help build concrete foundations for abstract ideas.

Secondly, *students did not explain how a delta may be formed*. One key informant suggested a step by step explanation of concepts so that students know exactly what happens in the formation of deltas. The other five believed that teaching aids like video tapes showing the formation of deltas will help concretise the concepts because as the tape runs the teacher will be explaining. Teachers should take the responsibility to make sure that explanations are clear so that students understand the concepts. Seeing the process of delta formation is better than just hearing how it happens as such students will understand it because they would be having a clear mental picture of how it happens.

Lastly, *students left unanswered a question that asked them to explain how a delta they have named may have formed.* Seven key informants suggested a basic lesson followed by practice with questions because it looks like students do not prepare well for the examination. Students need to take responsibility of their learning otherwise this attitude will impact negatively on their performance. In spite of this, if students keep practicing with different questions in future as suggested, finally they will get to understand how different types of deltas form. Although key informants are not specific as to how they will teach different types of deltas, teaching aids such as video tapes showing how different types of deltas are formed are necessary because students will get a chance to see how each gets formed as a result they are able to understand better than just being told about them.

Weather and Climate

Firstly, *students left unanswered a question that asked them to state why a Stevenson's Screen should be placed on a grass surface.* Four key informants indicated that students leave questions unanswered only when they do not know and so teaching concepts thoroughly will serve as a corrective strategy. So teachers need to ensure that all the necessary details are not left out when teaching so that concepts are made clear and are understandable to students. Nevertheless, sometimes students do not take their work seriously even when teachers show commitment. To follow up, three key informants suggested that students should be given regular exercises and internal tests as they create an atmosphere which prepares students for external examination. Regular exercises and internal tests create a practical situation in which

students put to use the knowledge they would have acquired. Given a chance to practice regularly helps students to understand concepts even better.

Secondly, *students did not say why one thermometer gives a lower reading than the other.* All the key informants said that after teachers have dealt with weather instruments, they should give students practice with instruments to ready them for examination. With more practice students will understand how weather instruments work. It is only when students understand how they work that they will understand why one thermometer gives a lower reading than the other.

Lastly, *students did not account for the features of the Stevenson's Screen.* Five key informants suggested excursions arguing that students will be looking at the instruments as the teacher explains and that they will understand why they are the way they are. Excursions facilitate understanding because students will be able to associate what they see with the content provided and have a better understanding as to why the Stevenson's Screen has the features it has. The other two suggested a follow up with practice to check whether students have understood. Practice is essential because it gives students an opportunity to put into use the knowledge they would have acquired and with more practice, students are better off understanding why the Stevenson's Screen is the way it is.

Weathering

Students did not explain how climate, rock composition, relief and pollution of the atmosphere may influence the rate of rock weathering. Four key informants suggested that teachers should work with the Science departments because weathering concepts are better explained from the Science background and that students will have a clear understanding. Explaining weathering concepts from a scientific point of view will speed up understanding because Science teachers are more knowledgeable and will provide a detailed explanation to make it easy for students to understand concepts. The other three believed that weathering requires the use of environment and diagrams because without teaching aids Geography becomes abstract. Teaching aids impact positively on learning if used effectively and so they will contribute to a better understanding of concepts. In the same question, a few students struggled to express their thoughts and ideas clearly. Three key informants suggested that students should be encouraged to write in point form because engaging in long sentences can distort meaning. The other four suggested that they should also stick to simple English that will make sense. It is a double challenge for students to learn English while simultaneously

learning the Geography content in English. There is a need for students to sharpen their English, hopefully speaking the language and interacting with other people may serve as a starting point and ultimately they will understand its social practice and usage.

I have discussed strategies such as field work, teaching aids like video tapes showing delta formation and weathering concepts, thorough teaching, seeking help from the Science department, knowing how and which questions to answer as well as writing in point form as corrective strategies that the key informants have suggested for errors made in physical Geography. They believe that if they are used effectively they will help students understand concepts in Physical Geography.

4.11.2.2 Corrections - Human Geography

Human Geography covered errors in population and settlement studies.

Population

Firstly, *students did not explain why education, contraception and jobs may help reduce birth rates.* All the key informants suggested that teachers should use teaching aids to clarify the concepts being taught. They argued that students become nervous when they see pictures for the first time in the examination so they need to be used regularly for familiarity with such questions. There is a need for teachers to illustrate what they are teaching with the use of teaching aids as they help make concepts clearer. This will also put students in a position to understand and answer questions that come in a picture form as it was the case with this particular question.

Lastly students did not state why many countries in Africa south of the Sahara have a high birth rate. Four key informants suggested the use of teaching aids such as diagrams, pictures, population structures that show how the population of Africa is like because as we teach they will help clarify the point. The remaining three indicated that examples could also help because as we give the description of their population structures we need to give examples and then extend to other countries in Africa south of the Sahara. Both teaching aids and examples help clarify the content being presented as a result they make it easier for students to understand.

Settlement studies

Firstly, *students did not give examples to show how countries in Africa south of the Sahara differ in their functions excluding Botswana, Lesotho and Swaziland.* Five key informants suggested that as many examples as possible should be given to clarify the point. They argued that beginning with students' local area and then extending to other countries in Africa south of the Sahara would be helpful because students would already have the knowledge of different functions in their local area so it will be easy to understand those of other countries. However, one really wonders if teachers gave examples in Africa south of the Sahara because all the students gave examples including Botswana, Lesotho and Swaziland, or is it because they did not understand "excluding"? If it is the case then teachers need to clarify key words in questions to make sure students understand what the question requires of them. The remaining two recommended exposure to past examination questions arguing that students will be prepared for examination with more practice. Students need this exposure because the more they work with different questions the better are their chances of understanding and being in a position to give examples to show how countries differ in their functions.

Lastly, *students did not say what is true of both settlements X and Y in part of a city in a tropical country.* Five key informants suggested teaching interpretational skills because diagrammatic questions require this skill. Although the strategy does not say much about understanding the two settlements, it is necessary for students to be in a position to interpret pictures, diagrams or graphs. Nonetheless, when teachers have instilled the interpretational skill, they can use teaching aids showing different types of settlements and guide students into interpreting their features and by so doing students understanding will be sped up. The other two suggested that students should be given enough practice with different kinds of questions before examination so that they get used to interpreting graphs. Practicing with the questions will not only help students understand settlement concepts but also prepare them for examination.

I discussed strategies such as teaching aids like diagrams, pictures and population structures, examples, interpretational skills and regular exercise have been argued for as corrective strategies for errors made in Human Geography. The key informants believe that these strategies will help enhance students' understanding of concepts in Human Geography.

4.11.3 Application

Application according to Cave (1971: 88) requires comprehension of the method, theory, principle or abstraction applied. Given an unfamiliar problem, the student will apply the appropriate abstraction without having to be prompted as to which abstraction is correct and without having to be shown how to use it in that situation. Knowledge and comprehension serve as prerequisites for application as confirmed by Brown et al. (1985: 146) "if someone is able to apply what he has learned he must have had the requisite knowledge and comprehension". Questions required students to apply acquired knowledge which they did not do as errors from Physical Geography, Human Geography and Map Reading indicated and the corrective strategies are shown in Table 13 below.

Table 12 Corrective Strategies for errors within the Cognitive Category of Application

Corrective Strategy	Physical Geography	Human Geography	Map Reading	Frequency
Practice	▪	▪	▪	07
Definition	▪	▪		03
Seek help	▪			01
Interpretational Skills	▪			01
Simplified Language		▪		01
Key Words		▪		01
Teaching Aids			▪	01

4.11.3.1 Correction - Physical Geography

Physical Geography covered errors in river processes, weather and climate and weathering.

River processes

Students did not calculate the gradient. All the key informants suggested giving students a practice after a basic lesson to help them grasp the concepts. Teachers need to take the responsibility to teach students thoroughly how gradient is calculated because it is only when they know and understand how to calculate it that they can be in a position to apply the knowledge they have acquired in a practical situation by calculating it.

Weather and Climate

Firstly, s*tudents did not calculate Relative Humidity.* Seven key informants suggested that students should practice with different questions to help them understand how it is calculated so that they can get it right in the examination. With more practice students will work with different structures of questions and in the process they will understand how relative humidity is calculated because it is only when they understand that they will be able to apply the principles they have learned.

Lastly, *students did not calculate the range of temperature.* Three key informants suggested defining concepts first so that they are clear. Students need to know what concepts mean and understand them to be in a position to do calculations. The other three suggested following up with practice because it is the best way to treat any concept that involves calculations. Thus, teachers need to take the responsibility to teach and also evaluate students' progress and difficulties because it is only when they understand the concepts that they can apply the knowledge they have acquired. One key informant suggested also that teachers should seek help from Mathematics teachers if they cannot do calculations. Seeking help from Mathematics teachers is essential because not all Geography teachers are Mathematics teachers. Since Mathematics teachers are well trained in the subject they will be in a position to give a detailed explanation regarding the calculation of the range of temperature to make it easy for students to understand.

Weathering

Students did not apply the concept of freezing and thawing on the diagram provided. Three key informants suggested providing clear definitions of the key words so that they make sense to students. Clear definitions are imperative because it is only when concepts make sense to students that they will understand them and it is this understanding that becomes a prerequisite to the application of knowledge acquired. The remaining four suggested that interpretational skills should be instilled to enable students to answer diagrammatic questions. The strategy serves as a prerequisite not necessarily a corrective measure because it only enables students to interpret diagrammatic questions correctly. So its deficiency contributes to loss of marks. While instilling the interpretational skills, teachers need to make use of teaching aids such as pictures or diagrams and guide students into conveying what they see on the diagrams into meaningful information.

I discussed strategies such as defining concepts, giving regular exercises, seeking help from Mathematics teachers and instilling interpretational skills as have been argued for by the key informants as corrective strategies to help students to be in a position to apply concepts in Physical Geography.

4.11.3.2 Correction - Human Geography

Human Geography covered errors in Population and Settlement studies.

Population

Students did not calculate birth and death rates. Two key informants suggested defining concepts clearly because it becomes easier for students to do calculations when they understand the concepts. Students need to know and understand first what birth and death rates mean and then they can do calculations. The other five suggested a basic lesson followed up with a lot of exercises. Playing around with the principles and procedures that students would have learned will make it easy for them to apply them when necessary.

Settlement studies

Students did not identify the transport policy most likely to reduce atmospheric pollution in a city. Four key informants indicated that though the question required common sense, teachers have to be flexible enough in the use of language. This implies that teachers have to use simplified language one that students can easily understand. The other three suggested that key words be clarified. It is also imperative for teachers to use simple language so that students can understand because they have to comprehend knowledge before the can apply it.

4.11.3.3 Correction - Map Reading

Map reading covered errors from grid reference, measurement, and interpretation of maps.

Measurement

Students did not calculate the distance between the road and the bridge. All the key informants said that students need to practice measuring distances on the map so that they get used to the way in which it is done. The more students measure distances the better they will become at it. However, it is not possible to give students as much practice as teachers would

like because they are constrained by the fact that they still have to cover other aspects of the curriculum.

Interpretation of Maps

Firstly, *students did not interpret the key as required.* Seven key informants said that students need to be exposed to a lot of map work questions to be familiar with them. Students will learn how to interpret maps faster than anticipated with practice.

Lastly, *students did not interpret the diagram provided showing a contour map of a volcano to show the land forms marked* ***X, Y and Z.*** Five key informants indicated that we always lecture without considering that diagrams may help explain what we teach as a result teachers need to instill interpretational skills to help students interpret questions correctly. Teachers need to guide students into interpreting diagrams so that they are able to convert what they see into meaningful information. In addition, the remaining two suggested practice with different questions to grasp the concepts. With more practice students will become more knowledgeable and applying concepts will become easier to carry out.

I have discussed teaching strategies such as practice with questions, teaching aids and interpretational skills that key informants have argued for as corrective strategies for errors made in Map Reading in the cognitive category of Application. They believe they will assist students into applying the knowledge acquired.

4.11.4 Analysis

Analysis according to Cave (1971: 89) is concerned with the breakdown of the material into its constituent parts, a recognition of the relative hierarchy of ideas and the detection of the relationship between parts or ideas once they have recognized. Knowledge, comprehension and application are prerequisites for carrying out analytical capabilities. Analysis involved errors in Physical Geography and the corrective strategies are shown in Table 13.

Table 13 Corrective Strategies for Errors within the Cognitive Category of Analysis

Corrective Strategy	Physical Geography	Human Geography	Map Reading	Frequency as per question
Seek Help	▪			01
Excursions	▪			01

4.11.4.1 Corrections – Physical Geography

Physical Geography covered errors from weather and climate.

Weather and Climate

Students did not differentiate between chemical and physical weathering. Two key informants suggested that teachers should seek help from Science teachers because it is always easier to deal with weathering concepts from the scientific background because students are able to draw from their Chemistry and Physics knowledge. Science teachers are well trained in the subject and this puts them in a position to give a detailed explanation of the concepts. The other two suggested excursions arguing that it is always best to take students out to see changes that occur on rocks after weathering has taken place. Excursions are a good idea because students get interested and motivated when they experience objects in the real world, for they will see how physically weathered rocks differ from those weathered chemically as a result they can note the differences. The remaining three suggested practice with past examination questions. With practice students stand a better chance to acquire the ability to analyse concepts. Morris (1968: 166) confirms that the more practice students have, the more likely they are to generalise what they have learned into a pattern of critical analysis that will enable them to solve the problems that they will face in future.

I discussed teaching strategies such as seeking help from the Science teachers to clarify concepts and excursions so that students experience the real world that key informants have argued for as corrective strategies for errors made in Physical Geography to help students analyse concepts.

4.12 Correcting Errors in Geography

In this section I discussed the key informants' perspectives in response to the third Research Question "How can errors be corrected in order to improve students' performance in Geography examinations?" The major findings suggest that the key informants have argued for pedagogy and amongst the teaching strategies suggested most prominent were teaching aids, excursions, definition of concepts and practice with past examination questions. Although the teaching strategies were similar for most questions, the corrections argued done differently depending on the category of cognitive behaviour. The finding also reveals that it is important that teachers help students with interpretational skills because students are losing marks due to the fact that they cannot interpret diagrams and other questions especially those

that have two parts. The classification of errors into categories of cognitive behaviour revealed that the examination placed more emphasis on the knowledge and comprehension of facts and less on the higher cognitive levels. However, it is still a shock that students could not recall basic knowledge of facts let alone carry out other higher abilities such as application and analysis.

The next chapter provides a concluding discussion with recommendations.