THE IMPACT OF A LAPTOP COMPUTER ASSISTED TECHNOLOGY OPTION ON BIOLOGY STUDENTS' CHOICE OF A MULTI-MEDIA INSTRUCTIONAL METHODOLOGY

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by

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DECLARATION

I, Ilhami Demirtas declare that this work is my original work and has not been submitted before now, in any form whatsoever, by myself or anyone else to this university or any other educational institution for assessment purposes.

I understand that any breach of this declaration may result in non-acceptance of this work by those concerned.

Signed: _____

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ABSTRACT

This investigation, conducted with volunteer students in Cape Town in 1998-1999, analyses a sample of 323 students' improvement in achievement scores in physiology. The aim of this study was to explore the impact of the three instructional options, achievement, and preferences, on biology students with respect to gender and choice of instructional programme. The quantitative data was obtained from pre-test to post-test improvement scores, and qualitative data from open-ended questionnaires.

The purpose of this investigation was to offer students a free choice of learning details of human physiology, using labels, by any one of three available options:

(a) by a laptop computer graphics physiology instructional programme; or

(b) by equivalent hand-held coloured pictures of human organs and systems; or

(c) by hands-on manipulation of the articulated components of the equivalent life-size dissembled torso model of a human body.

The investigation sought firstly to record how many students chose instructional method (a), (b) or (c). It aimed to investigate whether the ***frequency distributions*** of choices might vary significantly with the gender of the student participants.

Another question for investigation focused on which one of the three equivalent instructional programme options promoted the greatest ***pre-test to post-test improvements*** in students' achievement scores in physiology.

The second part of the investigation was a ***qualitative study***. It synthesizes the main reasons given by the students for favouring their particular choice of

instructional strategy. It also discusses their suggestions for improving each of the three programmes in a diversity of South African school contexts.

The investigation gathered data to test fifteen null hypotheses. The most important findings were:

(1) for both females and males the computer and torso options were significantly more popular than the chart / picture option;

(2) both females and males responded more or less equally with respect to gender when choosing or avoiding the computer, torso or picture option;

(3) significant pre-test to post-test improvements in achievement scores occurred for all groups of learners, in all three forms of instructional programmes on offer;

(4) the females demonstrated significantly more prior knowledge than the males on the pre-test;

(5) the females demonstrated significantly higher post-test scores and achievement gains than the males; and

(6) all three instructional intervention programme options were equally effective in terms of the overall final performance post-test scores achieved by the learners who selected them.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
APUs	Assessment of Performance Units
AUS	Australia
BEd	Bachelor of Education
BSc	Bachelor of Science
CAI	Computer-Assisted Instruction
CAN	Canada
CZE	Czechoslovakia
DEN	Denmark
DES	Department of Education and Science
GER	Germany
HDE	Higher Diploma in Education
HMC	Head Masters Conference
IAEEA	International Association for the Evaluation of the Educational Achievement
INT	International average
METU	Middle East Technical University, Ankara, Turkey.
NAEP	National Assessment of Educational Progress
NET	Netherlands
NZ	New Zealand
PCs	Personal computers
RSA	Republic of South Africa
RUS	Russia
SA	South Africa
SWE	Sweden
USA	United States of America

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CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

This chapter focuses on the origin, background and importance of the research problem. It includes the purpose of the research, the questions to be asked, clarification of terms, list of dependent and independent variables, research approach, assumptions of the study, the delimitation of the research and organization of the dissertation.

The research reported in this investigation has already been disseminated recently in four refereed publications: *Proceedings* of the National subject Didactics / Learning Area Symposium, University of Stellenbosch (1999: 42-47); a chapter in: The pursuit of Excellence in Mathematics and Science Education, Ogunniyi, M. B. (ed.) University of Western Cape (1999: in press); *Abstracts* of the 11th Biennial Congress of the South African Association for Research and Development in Higher Education (1999: 9); and *Proceedings* of the 8th Annual Conference of the Southern African Association for Research in Mathematics and Science Education, University of Port Elizabeth (2000: in press). A fifth in press refereed publication will be appearing in the *Proceedings* of the 2nd Global Congress on Engineering Education, Wismar, Federal Republic of Germany, July 2-5 (2000). Sample copies of these research articles and papers are attached in Appendix A.

1.1. Purpose of the research

The purpose of this investigation was to offer 323 biology students a free choice of learning details of human physiology using labels, by any one of three available options:

(a) by a laptop Pentium computer graphics physiology instructional programme; or
(b) by an equivalent hand-held large coloured picture (chart) of human organs and systems; or
(c) by hands-on manipulation of the articulated components of the equivalent life-size dissembled torso model of a human body.

The investigation sought firstly to record how many students chose instructional method (a), (b) or (c); and then aimed to investigate whether the frequency distributions of choices varied significantly with the *gender* of the student participants.

In the current investigation, prior computer literacy was not important because the students merely had to press only four or five keys, with brief administrative assistance. Prior knowledge did not matter because, whether a student scored 1 out of 16, or 15 out of 16, on the pre-test, it was the magnitude of his or her *change* in score which was the critical variable.

Other questions for investigation focused on which one of the three equivalent instructional programme options was the most efficient for students to complete; and which one of the three equivalent instructional

programme options promoted the greatest "pre-test to post-test improvements" in students' achievement scores in physiology.

The second part of the investigation was a qualitative study. It synthesized the main reasons given by the students for favoring their particular choice of instructional strategy; and it discussed their suggestions for improving each of the three programmes in a diversity of South African school contexts.

The Pentium Computer and its physiology equivalent programme cost R 15000, and the life-size torso model cost approximately R 8000, but the equivalent life-size coloured chart for teaching purposes cost only R 300. Therefore, this investigation also sought to establish whether the much more expensive torso and computer were replaceable in effectiveness by the much simpler and cheaper instructional chart equivalent programme.

1.2. Origin, importance and background of problem

Ten years ago, National Co-ordinator for Biology in Head Masters Conference schools wrote: -

> *In the twenty years I have been teaching biology to secondary school students in private schools of South Africa, I have come to ask myself serious questions about the relevance of the kind of biology that I have to teach these young people. I ask the first of many questions relating to the teaching of biology in this country:*
>
> *Is the biology that we teach our students serving South Africa well?*
>
> *Will the biology that we teach our children serve South Africa well in the 21st century?* (Watson 1990: 49)

It is suggested that each country or region in each phase of its growth and development should carefully ask these questions and re-examine its instructional programmes in biology education. Biology is a rapidly developing branch of science. The major advances that are made continuously affect our life. However, biology is a content subject fraught with complicated terminology. Many students have difficulty in mastering these terms, but their understandings can be enhanced with the aid of multi-media instructional methodology (Teker & Ozet, 1996:6).

Biological systems are complex, and instructional programmes for teaching biology need to be developed (Beveridge, 1980; Levins, 1970). The science education literature, especially during the last 15 years, is not scarce in articles that focus on making biology courses relevant, practical and process-oriented. Instructional programmes are believed by many to be critical in preparing students to meet the challenges of a technological society (Fensham, 1985). It is clear that one of the persistent problems in the teaching of biology in most countries of the world is the choice of instructional methodology by the instructor. The impacts of new technology have emerged in the past decade, with the development of promising multi-media instructional programmes, teaching strategies and learning materials in biology education. The dimensions of this problem are increasing with the consideration of contextual factors such as gender differences, home language differences, and students' motivations and interests that bear on the provision of facilities for the effective teaching of biology.

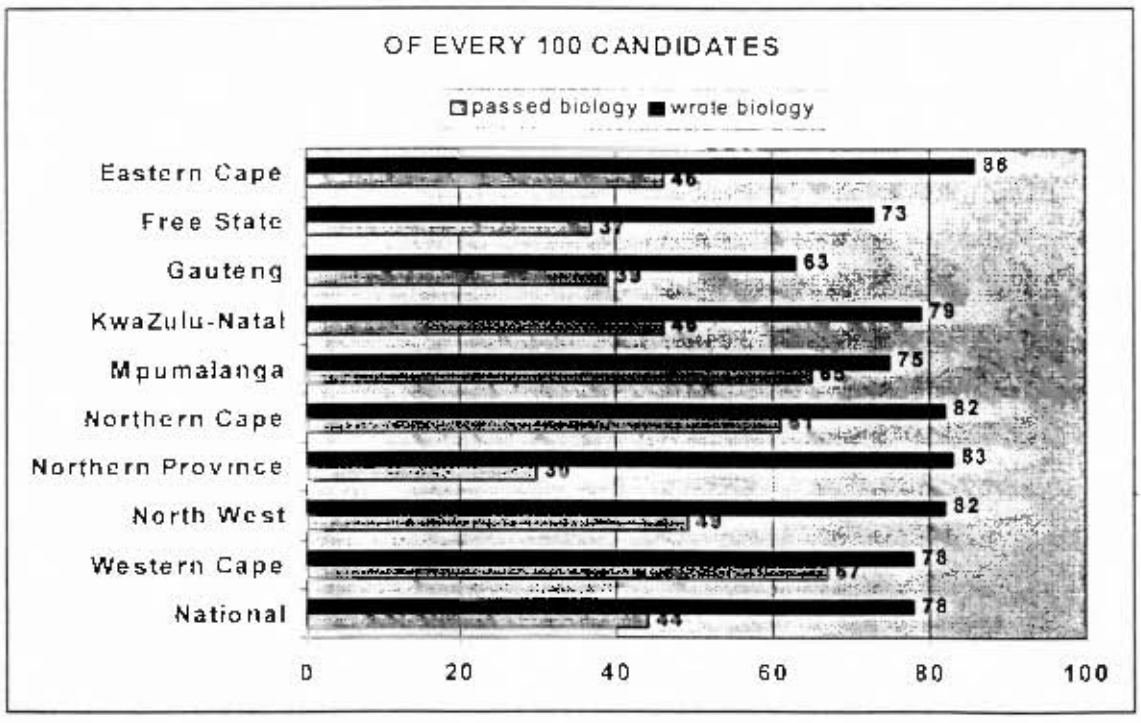
The problem chosen for investigation is an important one because, with careful and thorough instructional intervention, it is possible for most

learners to score very high marks for achievement tests in science/biology (e.g. Block, 1971). However, in the 1998 senior certificate (Matriculation) biology examinations in South Africa, the government-released statistics disclosed unsatisfactory achievement and low pass rates in biology in many provinces - see Table 1.1, column 7, and note especially the high failure rates in the Free State and Northern Province. In the 1999 Senior Certificate examinations, biology recorded only a 52.2% pass rate. (Cape Times, 31 December 1999, page 1) - down from the 57% recorded in 1998.

Table 1.1 Provisional pass rates in Higher Grade and Standard Grade Biology in the 1998 RSA Matriculation Examination.

BIOLOGY

	Total Full-time candidates	Number who wrote biology	% of all candidates	Number who passed biology	% of all candidates	Pass rate as a % of those who wrote biology
Male	244 040	185 475	76	110 501	45	60
Female	309 111	246 820	80	134 905	44	55
Total	**551 151**	**432 295**	**78**	**245 406**	**44**	**57**

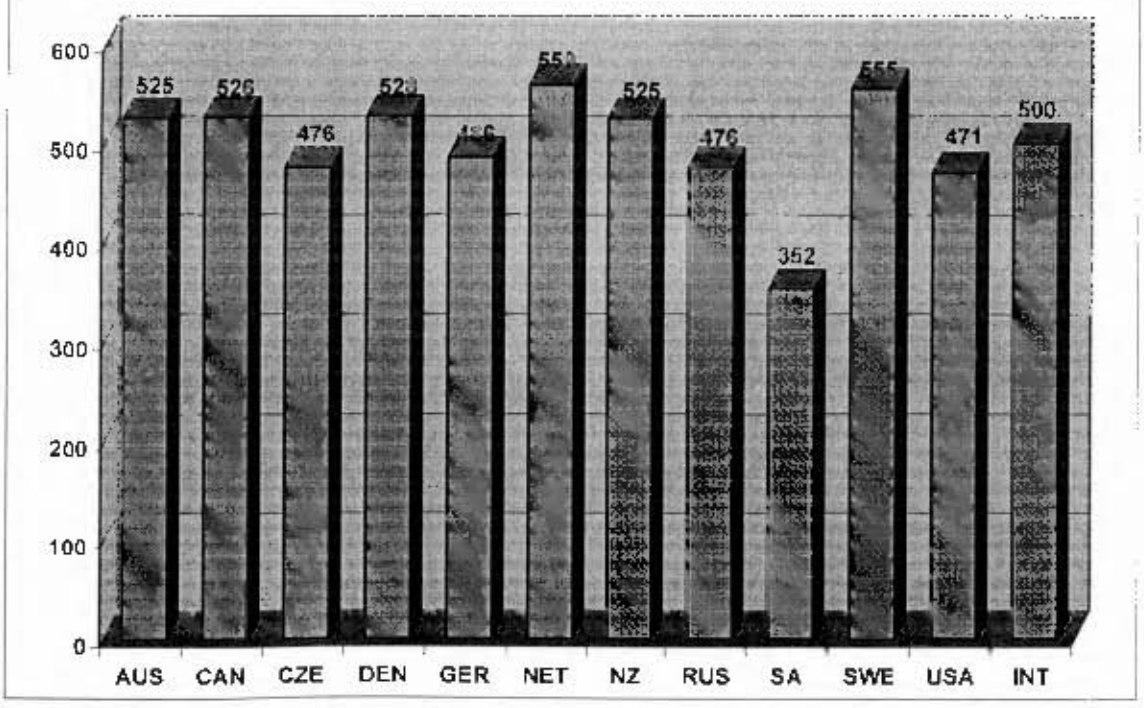


With the approach of the 21st century, the demand for scientific and technological understanding and expertise is greater than ever before. Consequently, countries around the world have been looking for methods of making teaching and learning in these areas more effective in their different school education systems (Howie & Hughes, 1998: 16).

However, in the Third International Mathematics and Science Study (TIMSS, in Howie & Hughes, 1998), conducted with more than 50 000 students in 41 countries, the overall scores of science of South African students were significantly lower than those in students in other countries- see Figure1.1. Thus, it is clear that current science / biology teaching methods can be improved, so this investigation now seeks to study how effective three types of classroom instructional strategy might be.

Figure 1.1

South African students' average mathematics and science score in comparison with other countries



1.3. Questions

In an attempt to investigate how the low science performance marks, as indicated in Figure 1.1, might possibly be improved using methodological intervention strategies, this multi-media study endeavors to answer the following twelve questions: -

When a random sample of 323 participant learners are invited to improve their knowledge of the structures of the human digestive system, and its associated organs by means of a torso model, a large picture chart with labels, or a laptop Pentium computer: -

(1) How many learners will choose the laptop computer option?

(2) How many learners will choose the picture option?

(3) How many learners will choose the torso option?

(4) Will more females than males choose the laptop computer option?

(5) Will more females than males choose the picture option?

(6) Will more females than males choose the torso option?

(7) Will the 179 females and the 144 males score equally on a 16-item test of prior knowledge of the parts of the digestive system (the pre-test)?

(8) Will the females and males score equally on the same pre-test, administered as a 16-item post-test, after learning intervention by means of a free choice of one of the three instructional programme options?

(9) Will the overall pre-test to post-test achievement gains by the 323 participant learners on the 16-item test be significant? (i.e. will the instructional intervention programmes be effective?)

(10) Will the 179 females' mean gains in achievement scores be better than the 144 males' gains in achievement scores?

(11) Will there be significantly different achievement performances between males and females who choose either the computer or the picture or the torso option?

(12) With regard to overall final performance achievement scores, which of the three instructional intervention programmes -laptop computer, picture or torso – will be the most effective?

1.4. Null hypotheses

The variables "programme choice", "gender", "achievement gain", and "final performance score" were used to formulate 15 null hypotheses in this investigation into learners' knowledge of the human digestive system, and its associated organs. The 15 null hypotheses are presented in detail in Chapter 3.

1.5. Clarification of terms

1.5.1. Computer-assisted instruction (CAI):

Computer-Assisted Instruction is an educational medium in which instructional content or activities are presented to students by some application of a computer.

1.5.2. Picture:

The large, commercially available, glossy, professional, coloured, hand-held, labeled picture (1.2 meters x 2.0 meters) of the human digestive system with attachable labels is used to teach the parts of the human digestive system as an instructional programme, like a chart.

1.5.3. Torso:

The life-size assembled model of human systems with attachable labels. It is used as an instructional programme to teach the basic components of the human digestive system.

1.6. List of dependent and independent variables

The following variables were selected to guide this study: -

1.6.1. Dependent variables for each student

- Pre-test physiology score out of 16
- Post-test physiology score out of 16
- Magnitude of the difference between pre-test and post-test scores.

1.6.2. Independent variables for each student

- Gender - Male
  - Female

- Formats of programme intervention - Hand-held picture
  - Laptop Pentium computer
  - Torso model

1.7. Research approach

For the purpose of this investigation the quantitative and qualitative response data were collected by means of pre-test scores, post-test scores and questionnaires. Sixteen items were employed for the quantitative study and two open-ended items for the qualitative study. Primary, secondary and tertiary school students who are English first or second language speakers took part in the investigation in small groups. The data collection was efficient, requiring a period of about fifteen to twenty minutes for a group of ten students. The programmes were run in thirty sessions, incorporating and accommodating the various samples. They ceased when data had been obtained from 323 participants, being mindful of the statistical need to group adequately according to gender and programme options selected. The

research analysis employed chi-square tests, t-tests for normal and non-normally distributed data, Scheffe tests for comparison of the final performance scores and ANOVA.

The method of analysis for the qualitative survey used categories to group and report the response data systematically for the three programme options; for example, for the computer option: -

- "It increases performance";
- "It is nice, exciting, enjoyable and fun"; etc.

1.8. Assumptions of the study

The study assumed that the respondents were of good eyesight, perceiving structures and drawings with reasonable accuracy. It assumed that the participating students were willing to learn about the insides of their bodies, and were not repelled by the idea of looking at representations of people's intestines, stomach, etc. It assumed that students' concentration spans would be sustained for 15-20 minutes, and that they were interested in the presentations of this topic even when their initial prior knowledge was minimal.

1.9. Delimitation of the research

The investigation was restricted to

- students in the age range 10-30 years.
- human physiology, rather than animal physiology in general.

- a maximum of 16 labelled components of the digestive system and its associated organs.
- conveniently available groups in the Western Cape Province.

1.10. Organization of the remainder of the dissertation

The next five chapters are arranged as follows-

Chapter 2 elaborates on *the literature survey* and on *the theoretical educational frameworks* in which the investigation is set.

Chapter 3 describes *the research methodology* in detail.

Chapter 4 consists of *the presentation and analysis of the quantitative results and a summary of the qualitative findings.*

Chapter 5 discusses and explains *the empirical findings* and *the qualitative results.*

Chapter 6 discusses and explains the *implications of the findings,* formulates *recommendations for further research* and presents *conclusions to the investigation.*

1.11. Chapter summary

In this introductory chapter the research problem has been clarified and its origin, importance and background have been stated. The aims of the

research, key terms, assumptions and variables have been clarified. The research approach and its delimitation have been mentioned.

In the ***next chapter*** the relevant ***literature*** will be reviewed and the ***theoretical framework*** for the thesis will be provided.

CHAPTER 2

LITERATURE REVIEW & THEORETICAL FRAMEWORK

CHAPTER 2

LITERATURE REVIEW

This chapter is divided into two parts. In part A, a review is presented of the theoretical educational frameworks in which the investigation is set, followed by a consideration of their implications for the present study. In part B, a literature summary is presented of related research findings into students' science achievement in different instructional contexts, with particular reference to the dependent and independent variables studied in the present investigation.

PART A: THEORETICAL FRAMEWORKS

2.1. Instructional programmes in science teaching: Theories of effectiveness

Effective science teachers tend to use a variety of teaching methods and instructional programmes, choosing the best for each lesson where possible. They keep in their mind the simple questions: "What do I want to teach?" and "How can I best teach it?". The answers to these questions will direct teachers to different teaching methods and instructional programmes.

Bruner (1986) described the characteristics of successful instructional programmes in terms of the following criteria:

- The programmes that will motivate the learner most effectively.
- The most effective way in which the instruction can be structured to enhance learning.
- The best sequence in which instructional programmes should be presented.
- The feedback and evaluation process. How should an instructional programme be evaluated? And how should an instructional programme be modified? (Trowbridge & Bybee, 1986: 25).

The assumption underlying an instructional programme is that it is an effective and efficient means to present the material. In order to be effective, one should use the appropriate programme for the subject and students, but there is no one best programme.

Wise and Okey (1983: 409) summarized the effects of various science teaching instructions on achievement as follows:

> "...The effective science classroom appears to be one in which students are kept aware of instructional objectives and receive feedback on their progress toward these objectives. Students get opportunities to interact with instructional materials and engage in varied kinds of activities. Alteration of instructional material occurred where it was thought that the change might be related to increased impact..."

Implication: Thus, for the purpose of the current investigation, when teachers lecture, show a film, use hand-held coloured pictures and models, or use computer-assisted instruction, they are using a range of instructional

techniques to develop understanding, motivate different students and help a diversity of students to learn science.

2.2. Theories of motivation in student learning

Individuals are complex psychosocial systems. Students are simultaneously motivated, learn, develop and are influenced by their peers. One of the most important conditions for learning is motivation of students. Science teachers often ask, " How can I motivate students? " Asking and answering questions about the motivation of students help the science teacher to find out the most appropriate factors for stimulating students. It is known that there are numerous factors motivating students. In *Mastery Teaching* Hunter (1982: 51) has described several very practical ways to increase students' motivation: -

- *Level of concern:* A moderate level of student concern will probably motivate student learning. Science teachers raise and lower the level of concern as appropriate to the educational situation.

- *Feeling tone:* How students feel in a situation affects their learning. Feeling tone can be thought of as a continuum ranging from pleasant through to unpleasant. Both pleasant and unpleasant atmospheres can motivate learning.

- *Success:* Few things will motivate students like success. To use success as a motivator, a teacher must design activities where students will have

to expend an effort in an uncertain situation. Success is felt when a student has a challenging goal and achieves.

- *Interest:* Interest in the learning task increases students' intention to learn. Students' interest can change from time to time. Teachers should use a variety of instructional programmes.

2.2.1. Theories of students' motivational differences:

To make our science teaching more effective, we need to concentrate on ways of developing the affective, of giving students a sense of satisfaction and personal achievement in their science. For, ultimately, it is not what science students know or can do that is important, but what they want to do (Woolnough, 1997).

Research has given important insights into motivational areas (Head, 1985; Hofstein & Walberg, 1995; Simpson *et al.,* 1994; Solomon, 1996). We need to concentrate more on the students, to find out what motivates them and recognize that different students are motivated by different things at different stages of their lives.

Adar (1969) identified four motivational 'needs': the need to achieve, the need to satisfy curiosity; the need to discharge a duty; and the need to affiliate with other people. These motivational needs were associated with different types of student called *'achiever students', 'curious students', 'conscientious students'* and *'sociable students'.* Each will relate best to

different teaching strategies, leading to different preferences by different students (Kempa & Diaz, 1990).

There is not one, single approach that will motivate all students; what switches some students on to science will be the same thing that switches another off! The more that the motivation can be intrinsic, rather than extrinsic, and students find satisfaction in doing science for its own sake, the more likely they are to follow it through into a satisfying career (Solomon, 1996). Just as there are different types of approaches to science, so different students will be motivated by different factors.

Implication: Thus, for the purpose of this investigation, materials have been specially selected for their capacity to motivate students, induce a moderate level of concern, make the students feel good, enjoy success, expend effort, be challenged, and appreciate a variety of choices.

2.3. Learners' multiple intelligences

2.3.1. Visual thinking and Gardner's theory of multiple intelligence:

Gardner (1993: 1-8) conceptualized human potential broadly, and initially mapped out the variety of human abilities into seven intelligences as follows: -

- *Linguistic Intelligence*
- *Logical-mathematical Intelligence*
- *Spatial Intelligence*

- *Bodily-kinesthetic Intelligence*
- *Musical Intelligence*
- *Interpersonal Intelligence*
- *Intrapersonal Intelligence*

According to Armstrong (1994:71-74), *Spatial Intelligence* particularly involves pictures: "the images in one's mind or the images in the external world". The three dimensional representation of biological structures is an example of images in one's mind. A "picture metaphor" expresses an idea in a visual image. "Idea sketching" is using a simple drawing in developing a powerful idea. Armstrong's advice to teachers is as follows:

> "Teachers should recognize the value which this kind of visual thinking can have in helping students articulate their understanding of subject matter."(p.73)

Implication: In the current investigation, modern computer technologies are very useful for encouraging or developing visual thinking. For example, with computer programmes, students are able to create concept maps, mind maps, etc. to generate and clarify ideas. Gardner's theory of multiple intelligences can help teachers ensure that they are meeting the needs of all their students by providing a variety of activities which draw on all of the intelligences, especially two-dimensional and three-dimensional visualization combined with linguistic skills of labelling and describing selected aspects of the bodily-kinesthetic dimension of human processes.

2.3.2. White's Model of Learning Science:

White (1988: 26-50) described several memory elements to tie into multiple intelligences. In fact, memory is just one part of intelligence and is believed to be the core of learning. White (1988:28) suggests seven different elements of memory to describe the actual learning of science: *strings, propositions, images, intellectual skills, motor skills and cognitive strategies.*

In particular, White (1988:29) advocated that images are mental pictures. Strings and propositions can be seen as images. Images are not only visual but relate to all five senses. At this point what is important is "the function images play in the learning of the science". "People vary in the intensity with which they experience imagery... across senses" and "people visualize more readily of words that they hear, talk, read, and think".

Ebezener (1998:8) concluded that, in the process of teaching and learning, a synthesis of multiple intelligence and elements of memory provide increasing students' achievement. The more meaningful the learning is in terms of multiple intelligences, the more memorable it is and the more likely it will be stored in of the forms listed by White.

Implication: Therefore, in this study, students are offered meaningful visual images of the human digestive system and memory elements such as attachable labels. The intention is that they will develop their *spatial intelligence with labelled images* as elements of memory.

2.4. Theories of how students perceive drawings and objects in Science

Not all students perceive drawings and objects in science in the same way. Some students are partially colour blind; others lack depth perception; others misjudge the height or width of spaces in door-ways, or of keys in key-holes; some cannot see blue bunsen burner flames; and so on. Such visually impaired students may need learning materials specially prepared to compensate for their individual handicaps. Tables 2.1, 2.2 and 2.3, after Rochford & Archer (1991:71) set out a more detailed theoretical analysis of students' visual deficits commonly encountered during science or biology practical work, and when using biological images and drawings.

Implication: For the purpose of the current investigation, a qualitative, open-ended response section has been built into the assessment and evaluation of students' reactions to the programmes of learning materials. The hundreds of students' reactions, final comments and suggestions written at the end of their period of instruction, may be classified and analyzed using theoretically structured frameworks such as those presented in Tables 2.1 to 2.3, and others described earlier in this chapter. However, this investigation is concerned primarily with documenting increased levels of student achievement and learner performance, rather than with the diagnosis of specific learning and perceptual disabilities, disorders and dysfunction. Consequently, applications and interpretations of Tables 2.1, 2.2 and 2.3 will not be covered in depth in the final qualitative analysis, which is more

concerned with evaluating reactions to the programme materials themselves as teaching methodologies.

Table 2.1. Theoretical analysis of a visual perception handicap into possible sub-categories of deficits, after Rochford & Archer (1991:71)

(a) Visual discrimination problems involve an inability to perceive dominant features in different objects and, thus, to discriminate one object from another. A typical visual discrimination task involves matching various shapes, designs or objects. Students with a problem in this area could experience difficulties with inversions and reversals, with subsequent confusion of symbols or diagrams.
(b) Visual figure-ground problems occur when an object can't easily be distinguished from its background. Students with difficulties in this area may experience problems perceiving parts and wholes.
(c) Visual orientation problems involve position in space. Students with disorders in this area usually record difficulties with spatial relations. The ability to perceive the positions of objects in space in relation to other objects and to the observer is affected.
(d) Visual form perception problems involve inaccurate two-dimensional representations of two- or three-dimensional objects.
(e) Visual sequencing problems include omissions, insertions or substitutions of symbols or connecting parts of diagrams by students.
(f) Visual memory is the ability to recollect the dominant features of a stimulus item or to recall the order of a number of items presented visually. Students with problems in this area may have difficulty recognizing geometric objects and symbols accurately.
(g) Visual constancy problems involve the misinterpretation of changes in size or shape or colour.
(h) Visual association and visual closure problems occur when a student is unable to identify figures that are presented in fragments, or unable to visualize the missing portion of a partially incomplete object or diagram.
(i) Problems can occur with rate of processing of visual information.

Table 2.2. Specific types of learning disability included on all cross referencing charts, after Rochford & Archer (1991:72).

1. ***Memory disabilities (short term)***
Students have problems in recalling on demand bits of information perceived or learned a few moments before.
2. ***Visual and auditory discrimination disabilities***
Students have problems in recognizing that two separate visual or auditory stimuli or patterns of stimuli are the same or different
3. ***Visual and auditory association disabilities***
Students have problems in relating separately perceived visual or auditory stimuli or sets of stimuli to each other.
4. ***Perceptual-motor disabilities***
Students have problems in recognizing the need for, or in performing, specific eye-motor behaviours, or relating visual stimuli to motor responses, or motor cues to visual stimuli.
5. ***Spatial awareness and orientation disabilities***
Students have problems in recognizing or adequately using temporal or spatial relationships between objects.
6. ***Verbal expression disabilities***
Students have problems in communicating information to others (either by speaking or writing) clearly.
7. ***Closure and generalization (convergence-divergence) disabilities***
Students have problems in interpolating parts from wholes or extrapolating to wholes from parts.
8. ***Attending disabilities***
Students have problems in keeping sustained focus of attention on a problem solving task over a space of several minutes.

Table 2.3. Types of residual problems in learning disabled college students and adults, after Rochford & Archer (1991:73).

Deficit Areas	Auditory and Visual Processing Deficits
A. Auditory Receptive Language Skills (Listening Comprehension) a) Semantic b) Syntactic c) Metalinguistic	1. Perception and recognition 2. Discrimination 3. Figure –ground 4. Memory 5. Sequencing 6. Analysis and induction 7. Synthesis, assembly and relational grouping 8. Visual-Auditory association; closure; Gestalt: parts and wholes 9. Spatial orientation and directionality
B. Auditory Expressive Language Skills (Oral Expression) a) Formulation b) Word-finding c) Apraxia/Mild Articulation problems d) Organization	
C. Visual Receptive Language Skills (Reading) a) Decoding automatically b) Comprehension: interference c) Rate d) Retention	

PART B: LITERATURE SURVEY: SCIENCE ACHIEVEMENT

2.5. Gender differences in science achievement

Keeves & Kotte (1996) reviewed sex differences in mean science achievement scores in ten countries. They summarized their patterns of findings not only in terms of age groups from 10 years to 18 years; but also within the major science fields of biology, chemistry, and physics. They concluded that clear differences in science achievement occurred between 10-year-old boys and 10-year-old girls; that these differences widened during the years of high school; and that they were greater in the physical sciences than in biology. .

In earlier years surveys of gender differences had been conducted by the Department of Education and Science using Assessment of Performance Units (APUs) (DES, 1989); by the International Association for the Evaluation of Educational Achievement (IAEEA) (Comber & Keeves, 1973); by the USA National Assessment of Educational Progress (NAEP, 1978); and by the British Columbia Science Surveys (BCSS)(Habbs *et al.*, 1979), as reported in Murphy (1991). All the surveys revealed the occurrence of sex differences in average level of achievement in science, irrespective of science content. Boys outperformed girls across the tests.

Smail & Kelly (1984) presented a clear picture of sex differences in science achievement, but they also proposed a plan of action to tackle the under achievement and under-representation of girls in science in the United Kingdom.

In Nigeria, Erinosho (1994) recorded that some differences occurred between boys and girls in their performances in physics, chemistry and biology. For example, in physics, 58.6% of girls passed in contrast with 55.4% of boys. In chemistry, 50.5% of boys and 48.1% of girls passed. In biology, 64.2% and 56.7% of boys and girls respectively passed.

With few exceptions, boys have been found to outperform girls in science achievement measures (Walberg, 1967; Fleming & Malone, 1983; Erickson & Erickson, 1984; Howe & Doody, 1989; Levin *et al.*, 1991; and Young & Fraser, 1994).

Walding *et al.* (1994) compared the performances of boys and girls in the Australian National Chemistry Quiz. They concluded that, although boys and girls solved some questions equally well, on many questions boys outperformed girls.

In Thailand, Klainin *et al.* (1987 and 1989) found remarkable sex or gender differences in science learning achievement in upper secondary school - remarkable because girls outperformed boys on almost every outcome measure.

A similar result was obtained in Malta. Ventura (1985) and Agius Delicata (1986) found that, in the study of a representative sample of 172 boys and 224 girls, the girls' performance was much higher than boys' performance in science.

Keeves (1992) compared the results of the first and second IEA studies and suggested that, for a few countries, female students outperformed male students, particularly in the physical sciences, narrowing the gender differences in science achievement.

2.5.1. What are the sources of gender differences in science achievement?

Many studies have focused on attempting to explain the sex-related differences that have been found in science achievement. The attempts to explain the gender differences have centered on two opposing theoretical perspectives: biological causes and sociological causes of sex-related differences in science achievement. The sociological causes appear to have wider acceptance in the educational community.

This was evidenced by Kelly's (1981) statement: -

> "But even if a biological contribution to girls' underachievement in science were to be established, I do not think that would be the end of the story. Biology is not destiny. Society has the option, through schooling and socialization, of providing additional training in the areas where each individual is weakest so as to produce citizens with well-rounded personalities and competencies." (p.82).

The Science Council of Canada (1984) supported this argument:

> "Some people maintain that there are genetic causes for differences in intellectual orientation between boys and girls, and that these differences prevent girls from excelling in science. Although this theory is not supported by any convincing evidence, it has received

> ample publicity that may indeed influence parents and teachers. The Science Council, however, finds the theory an entirely inadequate account for the large disparity in participation rates.
>
> In the Science Council's views, it is more likely that societal attitudes are responsible. The cultural and moral values transmitted by parents to daughters from the earliest age tend to turn them away from science and technology. Such common actions as giving construction kits to boys but dolls to girls reinforce this attitude, and reinforcement continues through the school system. Over the years, parents, teachers, guidance counsellors, curriculum developers and policy makers unwittingly contribute to discouraging girls from studying science and engineering and restricting their career opportunities."(p.36)

Johnson & Murphy (1984) stated that society's role expectations for men and women result in the kinds of differences in the early socialization of boys and girls that are reinforced by appropriate role models from real life in the media and textbooks and in the hidden curriculum.

Among Nigerian chemistry students, gender differences were attributed to social attitudes, values, interests, aspirations and other cultural practices like socialization (Adigwe, 1992).

Theorists favoring sociological explanations for gender differences in science achievement have frequently focused on the classroom process as a possible key to understanding the origins of gender differences in science achievement (Hacker, 1992).

They suggested that gender differences in science achievement arose from differences in some factors associated with everyday out-of-school activities

and classroom experiences (Johnson *et al.* 1983; Kahle *et al.* 1983; Johnson *et al.* 1984; Johson, 1986; Hoffman, 1987; Haggerty, 1987).

Weinburgh (1995) reviewed the literature between 1970 and 1991 to analyze gender differences in student attitudes towards science in the parallel differences in their science achievement. Her findings suggested that males might have shown more positive attitudes than females toward science in the parallel differences in their science achievement.

Implication: A gender effect might be expected in this investigation because there is evidence from previous studies that gender might be a significant variable.

2.6. Achievement in biology using computer-assisted instruction

The introduction of personal computers (PCs) into school science classrooms - and the increasing availability of appropriate software in order to explore and develop further ideas, such as curiosity and creativity in science (Oliver & Okey, 1986) - provide opportunities for teaching and learning.

Computers have the high potential to enhance teaching in the educational setting (Bangertdrowns, Kulik and Kulik, 1985).

One of the areas of high potential for the use of computers is obviously to teach and learn biological subjects. The learning and teaching of biology is usually considered a difficult task. Pupils have a set of ideas (more or less

connected) about the world that they often use to generate explanations in particular situations and in response to particular questions or cues (Driver, 1985).

Studies by Hughes (1974) and Sasser (1990) showed that the use of computers in the instructional process produced significantly greater achievement in science and mathematics.

Lunettta & Hofstein (1981) stated that computers open the possibility for better science instruction.

Woodhouse & Jones (1988) suggested that schools and teachers would have to revise their curricula so as to investigate computer use as part of the educational activity.

Hounshell & Hill (1989) concluded that students in a computer-enhanced biology class did significantly better on the biology tests, and had more positive attitudes toward biology.

Computer assisted instruction is receiving a considerable amount of attention in education, and it can be used not only to inform and entertain, but also can also be used effectively to teach students (Ananthakrishnan & McDermott, 1996; Tai, Tsai and Chang 1999).

Implication: The literature review adds support for decision to include an expensive computer programme in this study as an option.

2.7. Achievement in biology using picture -aided instruction

Thomas (1978:402) drew the following conclusion concerning poster-aided instruction use with fourth-grade science students: "The findings appear to indicate that the inclusion or exclusion of pictures in elementary science does not influence the comprehension of the material."

Thomas' view reflects the opinions of the majority in the field through much of the 1970s. Posters and pictures supported 60% of the science instructions (Evans *et al*, 1987) because 85% of all the messages we receive are visual in nature (Doblin, 1980).

Dwyer (1972:51) designed a controlled experiment in which he investigated an illustrated instructional sequence on the topic the heart. Using a variety of photographs of the heart in black-and-white and in colour, he determined that "all types of visuals are not equally effective in facilitating students' achievement by different learning objectives." His statistical analysis revealed that students preferred colour in pictures.

In 1981, Holiday reported another approach to learning, based on picture-word diagrams, using biogeochemical cycles (oxygen, nitrogen, carbon dioxide, and water cycles). He concluded that the picture-word method should be supported completely.

Hayes & Readence (1983) examined the degree of recall from several levels of picture-aided instruction in science. They reported that instructions depend on pictures because they produce much higher recall.

Levie (1987:27) summarized: -

> "It is clear that 'research on picture' is not a coherent field of inquiry. An aerial view of the picture research literature would look like a group of small topical islands with only a few connecting bridges in between them. This brings together data and ideas from separate items and contributes much to our understanding of the pervasive, versatile mode of communication."

Implication: The literature review proves achievement gains using pictures in biology teaching, and it adds support for the decision to include the large coloured instructional chart as a programme choice in the current investigation.

2.8. Achievement in biology using models

Where the objects being taught are 3-D in shape like the torso, it seems logical that actual 3-D models might prove to be the most effective instructional programme as, found by Bishop (1978).

Bradley (1981) concluded that there were significant differences in achievement in biology, related to the use of different models.

Isekenegee (1974) found that chemistry students who had been taught by models did significantly better than those who were not.

Implication: The literature review offers preliminary support for the decision to include a torso model as an programme choice in this investigation.

2.9. Chapter summary

In this chapter the theoretical frameworks and the literature survey for this investigation have been presented. In part A, the theory of programme intervention, theories of students' motivational differences and theories of how students perceive drawings and objects in science have been described. The relationships amongst multiple intelligences, elements of memory, instructional programmes and science achievement have been mentioned.

In part B, the effect of gender difference as an independent variable on biology achievement has been reviewed. The effects of using different instructional programmes as intervention variables in biology achievement have been summarized

Finally, this chapter has pointed out, step by step, how the various aspects and findings and recommendations from the literature review have been used to define and support the shape and design of the present investigation, taking their earlier results and suggestions into consideration at appropriate points.

In ***Chapter 3*** the ***Research Methodology*** of this investigation will be presented.

CHAPTER 3

RESEARCH METHODOLGY

CHAPTER 3

RESEARCH METHODOLOGY

In this chapter the samples, methodology and instruments used in the study are presented and discussed. The research methods employed in the investigation are identified, and the selection of the data-gathering instruments and details of the three instructional intervention programmes are described. The hypotheses to be tested are specified. The formats of the proposed statistical analysis and the intended treatment of the data are also explained.

3.1. Population and samples

Geographically, eight conveniently and randomly available samples - broken into 30 sub-groups or sessions - were used in this study. The overall size of the resultant population was 323 participant learners drawn from primary, secondary and tertiary education institutions in Cape Town, during the period 1998-1999.

The nature and characteristics of the samples were as follows:

- Sample 1 : A randomly available sample of secondary school students (N=20) from a middle school science class in Star International High School in Cape Town. All of them were boys.

- Sample 2: A convenient sample of adult students (N=5) from the science education post-graduate Higher Diploma in Education group

at the School of Education at University of Cape Town. One student was male and four were females.

- Sample 3: A randomly available sample of secondary school students (N=16) at a well-established private school in Cape Town. Six of them were girls, ten of them were boys.

- Sample 4: A randomly available sample of Xhosa/English speaking secondary school students (N=16) from a biology class in Oscar Mpeta High School located in one of Cape Town's informal settlement areas. Five of them were girls; eleven of them were boys.

- Sample 5: A convenient sample of adults students (N=10) in a graduate science education research group at the University of Western Cape in Cape Town. Five of them were females; five of them were males.

- Sample 6: A randomly selected participant sample of secondary school students (N=55) invited from among the Science Expo'99 visitors to the School of Education at the University of Cape Town. Twenty-five of them were girls; thirty of them were boys.

- Sample 7: A sample of adult students (N=11) comprising the primary school teacher training group in the School of Education at the University of Cape Town. All of them were females.

- Sample 8: An available sample of secondary school students (N=190) from science and biology classes at Islamia College in Cape Town.

One hundred and twenty three of them were girls; 67 of them were boys. They participated in the study in consecutive groups of 10-15 students at a time.

3.2. Research methodology

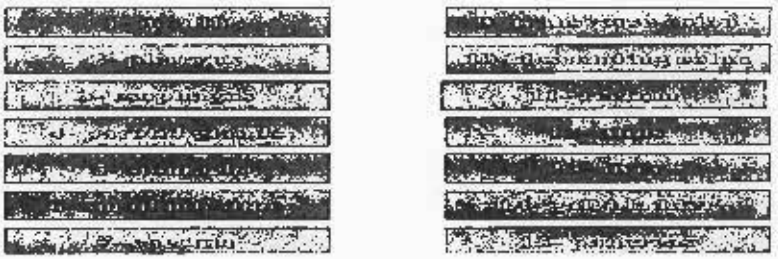
3.2.1. Survey research method

The method available for gathering the information for this research was the *simple random / convenience sampling*. Cohen & Manion (1995:87-88) stated that in *simple random* sampling each member of the population under study has an equal chance of being selected for the investigation. Some information was gathered by *convenience sampling* which involved choosing the nearest individuals geographically to serve as respondents and continuing that process until the required sample size had been obtained.

3.2.2. Selection of the topic of instruction

A labelled knowledge of the location and names of the components of the human digestive system and its associated organs, presented in figure 3.1, was selected as the biology topic to teach and assess.

Figure 3.1. ***Names of the components of the digestive system and its associated organs, as labelled.***



3.2.3. **Selection of the pre-test items**

Initial pilot studies began with only eight labels, to see whether the basic research plan was feasible, workable and understandable. Subsequently, 16 pre-test items comprised the 16 missing labelled parts of the coloured digestive system, as presented in figure 3.2. Parts were to be named and labelled on a photocopied A4 size black-and-white picture by each responding pupil who also had access to a coloured one of similar size for clearer reference (See appendices E and F). This was the pre-test measure of the pupils' prior knowledge, each correctly labelled part of the pre-test earning one mark. The maximum possible pre-test score was 16.

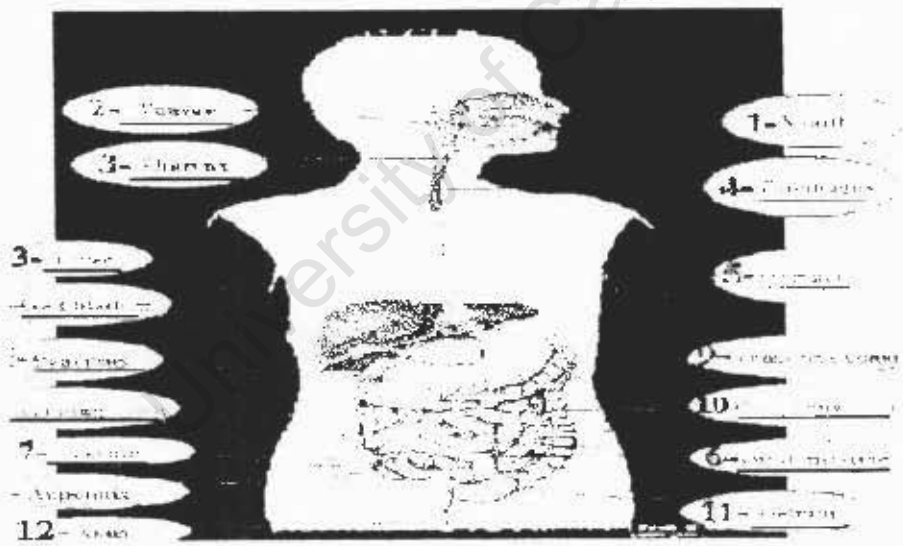


Figure 3.2. ***Sixteen missing labelled parts of the digestive system.***

3.2.4. **Selection of the post-test items**

The same unlabelled parts of the digestive system, presented as a re-test, were to be identified and labelled on a second blank copy of the diagram, as in Figure 3.2, and in Appendix F.

3.2.5. Selection of the qualitative survey questions

On the back of the post-test sheets, all respondents were invited to complete the open-ended sections, in which they described in their own words the features which they liked about the teaching materials, and their suggestions for improving them. A copy of this survey response sheet is presented in Figure 3.3.

Figure 3.3. *Open-ended questionnaire*

Name or Nickname	
Are you male or female?	
In which school and which grade are you currently registered?	
What is your home language (English, Afrikaans, Xhosa, etc.)?	

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME?

1-

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS?

1-

2-

3.2.6. Details of the instructional intervention media

(i) Details of the human torso as the first instructional programme option available

A photograph of the life-size assembled and articulated torso model of the human digestive system is presented in Figure 3.4. Attachable labels were provided.

Figure 3.4. *Torso model of the internal human systems.*

(ii) Details of the coloured pictures and labels, as the second instructional programme option available

A black and white reproduction of the coloured hand-held coloured picture (a chart measuring 120x200 cm) of the human digestive system, as an instructional medium, is presented in Figure 3.5.

Figure 3.5. ***Hand-held coloured picture of the human digestive system.***

(iii) Details of the computer programme as the third instructional programme option available

The computer programme, prepared as a Microsoft Power Point Presentation programme, presented the human digestive system's graphics in a Pentium 133-laptop computer. It was utilised by the simple repetitive pressing of a single key in the classroom where there were students who chose the computer as an instructional programme.

3.3. Treatment of the data and selection of the statistical methods of analysis

The data was obtained from 323 participant-learners in Cape Town during 1998- 1999 over a period of 30 sessions, 5-15 pupils at a time: -

3.3.1. Numbers of participants choosing each of the three optional teaching methods

Tables of headcounts and histograms will be presented to illustrate the distributions of choices according to gender, as an independent variable, and academic achievement.

Chi-square tests will be used to establish whether significant differences exist between the response frequency patterns of the various sub-groups.

3.3.2. Pre-test to post-test score improvements

t-tests and/or ANOVA (for non-normal distributions) will be used to establish whether different groups' mean test score improvements were significantly greater using either the computer or the torso or the hand-held coloured pictures and labels; and also with respect to gender.

Data will be analysed and interpreted to support or reject the hypotheses and answer the various research questions.

3.3.3. Qualitative findings

This section will categorise and summarise the main suggestions made by the 323 respondents for improving the three instructional intervention programmes. It will also analyse and summarise the main features acknowledged to be commendable by the respondents.

A qualitative report also will be supplied on the behavioural interactions which were recorded for members interacting with the materials within each of the three groups.

Following ***chapter 4 (results and findings)***, a more detailed discussion of the quantitative and qualitative findings will be presented in ***Chapter 5***.

3.4. Null Hypotheses

The following null hypotheses will be tested:-

Null Hypothesis 1: ***Programme choices by the 323 participant learners***

There will be no significant difference between the frequencies of free choices of the three instructional programme options by the 323 participants.

Null Hypothesis 2a: ***Programme choices by 179 female learners***

There will be no significant difference between the frequencies of choices of the three instructional programme options among the 179 female learners.

Null Hypothesis 2b: ***Programme choices by the 144 male learners***

There will be no significant difference between the frequencies of choices of the three instructional programme options among the 144 male learners.

Null Hypothesis 3a: ***Computer graphic choice and gender***

There will be no significant difference between the frequencies of choice or avoidance of the computer graphic as an instructional method by the 179 female and the 144 male learners.

***Null Hypothesis 3b:* Hand-held coloured picture choice and gender**

There will be no significant difference between the frequencies of choice or avoidance of the large hand-held coloured picture as an instructional strategy by the 179 female and the 144 male learners.

***Hypothesis 3c:* Torso choice and gender**

There will be no significant difference between the frequencies of choice or avoidance of the torso as an instructional medium by the 179 female and the 144 male learners

***Null Hypothesis 4:* Achievement gains by the 323 participant learners**

Irrespective of instructional programme chosen, the learners' mean pre-test to post-test gains in achievement scores will not be significant.

***Hypothesis 5a:* Achievement gains by the 179 female learners**

Irrespective of instructional programme chosen, the 179 female learners' mean pre-test to post-test gains in achievement scores will not be statistically significant.

***Null Hypothesis 5b:* Achievement gains by the 144 male learners**

Irrespective of instructional programme chosen, the 144 male learners' mean pre-test to post-test gains in achievement scores will not be statistically significant.

Null Hypothesis 5c: ***Pre-test scores; post-test scores and achievement gains by gender***

Compared according to gender, there will be no significant difference between males' and females' pre-test scores, post-test scores and mean achievement gains.

Null Hypothesis 6a: ***Gender and achievement gains by students taking the computer graphic choice***

Female and male pupils' mean pre-test to post-test gains in achievement scores under the computer graphic choice will not be significantly different.

Null Hypothesis 6b: ***Gender and achievement gains by picture choice***

Female and male pupils' mean pre-test to post-test gains in achievement scores by picture choice will not be significantly different.

Null Hypothesis 6c: ***Gender and achievement gains by torso choice***

Female and male pupils' mean pre-test to post-test gains in achievement scores by torso choice will not be significantly different.

***Null Hypothesis 7:* Post-test final performance scores with respect to programme choices and gender**

That no statistically significant differences will occur among the post-test scores of the six sub-groups defined by programme choice and gender.

***Null Hypothesis 8:* Overall post-test final performance scores under three different programmes**

Compared according to programme chosen, the three groups of participant learners' mean post-test final performance scores will not be significantly different from each other.

3.5. Pilot trials of the materials and programme instructions

Rehearsals were used to check whether South African students speaking different home languages would be able to understand the instructions and procedure of the tests. Pilot studies were carried out on a random sample of volunteers in Cape Town in 1998 using only eight labelled components of the digestive system before developing the longer assessment instrument and questionnaire. Then another pilot study followed, with extensive exploratory discussion to time and check the measuring instrument and questionnaire for comprehensibility, efficiency and precision.

3.6. Data collection

The data were collected by the pre-test, intervention treatment and re-test method as a part of normal classroom lessons. These were administrated by the researcher with the help of enthusiastic and informed colleagues at the selected institutions.

After mentioning the purpose and procedure of the study (assessment, options, instructions), participants were given the pre-test comprising 16 items to label, in order that they should disclose their prior knowledge, i.e. what they already knew. They were told that, if they knew nothing, it didn't matter. With access to the more expensive coloured form of the pre-test (Appendix E), the 323 participants labelled the items themselves on their much cheaper black and white photocopied versions of the pre-test (Appendix F). It took nine minutes, on average, for a class to complete the pre-test.

After finishing the pre-test, all participants then freely chose one of three instructional programmes on offer. The three instructional programmes were organised and presented separately on three different desks: torso, coloured picture and computer graphic. Participants observed and investigated the three displayed programmes, then chose one of them.

The participants received instructions according to their chosen learning programme, and then they practised and labelled the sixteen parts of the digestive system themselves. The school students in particular typically expressed excitement about their participation in the exercise.

After finishing the instructional intervention section, students reflected on their task accomplished. They looked typically very happy, pleased and satisfied. The instructional intervention phase took a total of 12 minutes, on average.

Finally, the post-tests (Appendix F) were given to all participants as the re-test. Again they labelled the 16 items on a blank fresh diagram page. It took approximately six minutes. On the back of the post-test sheet there was a questionnaire evaluating the programme of study. Most students completed the questionnaire and wrote their comments, suggestions and recommendations.

Administration of the whole study took 25-30 minutes for each session.

The data were entered and stored using the computer software programme Microsoft Office Excel (Appendix B), and data were imported to the Statistica programme for statistical analyses. The data file was analysed using figures and tables according to the statistical distributions.

3.7. Chapter summary

In this chapter, the samples engaged in the investigation have been described, and the instruments used in this survey have been explained. The hypotheses to be tested, the proposed methods for treatment of the data, the statistical methods selected, and the intended data collection procedures have been described.

The ***results and findings*** of the research study now follow in ***Chapter 4.***

CHAPTER 4

RESULTS AND FINDINGS

CHAPTER 4

RESULTS AND FINDINGS

In this chapter the results and findings are presented with figures and tables, and the hypotheses are tested and analyzed.

The chapter is divided into two parts. Part A, the **quantitative findings**, presents the significant differences found between various sub-groups of the 323 participant learners. In part B, an analysis and summary of the **qualitative findings** are presented.

PART A: PRESENTATION OF THE QUANTITATIVE FINDINGS

4.1. Testing of the hypotheses

***Hypothesis 1:* Programme choices by the 323 participant learners:**

The null hypothesis that *there will be no significant difference between the frequencies of free choices of the three instructional programme options* is rejected.

Figure 4.1 shows that 141 of the 323 learners (43.7%) chose the computer graphic as their preferred instructional method; 61 of the 323 learners (18.9%) preferred the hand-held coloured picture as their instructional medium of free choice; and 121 of the 323 learners (37.4%) opted for the torso as their learning strategy.

Figure 4.1 Frequencies of choices of the three instructional programme options by the 323 learners.

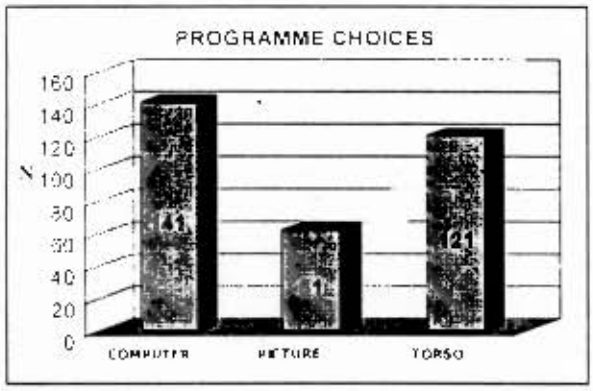


Table 4.1 presents the chi-square analysis of the distribution frequencies of responses depicted in Figure 4.1, assuming an expected equal distribution of responses to the three programme options by 323 learners.

Table 4.1 Chi-square analysis of the 323 responses to a free choice of the three instructional programme options.

OPTION	Observed	Expected	O - E	$(O - E)^2 / E$
Computer choice	141	108	33	10.08
Picture choice	61	107	-44	18.09
Torso choice	121	108	13	1.56
SUM	323.00	323	0.00	**29.73**

Chi-square=29.73 df=2 p = .000000

Thus, there is a statistically highly significant difference between the frequencies of choices of the three instructional programmes by the sample of 323 learners, in favour of the computer and, to a lesser degree, in favour of the torso option.

Hypothesis 2a: ***Programme choices by 179 female learners:***

The null hypothesis that *there will be no significant difference between the frequencies of choices of the three instructional programme options among the 179 female learners* is rejected.

Figure 4.2a shows that 70 of the 179 female learners chose the computer graphic as their preferred instructional method; 37 of the 179 female learners selected the hand-held coloured picture as their instructional medium of free choice; and 72 of the 179 female learners opted for the torso as their learning strategy.

Figure 4.2a Frequencies of choices of the three instructional programme options by the 179 female learners

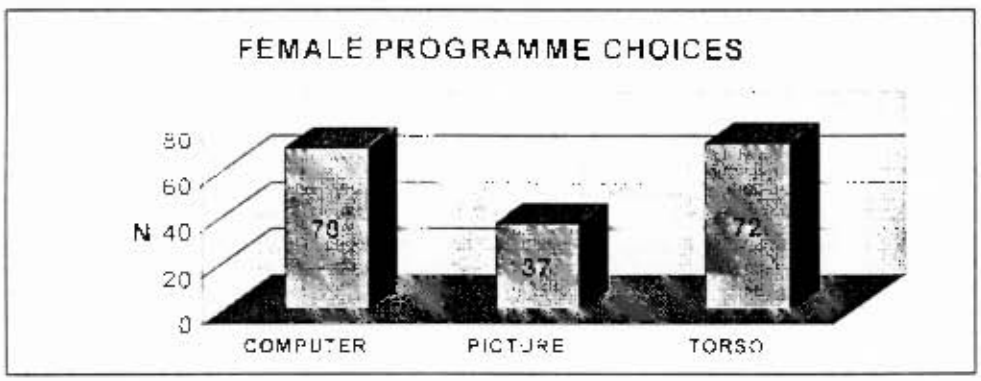


Table 4.2a presents the chi-square analysis of the distribution frequencies of responses depicted in Figure 4.2a, assuming an expected equal distribution of responses to the three programme options by 179 female learners.

Table 4.2a Chi-square analysis of the 179 female responses to a free choice of the three instructional programme options.

OPTION	Observed	Expected	O - E	$(O - E)^2 / E$
Computer choice	70	60	+10	1.67
Picture choice	37	59	-22	8.20
Torso choice	72	60	+12	2.40
SUM	179	179	0.00	12.27

Chi-square=12.27 df=2 p = .002

Thus, there is a statistically highly significant difference between the frequencies of choices of the three instructional programmes by the sample of 179 female learners, in favour of both the torso and computer options.

***Hypothesis 2b:* Programme choices by the 144 male learners:**

The null hypothesis that *there will be no significant difference between the frequencies of choices of the three instructional programme options among the 144 male learners* is rejected.

Figure 4.2b shows that 71 of the 144 male learners chose the computer graphic as their preferred instructional method; 24 of the 144 male learners preferred the hand-held coloured picture as their instructional medium of free choice; and 49 of the 144 male learners opted for the torso as their learning strategy.

Figure 4.2b Frequencies of choices of the three instructional programme options by the 144 male learners.

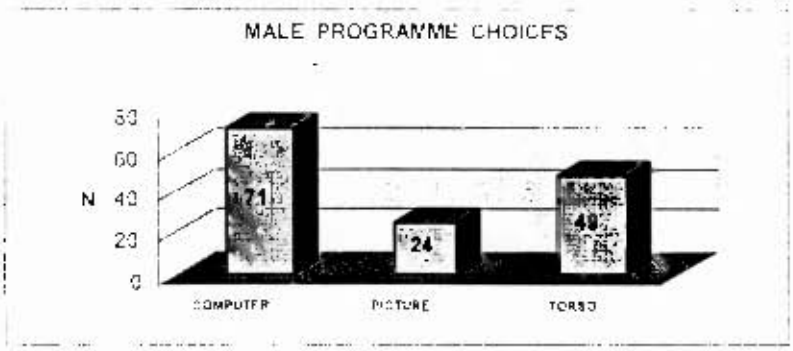


Table 4.2b presents the chi-square analysis of the distribution frequencies of responses depicted in Figure 4.2b, assuming an expected equal distribution of responses to the three programme options by 144 male learners.

Table 4.2b Chi-square analysis of the 144 male responses to the free choices of the three instructional programme options.

OPTION	Observed	Expected	O - E	$(O - E)^2 / E$
Computer choice	71	48	−23	11.02
Picture choice	24	48	-24	12.00
Torso choice	49	48	1	0.02
SUM	144	144	0.00	**23.04**

Chi-square= 23.04 **df=2** **p = .0002**

Thus, there is a statistically highly significant difference between the frequencies of choices of the three instructional programmes by the sample of 144 male learners, in favour of the computer option and away from the picture option.

***Hypothesis 3a:* Computer graphic choice and gender:**

The null hypothesis that *there will be no significant difference between the frequencies of choices of computer graphic as an instructional method by the 179 female and the 144 male learners is* supported.

Figure 4.3a shows that 141 learners out of 323 chose the computer. Of the females, 70 out of 179 selected the computer; of the males, 71 out of 144 chose the computer.

Figure 4.3a Frequencies of choice of the computer by 179 female and 144 male learners.

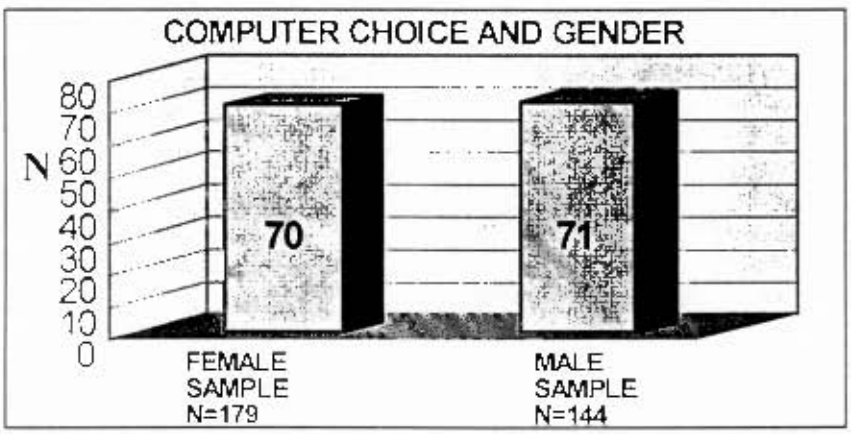


Table 4.3a presents the chi-square analysis of the female and male response distribution frequencies of responses with respect to choosing or avoiding the available computer option.

Table 4.3a Chi-square (2x2 table) analysis of the response frequencies of male and female learners to choosing or avoiding the computer option.

Computer option	Chosen	Avoided	Total
Female	70	109	179
Male	71	73	144
Total	141	182	323

Chi-square= 2.92 **df=1** **p = .0847**

Thus, there is no statistically significant difference between the responses of females and males in respect to choosing or avoiding the computer option for instruction.

***Hypothesis 3b:* Hand-held coloured picture choice and gender:**

The null hypothesis that *there will be no significant difference between the frequencies of choice of hand-held coloured picture as an instructional strategy by the 179 female and the 144 male learners* is supported.

Figure 4.3b shows that 61 learners out of 323 chose the picture. Of the females, 37 out of 179 selected the picture; of the males, 24 out of 144 chose the picture.

Figure 4.3b Frequencies of choice of the large picture by 179 female learners and 144 male learners.

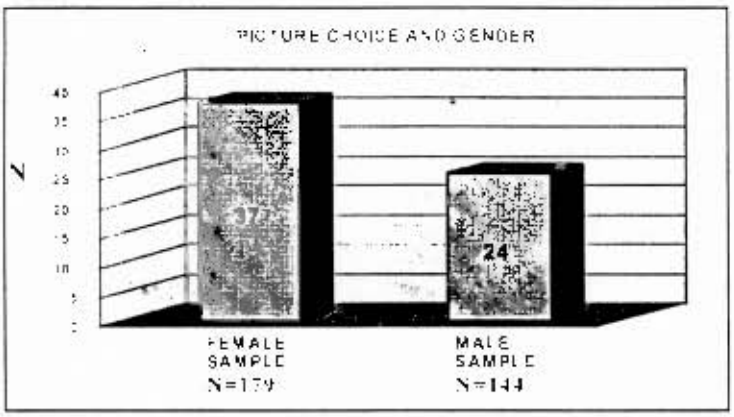


Table 4.3b presents the chi-square analysis of the female and male response distribution frequencies with respect to choosing or avoiding the available picture option.

Table 4.3b Chi-square (2x2 table) analysis of the response frequencies of male and female learners to choosing or avoiding the picture option.

Picture option	Chosen	Avoided	Total
Female	37	142	179
Male	25	119	144
Total	62	261	323

Chi-square 0.37 **df=1** **p = 0.54**

Thus, there is no statistically significant difference between the responses of females and males in respect to choosing or avoiding the picture option for instruction.

***Hypothesis 3c:* Torso choice and gender:**

The null hypothesis that *there will be no significant difference between the frequencies of choice of torso as an instructional medium by the 179 female and the 144 male learners is* supported.

Figure 4.3c shows that 120 learners out of 323 chose the torso. Of the females, 72 out of 179 selected the torso; of the males, 49 out of 144 chose the torso.

Figure 4.3c Frequencies of choice of the torso by 179 female learners and 144 male learners.

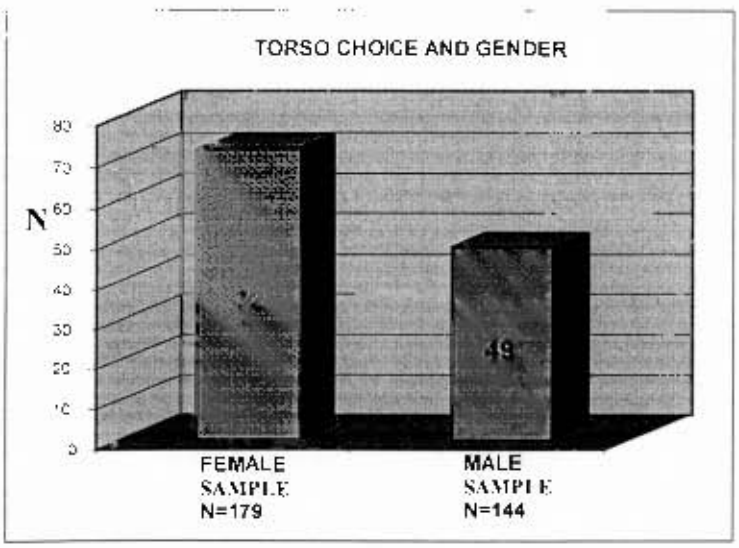


Table 4.3c presents the chi-square analysis of the female and male response distribution frequencies with respect to choosing or avoiding the available torso option.

Table 4.3c Chi-square analysis of the response frequencies of male and female learners to choosing or avoiding the torso option.

Torso option	Chosen	Avoided	Total
Female	72	107	179
Male	48	96	144
Total	120	244	323

Chi-square= 1.34 **df=1** **p = 0.25**

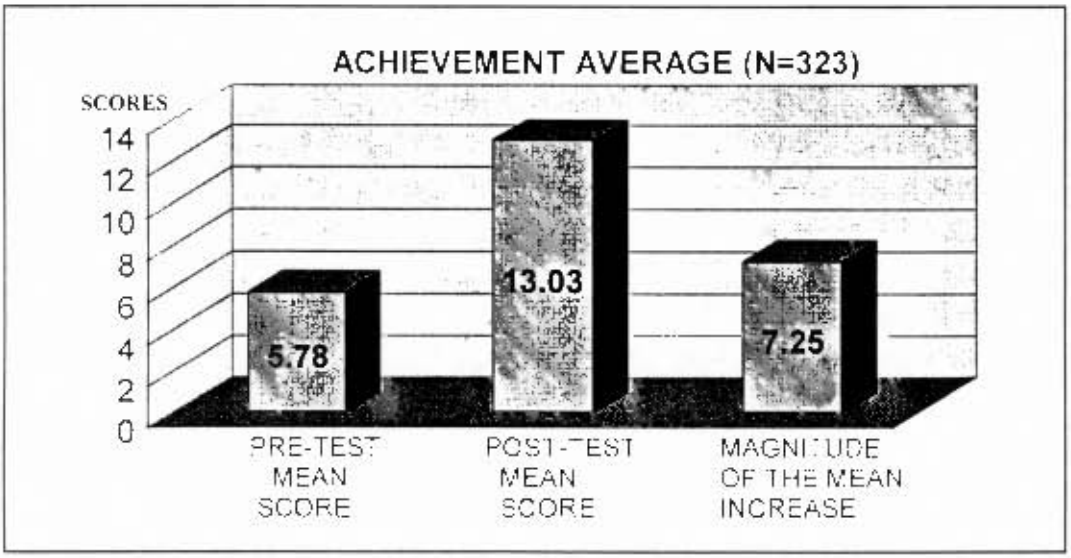
Thus, there is no statistically significant difference between the responses of females and males in respect to choosing or avoiding the torso option for instruction.

Hypothesis 4: ***Achievement gains by the 323 participant learners:***

The null hypothesis that *irrespective of instructional programme chosen, the learners' mean pre-test to post-test gains in achievement scores will not be significant* is rejected.

Figure 4.4 shows that the pre-test mean is 5.78 and the post-test mean is 13.03 out of sixteen. The mean pre-test to post-test score increase is 7.25.

Figure 4.4 Means of the pre-test scores, the post-test scores and the pre-test to post-test score increases by 323 participant learners.



Note: ANOVA and t-test calculations assume that distributions of data have approximately equal variances, and are approximately normal. This assumption of normality applies to the pre-test scores, but not necessarily to the post-test scores. However, inspection alone shows that the size of the average increase in achievement is both considerable, and appreciable in terms of actual performance by the learners.

Table 4.4 presents the t-test analysis of the pre-test to post-test gains in achievement scores depicted in figure 4.4. by the sample of 323 participant learners. assuming approximate normality in the distributions of their scores. ,

Table 4.4 t-test analysis of the 323 participant learners' mean pre-test to post-test gains in achievement scores.
(t-test for two sets of dependent data)

Variable	Mean	SD	N	t-value
Pre-test (max. 16)	5.78	2.79	323	
Post-test (max. 16)	13.03	3.20	323	**41.62**
Mean achievement score gain	7.25		323	

t-value=41.6 **df=322** **p = .000000**

Thus, there is a statistically highly significant improvement in the 323 participant learners' pre-test to post-test achievement scores.

***Hypothesis 5a:* Achievement gains by the 179 female learners:**

The null hypothesis that, *irrespective of instructional programme chosen, the 179 female learners ' mean pre-test to post-test gains in achievement scores will not be statistically significant* is rejected.

Figure 4.5a shows that the 179 female learners' pre-test mean is 5.11 and their post-test mean is 14.26 out of sixteen. The mean pre-test to post-test score increase is 7.92.

Figure 4.5a Means of the pre-test scores, the post-test scores and the pre-test to post-test score increases by 179 female learners.

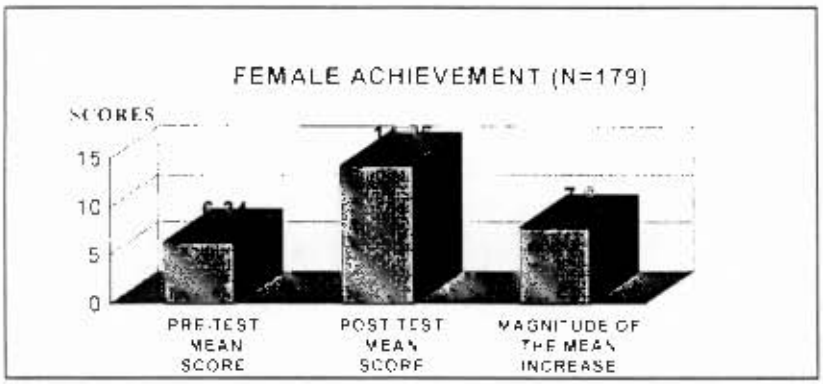


Table 4.5a presents the t-test analysis of the 179 female learners' mean pre-test to post-test gains in achievement scores depicted in figure 4.5a, assuming normality in the distribution of their scores.

Table 4.5a t-test analysis of the 179 female learners' mean pre-test to post-test gains in achievement scores.
(t-test for two sets of dependent data)

Variable	Mean	SD	N	t-value
Pre-test	6.34	2.89	179	
Post-test	14.26	2.31	179	34.46
Mean achievement score gain	7.92		179	

t-value= 34.46 **df= 178** **p= .00000**

Thus, there a statistically highly significant improvement in the 179 female learners' pre-test to post-test achievement scores.

Hypothesis 5b: ***Achievement gains by the 144 male learners:***

The null hypothesis that, *irrespective of instructional programme chosen, the 144 male learners' mean pre-test to post-test gains in achievement scores will not be statistically significant* is rejected.

Figure 4.5b shows that the 144 male learners' pre-test mean is 5.08 and their post-test mean is 11.52 out of sixteen. The mean pre-test to post-test score increase is 6.43.

Figure 4.5b Means of the pre-test scores, post-test scores and the pre-test to post-test score increases by 144 male learners.

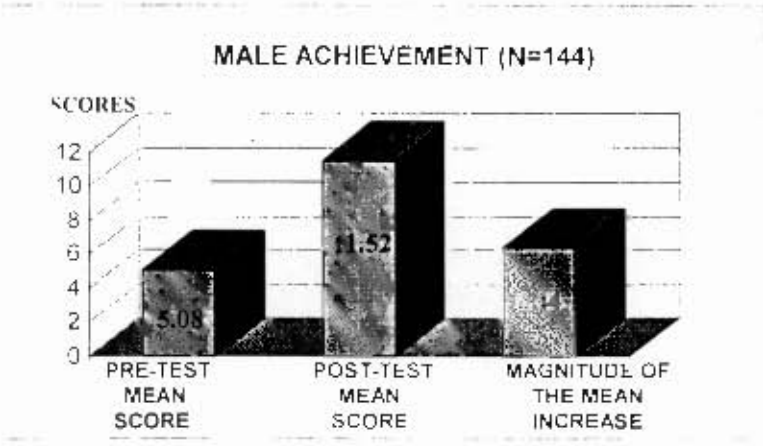


Table 4.5b presents the t-test analysis of the 144 male learners' mean pre-test to post-test gains in achievement scores depicted in figure 4.5b, assuming approximate normality in the distributions of their scores.

Table 4.5b t-test analysis of the 144 male learners' mean pre-test to post-test gains in achievement scores.
(t-test for two sets of dependent data)

Variable	Mean	SD	N	t-value
Pre-test (max. of 16)	5.08	2.49	144	
Post-test (max. of 16)	11.52	3.50	144	25.57
Mean achievement score gain	6.43		144	

t-value=25.57 **df=143** **p = .000000**

Thus, there is a statistically highly significant improvement in the 144 male learners' pre-test to post-test achievement scores.

Hypothesis 5c: ***Pre-test and post-test and achievement gains compared by gender:***

The null hypothesis that, *compared according to gender, there will be no significant difference between males' and females' pre-test scores, post-test scores and mean achievement gains* is rejected.

Figure 4.5c shows that the 179 female learners' pre-test mean is 6.34 and their post-test mean is 14.26. The 144 male learners' pre-test mean is 5.08 and their post-test mean is 11.52 out of 16.

Figure 4.5c Average pre-test and post-test scores by 179 female and 144 male learners.

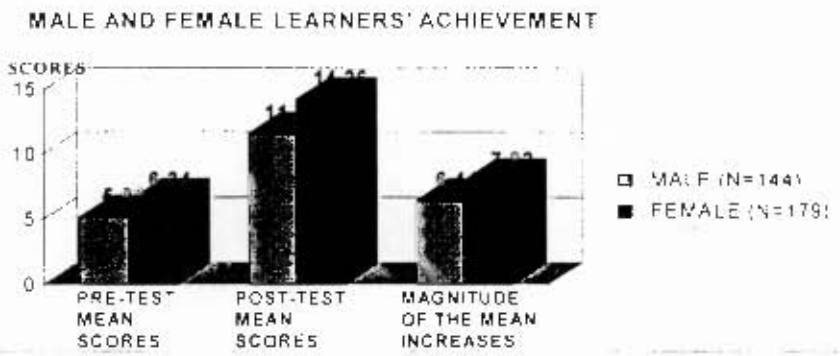


Table 4.5c(I) presents the t-test analysis of the 179 female and 144 male learners' pre-test scores depicted in figure 4.5c. assuming approximate normality in the distribution of their scores.

Table 4.5c(I) t-test analysis of the 179 female and the 144 male learners' pre-test scores. (t-test for two sets of independent data)

Variable	Mean	SD	N	t-value	F ratio var.	p-variance
Female Pre-test	6.34	2.90	179			
Male Pre-test	5.08	2.49	144	4.12	1.35	0.605
Difference	1.26					

Note: In this case the assumption of approximately equal variances is satisfied: $F=1.35$; $p > 0.05$.

t-value=4.12 **df=321** **p = .00048**

Thus, there is a statistically highly significant difference between the 179 female and the 144 male learners' pre-test achievement scores, with the females demonstrating significantly more prior knowledge of the parts of the human digestive system than the males.

Table 4.5c(II) presents the t-test analysis of the 179 female and the 144 male learners' post-test scores depicted in figure 4.5c. However, the assumptions of equal variances and normalities are not satisfied, so this use and application of the t-test is not strictly valid, although it is a reasonable and convenient guide because the differences in achievement means (i.e. performance) are great, not marginal.

Table 4.5c(II) t-test analysis of the 179 female and 144 male learners' post-test scores.
(t-test for two sets of independent data)

Variable	Mean	SD	N	t-value	F ratio var.	p-variance
Female Post-test	14.26	2.31	179	8.42	2.29	0.000
Male post-test	11.52	3.50	144			
Difference	2.74					

t-value=8.42 **df=321** **p = .00000**

Thus, there is a statistically highly significant difference between the 179 female and the 144 male learners' post-test achievement scores, with the females demonstrating significantly more knowledge of the parts of the human digestive system than the males, after participation in one of the three instructional programmes.

Table 4.5c(III) presents the ANOVA and Scheffe results of the female and male data depicted in figure 4.5c on page 61, taking into account the significantly better pre-test scores of females.

Table 4.5c(III) ANOVA results of the female and male data.

GENDER	PRE-TEST MEANS	PRE-TEST SD	POST-TEST MEANS	POST-TEST SD	N
FEMALE	5.08	2.49	11.52	3.50	179
MALE	6.34	2.89	14.25	2.31	144

Post-hoc comparison with Scheffe test (p-values)

	MALE PRE-TEST ($\bar{X}$=6.34)	FEMALE PRE-TEST ($\bar{X}$=5.08)
FEMALE PRE-TEST	0.000048	
MALE PRE-TEST		0.000048
	MALE POST-TEST ($\bar{X}$=11.52)	FEMALE POST-TEST ($\bar{X}$=14.26)
FEMALE POST-TEST	0.000	
MALE POST-TEST		0.000

The findings recorded in table 4.5c(III) show that, despite their significantly better pre-test scores, the 179 females still made significantly better achievement gains ($\bar{x}$= 7.92) than their 144 male peers ($\bar{x}$= 6.44) on the instructional programmes offered.

Hypothesis 6a: ***Gender achievement gains by students taking the computer graphic choice:***

The null hypothesis that *female and male pupils' mean pre-test to post-test gains in achievement scores under the computer graphic choice will not be significantly different* is rejected.

Figure 4.6a shows that the 70 female learners' pre-test mean is 6.14 and their post-test mean is 14.64 out of sixteen under the computer graphic choice. The mean pre-test to post-test score increase is 8.50 under the computer graphic choice.

Figure 4.6a also shows that the 71 male learners' pre-test mean is 5.11 and post-test mean is 11.77 out of sixteen under the computer graphic choice. The mean pre-test to post-test score increase is 6.66 under the computer graphic choice.

Figure 4.6a Average of the pre-test, the post-test and the pre-test to post-test score increase by the 70 female and the 71 male learners with respect to computer graphic choice.

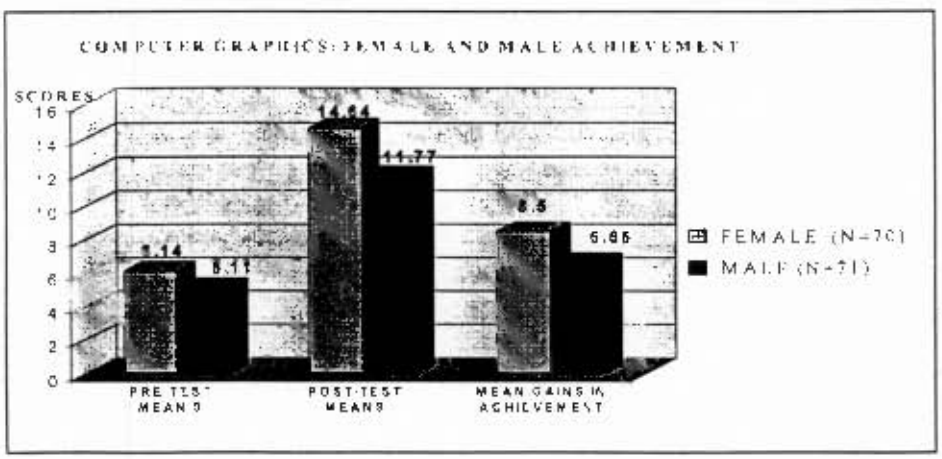


Table 4.6a(I) presents the t-test analysis of the 70 female learners' mean pre-test to post-test gains in achievement scores depicted in figure 4.6a, with respect to computer graphic choice. Statistically, the achievement gains are highly significant.

Table 4.6a(I) t-test analysis of the 70 female learners' mean pre-test to post-test gains in achievement scores with respect to computer graphic choice.

Computer choice	Mean	SD	N	t-value
Pre-test (max. 16	6.14	2.70	70	
Post-test (max. 16)	14.64	1.93	70	29.19
Mean achievement score	8.50		70	

t-value= 29.19 **df=69** **p= .000**

Table 4.6a(II) presents the t-test analysis of the 71 male learners' mean pre-test to post-test gains in achievement scores depicted in figure 4.6a, with respect to computer graphic choice.

Table 4.6a(II) t-test analysis of the 71 male learners' mean pre-test to post-test gains in achievement scores with respect to computer graphic choice.

Computer choice	Mean	SD	N	t-value
Pre-test	5.11	2.39	71	
Post-test	11.77	3.42	71	18.20
Mean achievement score gain	6.66		71	

t-value=18.20 **df=70** **p= .000**

Thus, there is a statistically highly significant gain in achievement scores by both the female and the male learners under the computer graphic choice.

***Hypothesis 6b:* Gender achievement gains by picture choice:**

The null hypothesis that *female and male pupils' mean pre-test to post-test gains in achievement scores by picture choice will not be significantly different* is rejected.

Figure 4.6b shows that the 37 female learners' pre-test mean is 6.29 and their post-test mean is 13.86 out of sixteen, under the picture choice. The mean pre-test to post-test score increase is 7.56 under the picture choice.

Figure 4.6b shows that the 24 male learners' pre-test mean is 4.66 and post-test mean is 11.70 out of sixteen, under the picture choice. The mean of pre-test to post-test score increase is 7.04 under the picture choice.

Figure 4.6b Average of the pre-test, the post-test and the pre-test to post-test score increase by the 37 female and the 24 male learners with respect to picture choice.

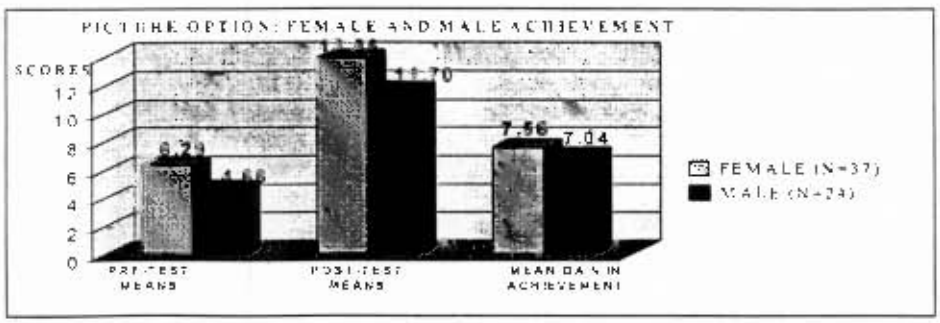


Table 4.6b(I) presents the t-test analysis of the 37 female learners' mean pre-test to post-test gains in achievement scores depicted in figure 4.6b, with respect to picture choice. Statistically, the achievement gains are highly significant.

Table 4.6b(I) t-test analysis of the 37 female learners' mean pre-test to post-test gains in achievement scores with respect to picture choice.

Picture choice	Mean	SD	N	t-value
Pre-test (max.16)	6.29	2.14	37	
Post-test (max.16)	13.86	2.4	37	15.5
Mean achievement score	7.56		37	

t-value=15.5 **df=36** **p= .000**

Table 4.6b(II) presents the t-test analysis of the 24 male learners' mean pre-test to post-test gains in achievement scores depicted in figure 4.6b, with respect to picture choice.

Table 4.6b(II) t-test analysis of the 24 male learners' mean pre-test to post-test gains in achievement scores with respect to picture choice.

Picture choice	Mean	SD	N	t-value
Pre-test (max.16)	4.66	2.14	24	
Post-test (max.16)	11.7	3.90	24	10.36
Mean achievement score gains	7.04			

t-value=10.36 **df=23** **p= .000**

Thus, there is a statistically highly significant gain in achievement scores by both the female and male learners under the picture choice.

***Hypothesis 6c:* Gender achievement gains by torso choice:**

The null hypothesis that *female and male pupils' mean pre-test to post-test gains in achievement scores by torso choice will not be significantly different* is rejected.

Figure 4.6c shows that the 72 female learners' pre-test mean is 6.55 and their post-test mean is 14.68 out of sixteen, under the torso choice. The mean pre-test to post-test score increase is 7.52 under the torso choice.

Figure 4.6c shows that the 49 male learners' pre-test mean is 5.24 and their post-test mean is 11.06 out of sixteen, under the torso choice. The mean pre-test to post-test score increases is 5.81 under the torso choice.

Figure 4.6c Average of the pre-test, the post-test and the pre-test to post-test score increase by the 72 female and the 48 male learners with respect to torso choice.

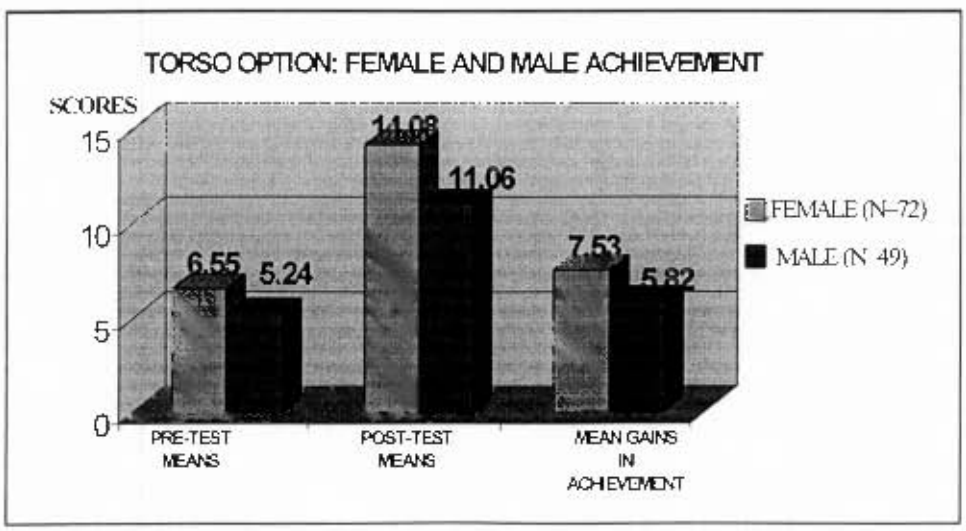


Table 4.6c(I) presents the t-test analysis of the 72 female learners' mean pre-test to post-test gains in achievement scores depicted in figure 4.6c, with respect to torso choice.

Table 4.6c(I) t-test analysis of the 72 female learners' mean pre-test to post-test gains in achievement scores with respect to torso choice.

Torso choice	Mean	SD	N	t-value
Pre-test (max. 16)	6.55	3.39	72	
Post-test (max.16)	14.08	2.55	72	17.78
Mean achievement score gain	7.52		72	

t-value=17.78 **df=71** **p= .000**

Table 4.6c(II) presents the t-test analysis of the 49 male learners' mean pre-test to post-test gains in achievement scores depicted in figure 4.6c, with respect to torso choice.

Table 4.6c(II) t-test analysis of the 49 male learners' mean pre-test to post-test gains in achievement scores with respect to torso choice.

Torso choice	Mean	SD	N	t-value
Pre-test (max.16)	5.24	2.79	49	
Post-test (max.16)	11.06	3.43	49	15.01
Mean achievement score gain	6.82		49	

t-value=15.01 **df=48** **p= .000**

Thus, there is a statistically highly significant gain in achievement scores by both the female and male learners under the torso choice.

Hypothesis 7: ***Post-test score final performance with respect to programme choice and gender:***

The null hypothesis that, *compared according to gender, the 323 learners' mean gender group post-test scores will not be significantly different after instructional programme options* is rejected.

Figure 4.7 shows that the 70 female learners' post-test mean is 14.64 and the 71 male learners' post-test mean is 11.77 out of sixteen with respect to computer choice.

Figure 4.7 shows that the 37 female learners' post-test mean is 13.86 and the 24 male learners' post-test mean is 11.7 out of sixteen with respect to picture choice.

Figure 4.7 shows that the 72 female learners' post-test mean is 14.08 and the 49 male learners' post-test mean is 11.06 out of sixteen with respect to torso choice.

Figure 4.7 Averages of post-test scores obtained by the 179 female and the 144 male learners with respect to programme options.

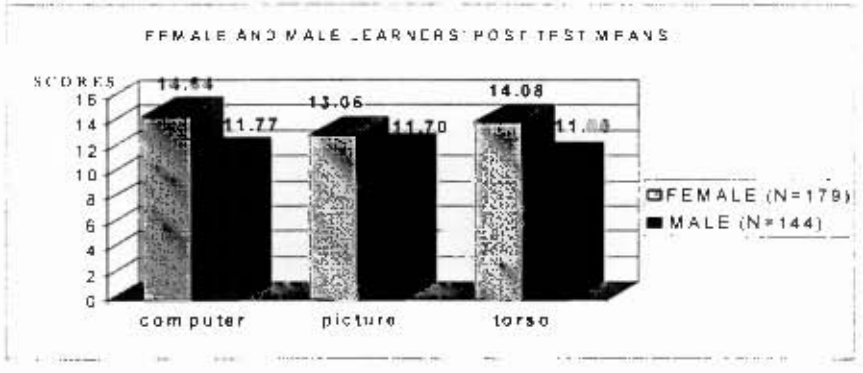


Table 4.7.1 presents the ANOVA results of the female learners' post-test scores and the male learners' post-test scores depicted in figure 4.7 with post-hoc comparison of means using the Scheffe test, with respect to programme option and gender.

Table 4.7 Scheffe test (p-values); variable: post-test scores for 323 participant learners.

	MC (N=71)	MP (N=24)	MT (N=49)	FC (N=70)	FP (N=37)	FT (N=72)
Male-computer (MC)		1.000	.881859	.000004*	.029340*	.000534*
Male-picture (MP)	1.000		.976799	.003142*	.157624	.036379*
Male-torso (MT)	.881859	.976799		.000000*	.001782*	.000013*
Female-computer (FC)	.000004*	.003142*	.000000*		.883457	.932579
Female-picture (FP)	.029340*	.157624	.001782*	.883457		.999635
Female-torso (FT)	.000534*	.036379*	.000013*	.932579	.999635	

Thus, there are statistically significant differences in final performances (post-test achievements) between the following pairs of combinations, in favour of the first combination in each case:-

Female – computer	>	male + computer ($p < 0.001$)
Female + picture	>	male + computer ($p < 0.05$)
Female + torso	>	male + computer ($p < 0.001$)
Female – computer	>	male + picture ($p < 0.01$)
Female – torso	>	male + picture ($p < 0.001$)

However, the following combinations are statistically more or less equally effective in terms of a similar outcome in final performances (post-test achievement):-

Male − computer	=	male − picture
Male − computer	=	male − torso
Male − picture	=	male + torso
Male + picture	=	female + picture
Female − computer	=	female + picture
Female − computer	=	female + torso

Statistical differences are more uncertain when data scores are obtained close to their maximum value (as in these cases), and when they are therefore most likely to have markedly skewed distributions (as in these cases).

Hypothesis 8: ***Final performance overall post-test scores under the three different programmes:***

The null hypothesis that *compared according to programme chosen, the three groups of participant learners' mean post-test final performance scores will not be significantly different from each other* is supported.

Figure 4.8 shows that the post-test mean of 141 learners who chose the computer graphic as their instructional method is 13.19; the post-test mean of 61 learners who chose the large hand-held coloured picture as their instructional medium is 13.06; and the post-test mean of 121 learners who chose the torso as their instructional strategy is 12.83 out of sixteen.

Figure 4.8 Average post-test score performance scores by 323 participant learners with respect to the three programme options.

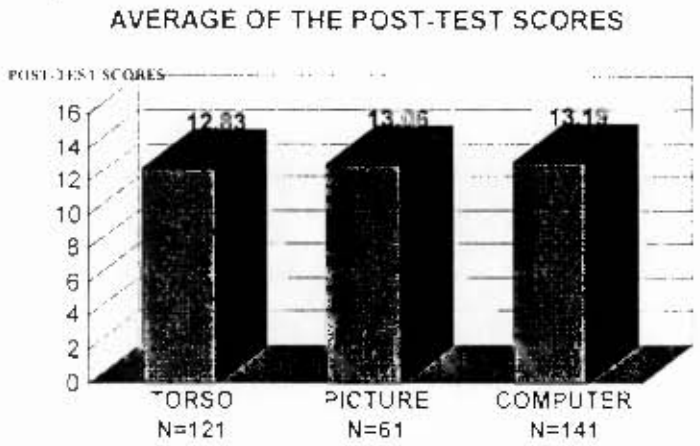


Table 4.8(I) presents the t-test or comparison between the post-test mean scores of the 141 learners who chose the **computer** graphic option and the 61 learners who chose the **picture** option, depicted in figure 4.8.

Table 4.8(I) t-test analysis of the post-test scores of the 141 learners who chose the **computer** option and the 61 learners who chose the **picture** option

Computer vs Picture option	Mean	SD	N	t-value
Computer post-test scores	13.19	3.13	141	0.375
Picture post-test scores	13.01	3.24	61	

t-value=0.375 **df=200** **p=0.707**

Table 4.8(II) presents the t-test analysis of the post-test scores of the 141 learners who chose the **computer** graphic option and the 121 learners who chose the **torso** option, depicted in figure 4.8.

Table 4.8(II) t-test analysis of the post-test scores of the 141 learners who chose the **computer** option and the 121 learners who chose the **torso** option.

Computer vs Torso option	Mean	SD	N	t-value
Computer post-test scores	13.19	3.13	141	0.854
Torso post-test scores	12.83	3.28	121	

t-value=0.854 **df=260** **p=0.393**

Table 4.8(III) presents the t-test analysis of the post-test scores of the 121 learners who chose the **torso** option and the 61 learners who chose the **picture** option, depicted in figure 4.8.

Table 4.8(III) t-test analysis of the post-test scores of the 121 learners who chose the **torso** option and the 61 learners who chose the **picture** option.

Torso vs Picture option	Mean	SD	N	t-value
Torso Post-test	12.83	3.13	121	0.305
Picture Post-test	13.01	3.24	61	

t-value=0.305 **df=180** **p=0.760**

Table 4.8(IV) shows the ANOVA results with a post-hoc test of means, with the Scheffe test of post-test final performance scores, with respect to the three programmes.

Table 4.8(IV) Scheffe test (p-values); variable: post-test scores.

	COMPUTER	PICTURE	TORSO
COMPUTER ($\bar{X}$=13.19)		0.963	0.657
PICTURE ($\bar{X}$=13.06)	0.963		0.899
TORSO ($\bar{X}$=12.83)	0.657	0.899	

p values > 0.05 : no significant differences occur.

Table 4.8 (IV) confirms that all three instructional intervention programmes (torso, picture and computer) are, on the whole, statistically equally effective in their capacity to produce more or less the same final average levels in achievement, as measured by the 16 post-test items employed in this investigation with a large randomly selected, heterogeneous population of learners.

PART B. PRESENTATION OF THE QUALITATIVE FINDINGS:

The 323 participants offered a total of about 700 written remarks on the instructional programmes. Thirty pages of sampled photocopies of the detailed comments and suggestions made by respondents are attached in Appendix C as illustrative examples.

The considerable amount of qualitative data obtained is now summarized and presented under three headings: Comments on the *value* of the instructional programmes, suggestions for *improving* the teaching materials, and feed-back reports to individual biology teachers in various schools.

4.2. Comments on the value of the instructional programmes

This section synthesizes the learners' main reasons for favouring their particular choice of instructional programme. The following list of comments is a combined summary of the reasons provided by the participant learners who responded to that part of the questionnaire which was on the back of the post-test.

The participants wrote no negative comments of outright rejection. However, some remarks were slightly critical or neutral or reserved, e.g. "I have a computer programme like this at home"; "It could be a more advanced programme"; "Use more colourful pictures"; "Use a more real model" etc.

Participants' positive written comments about the three instructional programmes are summarized, and quoted *verbatim*, as follows:

4.2.1. Perceptions about, and reactions to, the Computer option: -

a) **It increases performance.** For example, "Learning with a computer increases my performance"; "From my results you can see that I did learn."

b) **It is nice, exciting, enjoyable and fun.** For example, "It was exciting and fun"; "Good and nice presentation"; "It seemed more exciting"; "It is quite nice studying from a computer."

c) **It is interesting.** For example, "It was interesting to learn things"; "It seemed interesting and original"; "You find more interesting things, and you don't get bored."

d) **It makes learning easy to understand.** For example, "It is an easy to understand the programme."

e) **It helps improve knowledge.** For example, "I learnt more about the human digestive system"; "I'm not happy because I was only known teeth, stomach and tongue. Now I know the parts of my body."

f) **It helps students to learn and remember quickly.** For example, "This programme makes me never to forget the digestive system"; "It helps me to remember easily because I love working with a computer."

g) **It makes concentration easy.** For example, "It makes you concentrate easily so that it can be easily for you to learn."

h) **It is logical and uses modern technology.** For example, "It is very fascinating to see what people can learn with new modern technology"; "The computer programme took you through the naming of the parts in a logical fashion."

i) **It gives more information in a short time**. For example, "It provided a lot of information in such a short period"; "It gave information quickly"; "I learn very much faster."

4.2.2. Perceptions about, and reactions to, the Picture option: -

a) **It helps improve knowledge and increase performance**. For example, "It was simple and very efficient. We taught ourselves and learnt a lot by our mistakes."

b) **It is nice, enjoyable and fun.** For example, "It was fun and enjoyable"; "It was straightforward and enjoyable"; "Fun exciting and a good learning experience."

c) **It is interesting.** For example, "It was interesting and a change from our normal everyday lessons"; "It was interesting as well as fun."

d) **It makes learning easy to understand.** For example, "It tries to teach us to be quick understanding"; "It gives me enough information"; "It was much easier to understand where each part goes."

e) **It helps students to learn and remember quickly.** For example, "It helps me remember all parts"; "The visual stimuli worked well as facts are easier to remember"; "The visual aid made it easier to remember."

f) **It is exciting, clear and enlightening.** For example, "It looks more clear"; "It was also enlightening"; "It was clear colourful and exciting"; "I can see the pictures clearly and at the same time I'm able to see the name of each specific organ."

4.2.3. Perceptions about, and reactions to, the Torso option: -

a) **It helps improve knowledge and increases performance.** For example, "We learnt a lot"; "I learnt a lot"; "I have learnt many new things"; "When they gave me the first sheet I was blank, I didn't know what was going on. When I started the second sheet, it was a breeze - not that I got it right though."

b) **It is nice, enjoyable and fun.** For example, "I think it was fun"; "I enjoyed everything"; "I enjoyed studying biology when I have the plastic model to study from"; "It was enjoyable."

c) **It is interesting and satisfying.** For example, "It was interesting and informative"; "It was interesting and educational and it gave us a more interesting look at the digestive system"; "It is interesting as the parts are movable."

d) **It makes learning easy to understand.** For example, "Easy understanding and it is very educational"; "I find it easier to learn with models- it helps you understand better."

e) **It helps students to learn and remember quickly.** For example, "I could take out the different parts and feel it so I could remember it better"; " I learnt things quicker than what I would."

f) **It is exciting, clear and enlightening.** For example, "It brings excitement in me, and it makes me really more enlightened and intelligent."

g) **It gives more information in a short time.** For example, "It was easy and much better to learn -you can pick it up quickly"; "We learnt to be quick."

h) **It is real and three-dimensional (3-D).** For example, "The model with plastic organs is really realistic with the organs looking at a 3-D structure"; "3-D is more comfortable for me"; "It is as if you are studying from a real body."

i) **It provides an opportunity for putting articulated organs back together.** For example, "I like working with a model that you are able to take apart & put back together."

j) **It shows where the organs are and makes students more aware of them.** For example, "It shows the exact way the organs are"; "The torso the most as it was a model that you could touch on hands."

4.3. Suggestions for improving the teaching materials

This section summarizes the learners' suggestions for improving each of the three instructional programmes in a diversity of South African school contexts.

4.3.1. For the computer option:-

Suggestions for improving the computer option were: "Have sound on the computer"; "Have a bigger screen"; "Have two-way communication with the computer, for example, by actually typing the labels"; "Get computers for us to be more anxious to learn and better something"; "Use more colour"; "More practical hands-on exercises, more graphics"; "Use a number of monitors connected to one computer"; and "They should let us work on computers instead of books as school."

4.3.2. For the picture option:-

Suggestions for improving the large picture option were: "Add colour and enlarge it for better clarity"; "The labels should be put in different colours"; "The picture method should involve less explaining and be a more practical exercise"; and "I want more pictures so that I should be clear- for example, I might have a problem with human structure but need to concentrate on the stomach. I need the stomach picture."

4.3.3. For the torso option:-

Suggestions for improving the torso option were: "It should include more things, not only the human body"; "Take the children to a live clinic and show them how it functions and how it works"; "Go into details with explaining. Describe each part on the digestive system"; "Could use book material as guide"; "They could make the parts more real, for example, the heart could be squishing and the intestines soft, etc."; "Labels should be small enough to pin onto each area"; "You may try starting with all parts dis-assembled, then tell pupils to figure out how they fit together"; "More time to play around with the model"; and "Identify the parts on my own body, too, and link them to a real body, real life."

4.4. Feedback reports to the biology teachers in various schools

Appendix D shows a copy of a typical feedback "evaluation report" written immediately after a trial of the programme materials in various schools, for the benefit of the biology teachers who allowed their classes to participate in this novel learning exercise.

4.5. Chapter Summary

In this chapter the results and findings have been presented. In part A, the hypotheses have been tested statistically and presented as quantitative findings. In part B, participant learners' comments on the value of the instructional programmes, and their suggestions for improving the teaching materials, have been summarized as qualitative findings.

An amplified explanation and a more detailed ***discussion*** now follow in ***Chapter 5.***

CHAPTER 5

DISCUSSION OF FINDINGS

CHAPTER 5

DISCUSSION OF FINDINGS

In the previous chapter significant agreements and significant differences were found to occur among the 323 participant learners with respect to the three instructional programme options. In this chapter these variations are discussed, and attempts are made to give possible explanations for the differences. Finally the findings discovered in Cape Town are linked to the findings of the earlier researchers reported in Chapter 2.

5.1. Discussions of the quantitative findings

5.1.1. Frequency distributions of instructional programme choices

In this particular investigation significant preferences were found to occur among the sample of 323 learners in favour of the computer option, and to lesser degree, in favour of the torso option. This indicates that individual students' preferences were different and they reacted differently to the possibility of different programmes. The choices of instructional methods by students were varied, perhaps because of different abilities, personalities, interests, perceptions, self-confidence, concerns or feelings of students. These particular 323 participants were appreciably more interested in computers. According to their comments, the reasons for favoring the computer might be summarized by saying that it was exciting, fun, logical, uses modern technology, and gives information in a short time.

5.1.2 Frequency distributions of instructional programme choices and gender

The highly significant difference between the frequencies of choice of the instructional programmes by the sample of female learners, in favour of both the torso and computer options, suggests that individual female learners' choices might vary because of differences in their own interests, feelings, concerns, perceptions and reactions.

The highly significant difference between the frequencies of choice of the instructional programmes by the sample of male learners, in favour of the computer, and away from picture option, indicates that individual male learners may also have their own different interests, feelings, concerns, perceptions, levels of self-confidence and reactions.

The learners' choices disclosed that female learners preferred the torso and computer options, whereas male learners tended more towards to the computer. The reason might be that more male learners than female learners felt confident in favoring the computer. However, in favoring both the computer and the torso, female learners might have been reflecting their own different personalities, concerns, perceptions and feelings. They might have thought that the computer programme was too complex and difficult for them, so they preferred a learning method that looked simpler. Both female and male learners favoring computers, away from the picture option, suggests that the picture programme might not have been as an attractive option as the others.

In this study, however, there was no significant difference between the response frequencies of female and male learners in respect to choosing

or avoiding the three programme options for instruction. This suggests that female and male learners might have felt similar perceptions, reactions, interests and concerns to the same programme options.

This suggests that teachers might, in future, provide both female and male learners with the same instructional options from which to choose.

5.1.3. Achievement gains by participant learners

In this particular investigation, high gains in the 323 participant learners' pre-test to post-test achievement scores indicate that the three instructional programmes developed content mastery, motivated different students, and helped a diversity of students to learn physiological terminology. Characteristics of successful instructional programmes described by Bruner (1986) and the effects of various science teaching instructions on achievement (Wise & Okey, 1983:43) might be related to the pre-test to post-test improvement in achievement scores. According to Hunter (1982:51) students' concerns, feelings, and interests towards instructional programmes can have an impact on students' motivation. This might be another reason for the improvements in achievement scores recorded by the Cape Town learners.

Almost all participant learners improved their achievement scores, except one who decreased his score. However, individual learners did not gain equally in achievement. The learners' different motivational needs might be a possible cause of the achievement score differences. Adar (1969) found that different motivational needs were associated with different types of learners which he called achievement students, curious students, conscientious students and sociable students.

Several participants failed to improve their pre-test scores on the post-test. It might be that the intervention programmes failed to succeed with individuals who had perceptual, reading, language or motor disabilities, as described on pages 21-24. However, such a diagnosis lies beyond the scope of the present study.

Educators might use more appropriately matched instructional programmes to motivate students, to make learners feel good, and to enjoy success for improving achievement scores.

5.1.4. Achievement gains and gender

Both female and male learners recorded large improvements in their pre-test to post-test achievement scores. However, the highly significant difference between female and male learners' post-test achievement scores - with the female learners demonstrating significantly more improvement than the male learners after participation in the one of the three instructional programmes - is consistent with the clear differences in achievement gains which occurred among the female and male learners recorded by previous researchers such as Keeves & Kotte (1996), Murphy (1991), Smail & Kelly (1984), Erinosho (1994) Ventura (1985) and Keeves (1992).

In general, with few exceptions, male learners have been found to outperform in science achievement measures as recorded by Walberg (1967), Erickson & Erickson (1984), Howe & Dody (1989), and Young & Fraser (1994). However, this study supports the findings of Erinosho (1994) who reported that female learners outperformed male learners across the tests. The reason might be that most female learners showed a

more conscientious attitude towards biology than male learners, but this suggestion would have to be explored in a future investigation.

A possible implication is that teachers and educators might also consider helping female learners to increase their self-confidence and attitude towards the physical sciences in order to be as successful as they are in biology. Also teachers and educators might help male learners to be more conscientious towards biology.

5.1.5. Achievement gains and programme options

The statistically highly significant gains in achievement by the participant learners under the three instructional programme options (computer, picture and torso) are recorded on pages 59-78. Together with the qualitative findings recorded on pages 79-86, these suggest that each programme had its own positive impact on learners' motivation, development, and stimulation. The instructional programmes appear to be useful for encouraging, developing or stimulating visual thinking as described by Gardner (1998:1-8). With computer graphics, picture and models, Gardner's own learners were able to create concept maps, mind maps etc. to generate and clarify ideas with the help of their multiple intelligence abilities.

The current programme options draw on all of Gardner's intelligences, especially 2-D and 3-D visualization increasing learners' achievement. White (1988:28) also described several memory elements, like images and motor skills, which are tied into multiple intelligences. Ebezener (1998:8) concluded that the more meaningful the learning is in terms of multiple intelligences, the more memorable it is, and the more likely it

will be stored in of the forms listed by White (1998:28).

Previous research has shown that computers in the instructional process produced significantly greater achievement in science (Oliver & Okey, 1986; Driver, 1985; Hughes, 1974; Sasser, 1990; Lunetta & Hofstein, 1981; Woodhouse & Jones, 1988; Hounsell & Hill, 1989). It is also showed that computers had a high potential to enhance teaching in the educational setting as concluded by Bangertdrowns & Kulik, 1985; Ananthakrishnan & McDermott, 1996; Tai, Tsai & Chang, 1999).

Another reason for the significant gain in this study might be that the software programme of the computer was appropriate and easy to handle. Oliver & Okey (1986) found that appropriate software caused learners to explore and develop further ideas, such as curiosity and creativity, and helped learners to increase their performance.

The picture option facilitated significant achievement gains in this investigation. According to Holiday (1981), and Hayes & Readence (1983), the effect of a picture is to encourage learners to invest more time in the cognitive effort.

The torso model also provided significant gains. According to the learners' comments one reason might have been its visual effects and its 3-D structure, an explanation supported by Bishop (1978).

Over all, it is suggested that teachers and educators might provide a variety of instructional programmes which draw on all multiple intelligences, including 2-D and 3-D visualization, and they might recognize the value which these kinds of variety can have in helping

learners articulate their understanding of subject matter stated by Armstrong (1994:71-74).

Although the instructional programmes facilitated highly significant gains in achievement scores, all three intervention options were, on the whole, statistically equally effective in their capacity to produce more or less the same final average levels in achievement.

This implies that effective instruction and high levels of achievement might not always require costly instructional programmes. Less expensive programmes, like the picture, can be almost as effective in instruction for biology teachers.

5.1.6. Achievement gains with respect to programme choice and gender.

All three instructional programmes produced significant differences in achievement between females and males. Highly significant differences in final performance scores between some pairs of combinations are presented on page 73, and more or less equal outcomes in final performance are given on page 74. One explanation might be that different genders tend to be sometimes motivated by different things, as previous studies have pointed out (Head, 1985; Hofstein & Walberg, 1995; Solomon, 1996). Teachers and educators might try to find out what motivates their learners. The findings presented on page 66-74, concluded that the females performed significantly better on each instructional programme than the males. This might be explained by a greater general ability of females in biology, and by a more serious effort by females to achieve in biology, while males might tend to treat biology as a fun

subject. less responsibly.

5.2. Discussion of the qualitative findings

In this particular investigation. participant learners completing the questionnaire have given reasons for favoring their particular choice of instructional strategy, and suggested improvement for each of the three instructional programmes.

As shown in Chapter 4, page 78-85. the respondents wrote no negative comments of outright rejection; they wrote positive comments about the three instructional programmes, and expressed excitement and eagerness to participate in the investigation. This confirms that the materials and programmes were easy, simple and clear for students to use, and were successful in fostering high performance and improving students' knowledge.

In addition, the learners showed different reactions and perceptions about different programme options. For example, most of the students who chose the computer option emphasized the logical. modern, exciting and enjoyable properties of computer in their comments. However, for the picture they emphasized the simple, clear, easy, colourful properties of picture in their comments. On the other hand, for the torso they emphasized the real and 3-D properties of the model in their comments. They also suggested adding sound, having a bigger screen and a two-way communication computer, more real models and a more colourful, more clearer and bigger picture as instructional programmes.

One explanation might be that the level of concerns, feeling tone,

successes and interests of students pointed out by Hunter (1982:51) can change from time to time. Also, different types of students - like curious students, conscientious students, achiever students and sociable students identified by Adar (1969) – might prefer different types of teaching strategies, and perceive and emphasize different aspects of instructional programmes.

On the basis of these comments and suggestions, teachers and educators are encouraged to use fashionable, modern, logical, enlightening, simple, easy, clear, exciting, enjoyable and more real instructional programmes for teaching biology.

5.3. Chapter summary

In this chapter the qualitative and quantitative findings of this investigation have been discussed. The findings discovered in Cape Town are linked to the findings of the earlier researchers reported in Chapter 2. . This chapter has also pointed out reasons, and attempted to give possible explanations for the findings.

In ***Chapter 6*** the ***Conclusions, Implications*** and ***Recommendations*** will be presented.

CHAPTER 6

CONCLUSIONS, IMPLICATIONS & RECOMMENDATIONS

CHAPTER 6

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

In the previous chapter the findings of this investigation were discussed and reasons and explanations were given to account for the findings. In this chapter possible conclusions are presented by answering key questions of the study. The implications and recommendations of this research are also formulated.

6.1. Summary of findings

The investigation gathered data to test fifteen null hypotheses. The most important findings were:

(1) for both females and males the computer and torso options were significantly more popular than the chart / picture option;

(2) both females and males responded more or less equally with respect to gender when choosing or avoiding the computer, torso or picture option;

(3) significant pre-test to post-test improvements in achievement scores occurred for all groups of learners, in all three forms of instructional programmes on offer;

(4) the females demonstrated significantly more prior knowledge than the males on the pre-test;

(5) the females demonstrated significantly higher post-test scores and achievement gains than the males; and

(6) all three instructional intervention programme options were equally effective in terms of the overall final performance post-test scores achieved by the learners who selected them.

6.2. Conclusions

Recent years have seen the development of many instructional programmes for biology teaching. Therefore, teachers in today's schools have numerous choices of materials with which to enhance teaching. Individual differences among students gender differences, and variations in background and experiences of students invite variations in methods and in instructional programmes.

This research yielded the following questions and answers: -

(1) How many learners will choose the laptop computer option?

Figure 4.1 on page 50 shows that 141 of the 323 learners (43.7%) chose the computer graphic as their preferred instructional method.

(2) How many learners will choose the picture option?

Figure 4.1 on page 50 shows that 61 of the 323 learners (18.9%) preferred the hand-held coloured picture as their instructional medium of free choice.

(3) How many learners will choose the torso option?

Figure 4.1 on page 50 shows that 121 of the 323 learners (37.4%) opted for the torso as their learning strategy.

(4) Will more males than females choose the laptop computer option?

No. Figure 4.3a on page 54 shows that 141 learners out of 323 chose the computer. Of the females, 70 out of 179 selected the computer; of the males, 71 out of 144 chose the computer. There was no statistically significant difference between the responses of females and males in respect to choosing or avoiding the computer option for instruction.

(5) Will more females than males choose the picture option?

No. Figure 4.3b on page 55 shows that 61 learners out of 323 chose the picture. Of the females, 37 out of 179 selected the picture; of the males, 24 out of 144 chose the picture. There was no statistically significant difference between the responses of females and males in respect to choosing or avoiding the picture option for instruction.

(6) Will more females than males choose torso option?

No. Figure 4.3c on page 57 shows that 120 learners out of 323 chose the torso. Of the females, 72 out of 179 selected the computer; of the males, 49 out of 144 chose the computer. There was no statistically significant difference between the responses of females and males in respect to choosing or avoiding the torso option for instruction.

(7) Will the 179 females and the 144 males score equally on a 16-item test of prior knowledge of the parts of the digestive system (the pre-test)?

No. Figure 4.5c on page 64 shows that the 179 female learners' pre-test mean is 6.0. The 144 male learners' pre-test mean was 5.08. There was a statistically highly significant difference between the 179 female and the 144 male learners' pre-test achievement scores, with the females demonstrating significantly more prior knowledge of the parts of the human digestive system than the males.

(8) Will the females and males score equally on the same pre-test, administered as a 16-item post-test, after learning intervention by means of a free choice of one of the three instructional programme option?

No. Figure 4.5c on page 64 shows that the 179 female learners' post-test mean was 14.26. The 144 male learners' post-test mean is 11.52 out of 16. There was a statistically highly significant difference between the 179

female and the 144 male learners' post-test achievement scores, with the females demonstrating appreciably more final knowledge of the parts of the human digestive system than the males, after participation in one of the three instructional programmes.

(9) Will the overall pre-test to post-test achievement gains by the 323 participant learners on the 16-item test be significant? (i.e. will the instructional intervention programmes be effective?)

Yes. Figure 4.4 on page 59 shows that the pre-test mean was 5.78 and the post-test mean was 13.03 out of sixteen. The mean pre-test to post-test score increase was 7.25. There was a statistically highly significant improvement in the 323 participant learners' pre-test to post-test achievement scores.

(10) Will the 179 females' mean gains in achievement scores be better than the 144 males' gains in achievement scores?

Yes. The findings recorded in table 4.5c(III) on page 66 show that the 179 females made significantly better achievement gains ($\bar{x}$= 7.92) than their 144 male peers ($\bar{x}$= 6.44) on the instructional programmes offered.

(11) Will there be significantly different achievement performances between males and females who choose either the computer or the picture or the torso option?

Yes. There were statistically significant differences in final performances (post-test achievements) between some pairs of gender / programme

combinations as shown on page 74, other combinations were statistically more or less equally effective in terms of final performance (post-test achievement), as shown on page 75.

(12) With regard to overall final performance achievement scores, which of the three instructional intervention programmes - laptop computer, picture or torso - is the most effective?

Table 4.8 (IV) on page 78 confirms that all three instructional intervention programmes (torso, picture and computer) were, on the whole, statistically equally effective in their capacity to produce more or less the same final average levels in achievement, as measured by the 16 post-test items employed in this investigation with a large randomly selected, heterogeneous population of learners.

6.3. Implications

The findings presented in this investigation might have a number of possible implications for teaching biology: -

- A major implication of this study is related to the broad goal of *motivation* of students. Students in South Africa come to classes with different backgrounds, different personalities and different experiences. They are motivated, learn, develop, and are influenced by appropriate instructional programmes. Students' senses can be stimulated and motivated by a diversity of teaching aids. Students frequently prefer or learn better by one programme more than another.

- Instructional programmes can be selected for their capacity to motivate students, induce a moderate level of concern, and make students feel good, enjoy success, expand effort, be challenged, and appreciate a variety of choices.

- Students can be offered a variety of visual images for encouraging or developing their *visual thinking* and multiple intelligence capacity.

- This study supports the occurrence of gender effects both in choosing instructional programmes and in achievement score performance.

6.4. Recommendations

The evidence gathered and presented in this study supports the following suggestions: -

Recommendation 1:

Students could be motivated, encouraged and enabled to achieve in biology by using a variety of instructional programmes. This is no small task since today's students are quite a diverse group. Nevertheless, educators can value this diversity and should be invited to provide a variety of programmes.

Recommendation 2:

Clear, enjoyable, appropriate, modern and logical instructional programmes could be integrated into biology courses.

Recommendation 3:

Educators might pay more attention to gender issues. Instructional programmes could be chosen which are suitable for the sociological and biological background of males and females.

Recommendation 4:

The study could be carried out with larger groups and with mixed groups, utilizing other topics such as the excretory system, circulatory system etc., or with whole biology topics.

Recommendation 5:

The effects of using instructional programmes on students with different characteristics such as home language, age, socio-economic background etc. could be investigated.

Recommendation 6:

This investigation used multi-media to teach students only knowledge of terminology, using labelling. In subsequent studies, multi-media might be used to teach and test higher orders of conceptual thinking such as understanding, application, analysis and synthesis of biological processes and systems.

Recommendation 7:

The participant learners made more than ten suggestions for improving the research design, materials and procedures adopted in this study. Subsequent investigators in this area of research should seriously consider these suggestions.

6.5. Chapter summary

In this chapter, possible conclusions, implications, limitations, suggestions and recommendations have been presented. The chapter has given final conclusions by answering twelve questions, addressing some applications of the findings, offering recommendations for further research, and presenting a successful outcome to its intended goal of accomplishment.

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APPENDIX A

NASIONALE VAKDIDAKTIEK/ LEERAREA - SIMPOSIUM

NATIONAL SUBJECT DIDACTICS/ LEARNING AREA SYMPOSIUM

UNIVERSITEIT VAN STELLENBOSCH
UNIVERSITY OF STELLENBOSCH

KURRIKULUM 2005: RETORIEK EN REALITEIT

CURRICULUM 2005: RHETORIC AND REALITY

14 – 17 SEPTEMBER 1999

REFERATEBUNDEL / PROCEEDINGS

MJ SMIT & AS JORDAAN

CURRICULUM 2005: INNOVATIVE ASSESSMENT USING DIVERSITY IN INSTRUCTIONAL METHODS IN TEACHING BIOLOGY

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ABSTRACT

In the context of the current debate on the feasibility of implementing *Curriculum 2005*, with emphasis on the attainment of "specific outcomes", the purpose of this investigation was to offer biology students a free choice of learning details of human physiology using labels, by any one of three available options:

(a) by a Pentium computer graphics physiology instructional programme; or
(b) by equivalent hand-held coloured pictures of human organs and systems; or
(c) by hands-on manipulation of the articulated components of the equivalent life-size dissembled torso model of a human body.

The investigation sought to record how many of 68 students chose instructional method (a), (b) or (c), the home language of the participant students being English, Xhosa and Afrikaans.

Prior computer literacy was not important because the students had to press only four or five keys, with administrative assistance. Prior knowledge did not matter because, whether a student scored 1 out of 16 or 15 out of 16 on the pre-test, it was the magnitude of his or her *change in score* which was the critical variable.

Other questions for investigation focused on which one of the three equivalent instructional programme options was the most efficient for students to complete; and which one of the three equivalent instructional programme options promoted the greatest "*pre-test to post-test improvements*" in students' achievement scores in physiology.

The second part of the investigation was a qualitative study. It synthesized the main reasons given by the students for favoring their particular choice of instructional strategy; and it discusses their evaluations of each of the three programmes in a *diversity* of South African school contexts.

Introduction / Theoretical Background

The focus of this paper is reflected in the preamble to Curriculum 2005, which states "Experimental work is a defining characteristic of science and should feature prominently in science learning programmes. Wherever possible practical work should involve active learner participation" (1).

The learning area for the natural sciences also has this rationale: "This development of appropriate skills, knowledge and attitudes... contributes to the creation and shaping of work opportunities" (2). Specific outcome number 2 for the natural sciences states that learners must "Demonstrate an understanding of concepts and principles and acquired knowledge"(3).
In this investigation only two out of eight critical outcomes are assessed in the context of teaching sixteen basic parts of the human digestive system by means of a diversity of instructional methods.

Key Questions to be Addressed

This investigation sought to answer the following questions:

1. Which one of the three instructional programmes (torso, picture or Pentium) significantly increases students' physiology achievement scores when compared to the other two methods?

2. How do the concluding focused qualitative comments of the students help to explain their choices of programme, and their subsequent successes?

Null Hypotheses

Two null hypotheses were guiding the focus of this preliminary investigation: -

Ho1- Achievement gains by each student:
Irrespective of instructional programme chosen, students' mean pre-test to post-test gains in achievement scores will not be significantly different.

Ho2- Programme choice and magnitude of the post-test scores:
Compared according to programme chosen, students' mean group post-test scores will not be significantly different after instruction.

Clarification of Terms

Computer-Assisted Instruction (CAI):

Computer-Assisted Instruction is an educational medium in which instructional contents or activities are delivered to students by some application of a computer.

Picture:

The coloured, hand-held, labelled picture of the human digestive system with attachable labels is used to teach the parts of the human digestive as an instructional programme.

Torso:

The life-size assembled model of human systems with attachable labels. It is used as an instructional programme to teach the basic components of the human digestive system.

Methodology

Dependent variables for each student

- Pre-test score out of 16
- Post-test score out of 16
- Magnitude of the difference between pre-test and post-test scores.

Independent variables for each student

- Format of programme intervention
  - Hand-held picture
  - Pentium computer
  - Torso model

Sample

A randomly available sample of students (N=68) in Cape Town. 20 of them were girls, 48 of them were boys, and 42 of them English speaking, 7 Afrikaans speaking and 19 Xhosa speaking. The students' ages ranged from 13 years to 30 years.

Research Approach

For the purpose of this investigation the response data were collected by means of pre-test scores, post-test scores and questionnaires. Sixteen items were employed for the quantitative study and two open-ended items for the qualitative study. Primary, secondary and tertiary school students who are English first or second language speakers took part in the investigation during normal classroom time. The data collection was efficient, requiring a period of about fifteen to twenty minutes for a group of ten students. To obtain simple, clear words for the programmes and their instructions, the materials were piloted and refined using ten senior primary school pupils in an economically depressed suburb of Cape Town, before being trailed with larger samples.

Results and observations

The investigation conducted with students in Cape Town found that 39.8% of the student participants chose the Pentium computer graphic as their preferred instructional method; 32.3% of students opted for the Torso as their teaching strategy; and 27.9% of the sampled students preferred a hand-held coloured picture of the human digestive system as their instructional medium of free choice. According to their comments, all students who took part in the exercise expressed excitement and eagerness to participate in the investigation and all improved. Some students' achievement scores increased by three or four marks out of sixteen. Some students' scores increased by much as ten or eleven marks out of sixteen, e.g. from 1/16 to 16/16 using the Pentium, during the period assigned for the experiment.

The averages of the pre-test to post-test score increases, according to students choices, were: Computer: 7.75, Torso: 4.86 and Picture: 5.05. It is clear that there are appreciable improvements in many individual students' achievement test scores. The threefold programme of assessment is successful in increasing students' scores on tests on human physiology; and the investigation is continuing with larger samples in Cape Town in 1999.

Discussion

For the Natural sciences critical outcome number 3 states "Learners should be able to demonstrate their ability to organize and manage themselves and their activities responsible and effectively." In this investigation all participants completed their chosen tasks successfully and enjoyed the exercises; and qualitative evidence supporting the attainment of critical outcome number 3 is provided by students who wrote the favorable remarks in their evaluation of the

programme.

Critical outcome number 5 states "Learners should be able to communicate effectively using visual, mathematical and / or language skills in the modes of oral and / or written presentation." Of the sample of 68 respondents only seventeen failed the post-test scoring a mark less than 8 out of 16. Qualitative evidence supporting the attainment of critical outcome number 5 is provided by students who wrote the following comments in their evaluation of the programme they had just completed: ***about the Computer*** - "Entertaining, very interesting medium to bring across information"; ***about the Torso*** - " It looks real. It helps you to understand better"; ***about the Picture*** - " The visual stimuli worked well as facts are easier to remember".

Therefore critical outcome number 5 using a diversity of instructional methods in teaching biology, was attained with more than three quarters of those who took part in the innovative programmes designed as part of Curriculum 2005.

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REGISTRATION INFORMATION

BIENNIAL SAARDHE CONFERENCE

THEME: THE RECONSTRUCTION OF HIGHER EDUCATION IN SOUTH AFRICA AND THE ROLE OF SAQA (SA QUALIFICATIONS AUTHORITY) AND NQF (NATIONAL QUALIFICATIONS FRAMEWORK)

ORGANISERS: SA ASSOCIATION FOR RESEARCH AND DEVELOPMENT IN HIGHER EDUCATION (SAARDHE)

DATE: 29-30 JUNE & 1 JULY 1999
PENINSULA TECHNIKON, BELLVILLE

HOSTED BY:

EDUCATIONAL DEVELOPMENT CENTRE, PENINSULA TECHNIKON

NQF assessment issues: the impact of a pentium technology option on biology students' choice of multi-media instructional methodology

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The initial purpose of this investigation into curriculum cost-effectiveness and issues in the provision of diversity of assessment strategies at the school and university level was to offer biology students a free choice of learning details of human physiology by any one of three available options:

a) by a pentium computer graphics physiology instructional programme; or
b) by equivalent hand-held coloured pictures of human organs and systems; or
c) by hands-on manipulation of articulated components of a life-size dissembled torso model of the human body.

The investigation aimed to record how many students freely chose instructional method (a), (b) or (c); and secondly to investigate whether the frequency distributions of choices varied significantly with the gender of the student participants, and with their home language (such as English, Xhosa or Afrikaans). Other questions for investigation focus on which one of the three equivalent instructional programme options (of widely different cost) would be the most efficient (time-saving) for students to complete; and which one of the three equivalent instructional programme options would promote the greatest pre-test to post-test improvements in students' achievement scores in physiology.

APPENDIX B

	NAME	GENDER	PR. LANG.	PRE-TEST	POST-TEST	DIFFERENCE	CH. PORG
1	AASHIQA	F	E	9	16	7	C
2	AB	F	XH	7	16	9	C
3	AISHAH	F	E	6	16	10	C
4	AKES	F	E	5	15	10	C
5	AKIAWE	F	XH	2	13	11	C
6	ALLIE	F	E	5	16	11	C
7	ANICIA	F	E	11	16	5	C
8	AYESHA	F	E	8	15	7	C
9	AYISAH	F	E	11	16	5	C
10	BABY	F	E	8	16	8	C
11	CYBERTHU	F	E	11	16	5	C
12	DALAAL	F	E	5	16	11	C
13	DELFA	F	E	2	11	9	C
14	DONGO	F	XH	3	9	6	C
15	FARHANA	F	E	7	14	7	C
16	FARZAANA	F	E	4	14	10	C
17	FARZANAH	F	E	8	16	8	C
18	FATIMA	F	E	5	15	10	C
19	FAWZIA	F	E	3	12	9	C
20	FUNKY	F	E	4	15	11	C
21	FUNMI	F	E	9	16	7	C
22	FUZZY	F	E	6	14	8	C
23	GANGSTER	F	E	6	16	10	C
24	GLORIA	F	XH	8	16	8	C
25	GOGGA	F	E	12	15	3	C
26	JIHAMI	F	A	8	16	8	C
27	JOCELYN	F	E	5	16	11	C
28	KAMIES	F	E	4	16	12	C
29	LEXI	F	E	4	9	5	C
30	LIEWE	F	A	5	16	11	C
31	MASEKA	F	E	7	12	5	C
32	MISHAH	F	E	7	15	8	C
33	MUNEERA	F	E	4	10	6	C
34	MUNEERAH	F	E	9	16	7	C
35	MYMAENA	F	X	2	10	8	C
36	NABZ	F	E	6	16	10	C
37	NAZEEN	F	E	5	15	10	C
38	NIHAAL	F	E	10	16	6	C
39	NISHAAT	F	A	3	16	13	C
40	NUHA	F	E	9	16	7	C
41	NUREEN	F	E	11	16	5	C
42	PINKY	F	XH	6	14	8	C
43	POSY	F	E	8	16	8	C
44	PUMMY	F	XH	8	16	8	C
45	RABIA	F	E	3	16	13	C
46	ROWENA	F	E	1	16	15	C
47	RUSHAA	F	E	9	16	7	C
48	RYON	F	A	3	11	8	C
49	SHAHISTA	F	A	7	16	9	C
50	SHAMIMA	F	E	4	15	11	C
51	SHAZ	F	A	6	14	8	C

52	SHOUNEEZ	F	E	7	14	7	C
53	SUMAYA	F	E	4	16	12	C
54	TASNEEM	F	E	6	14	8	C
55	TASNEEM	F	E	6	14	8	C
56	THASY	F	XH	8	13	5	C
57	THERESA	F	XH	3	12	9	C
58	WADIA	F	E	6	15	9	C
59	WH	F	E	3	11	8	C
60	YUMNA	F	E	3	11	8	C
61	YUSRAH	F	E	5	16	11	C
62	ZAHRAH	F	E	6	14	8	C
63	ZARAH	F	E	3	15	12	C
64	ZAYNAB	F	E	5	14	9	C
65	ZEENAT	F	E	2	16	14	C
66	JACQUEI	F	E	12	16	4	C
67	MISS WORL	F	E	8	16	8	C
68	GILLIAM	F	E	6	16	10	C
69	ANGELA	F	E	7	15	8	C
70	MICHELA	F	E	11	16	5	C
71	KAJRE	F	E	7	16	9	P
72	RAULA	F	E	2	13	11	P
73	DANIELLA	F	E	9	14	5	P
74	1	F	A	2	7	5	P
75	22	F	E	4	12	8	P
76	Adelina	F	ST	7	15	8	P
77	ARSHIYA	F	E	8	16	8	P
78	BADRUNNIS	F	E	6	16	10	P
79	Bronwyn	F	E	7	15	8	P
80	Claire	F	E	6	16	10	P
81	Ettet	F	A	3	10	7	P
82	FAZLIN	F	E	7	16	9	P
83	HIBAH	F	E	9	11	2	P
84	JEWEL	F	E	8	16	8	P
85	KARIEMA	F	E	3	16	13	P
86	LOODA	F	E	2	16	14	P
87	Lyapa	F	E	9	14	5	P
88	MARIAM	F	E	4	12	8	P
89	Meil	F	E	6	12	6	P
90	Melon	F	E	5	16	11	P
91	Nolut	F	XH	6	11	5	P
92	Nuraan	F	E	8	15	7	P
93	R. B.	F	E	6	16	10	P
94	RABIA	F	E	9	16	7	P
95	RAFIEKA	F	E	8	10	2	P
96	Rose	F	E	8	14	6	P
97	RUKAYYA	F	E	2	16	14	P
98	SHABS	F	E	7	16	9	P
99	SHANANT	F	E	6	12	6	P
100	Sithlola	F	XH	7	11	4	P
101	STARDUST	F	E	8	16	8	P
102	TAZ (1)	F	E	7	16	9	P
103	TAZZ	F	E	7	16	9	P

104	UMKULTHU	F	E	7	13	6	P
105	UNAIZAH	F	E	7	12	5	P
106	Whithead	F	E	8	10	2	P
107	Zanelle	F	XH	8	14	6	P
108	ABBY	F	E	7	14	7	T
109	ALIEMA	F	E	2	9	7	T
110	AMENDA	F	E	7	11	4	T
111	ANGEL	F	E	12	13	1	T
112	ANISHA	F	E	6	16	10	T
113	ARIFA	F	E	14	16	2	T
114	ASIYAH	F	E	7	14	7	T
115	ASTO	F	XH	3	10	7	T
116	BEAUTY	F	E	12	16	4	T
117	CARRINC	F	E	6	16	10	T
118	CATTY	F	A	6	16	10	T
119	CLU	F	XH	7	8	1	T
120	DAISY	F	E	5	16	11	T
121	DALIYAH	F	E	8	15	7	T
122	DENNIS	F	E	4	12	8	T
123	DHOMAY	F	E	5	16	11	T
124	FADEELAH	F	E	2	15	13	T
125	FARZAAN	F	E	2	14	12	T
126	FARZANA	F	E	3	9	6	T
127	FERAZA	F	E	6	10	4	T
128	FIRDEWS	F	E	5	14	9	T
129	FIRDEWS	F	E	6	15	9	T
130	GAFIZA	F	E	6	16	10	T
131	GRETCH	F	E	7	5	-2	T
132	HAJIRAH	F	E	2	11	9	T
133	HAYIERA	F	E	15	16	1	T
134	HOWA	F	E	10	14	4	T
135	KALDIA	F	E	11	16	5	T
136	KAMILAH	F	E	3	12	9	T
137	LAYLA	F	E	6	16	10	T
138	M. M.	F	E	7	16	9	T
139	MAALIEKAH	F	E	7	11	4	T
140	MAEMIENA	F	E	4	11	7	T
141	MARK	F	E	8	15	7	T
142	MBADU	F	XH	3	14	11	T
143	MILKY	F	E	2	14	12	T
144	NASEEMA	F	E	5	11	6	T
145	NOSIBHO	F	XH	10	15	5	T
146	NUSRAT	F	E	5	15	10	T
147	RABIA	F	E	14	16	2	T
148	RAY	F	E	10	14	4	T
149	RIDWANA	F	E	7	16	9	T
150	RIZYAH	F	E	6	16	10	T
151	ROSE	F	E	3	15	12	T
152	RUBEENA	F	E	9	16	7	T
153	S. S.	F	E	9	15	6	T
154	SAADIKA	F	E	4	14	10	T
155	SAJIDE	F	E	12	16	4	T

156	SAMEERA	F	E	3	9	6	T
157	SAMEERA	F	E	14	16	2	T
158	SHAKES	F	E	15	16	1	T
159	SITTARA	F	E	9	16	7	T
160	SLELLY	F	A	6	10	4	T
161	SMASH	F	E	5	9	4	T
162	SOLO	F	E	4	15	11	T
163	SOND	F	E	7	16	9	T
164	SUMAYYE	F	E	5	16	11	T
165	SUNFLOWE	F	E	5	16	11	T
166	SUX	F	A	9	13	4	T
167	TAAHIRAH	F	E	13	16	3	T
168	TASNEEM	F	E	5	13	8	T
169	TASNEEMA	F	E	3	16	13	T
170	VIOLET	F	E	5	16	11	T
171	WAAGHEDA	F	E	8	16	8	T
172	WASEEMA	F	E	4	16	12	T
173	ZAHIRAH	F	E	3	16	13	T
174	ZARINAH	F	E	5	16	11	T
175	ZEENAT	F	E	7	15	8	T
176	ZURAAN	F	E	5	13	8	T
177	JANET	F	E	5	16	11	T
178	TESSA	F	E	4	16	12	T
179	MANDY	F	E	3	16	13	T
180	$	M	E	6	16	10	C
181	A. GAFEET	M	E	5	7	2	C
182	ANDLE	M	XH	7	16	9	C
183	ANDREW	M	E	1	16	15	C
184	ASH	M	E	9	16	7	C
185	ASHRAF	M	E	8	14	6	C
186	AZEEM	M	E	4	15	11	C
187	BAHAIJAAN	M	E	7	16	9	C
188	BAPOO	M	E	6	16	10	C
189	BOOF	M	E	3	6	3	C
190	BRADLEY	M	E	1	7	6	C
191	CHRIS	M	A	8	15	7	C
192	DUMISA	M	XH	5	9	4	C
193	DVI	M	E	4	8	4	C
194	EBOBAKER	M	E	4	9	5	C
195	ESSAMOH	M	E	1	11	10	C
196	GEORGE	M	E	2	14	12	C
197	GLADWIN	M	XH	3	7	4	C
198	HEXEN	M	E	7	14	7	C
199	INAL	M	E	5	14	9	C
200	JOSEPH	M	E	6	16	10	C
201	JUDE	M	E	6	11	5	C
202	LANWOBA	M	XH	4	12	8	C
203	LELILE	M	XH	5	11	6	C
204	LEROY	M	A	1	6	5	C
205	LOYAL	M	E	1	16	15	C
206	LUCKY	M	E	7	16	9	C
207	LUQMAAN	M	E	3	9	6	C

208	LUZOKO	M	XH	2	10	8	C
209	M.FUNDOS	M	A	4	8	4	C
210	MAAMMIEZ	M	E	6	9	3	C
211	MAHIER	M	E	6	13	7	C
212	MAKELERA	M	XH	6	14	8	C
213	MDMULULI	M	XH	3	8	5	C
214	MOOR	M	E	6	9	3	C
215	NEVILLE	M	A	2	7	5	C
216	OO7	M	E	7	6	-1	C
217	PERCY	M	XH	3	11	8	C
218	PETER	M	E	7	15	8	C
219	RAFEEQ	M	E	8	10	2	C
220	RATTY	M	A	5	9	4	C
221	RIYAAZ	M	E	6	16	10	C
222	SABATHA	M	E	5	13	8	C
223	SALIE	M	E	7	16	9	C
224	SAM	M	E	7	9	2	C
225	SAMMY	M	E	10	16	6	C
226	SEAN	M	XH	8	12	4	C
227	SHAKIR	M	E	4	14	10	C
228	SIRAAJ	M	E	4	7	3	C
229	SIVUYILE	M	XH	8	15	7	C
230	SNIPER	M	E	0	11	11	C
231	STEFAN	M	E	9	14	5	C
232	SULEIMEN	M	E	8	15	7	C
233	T.BOSE	M	XH	7	16	9	C
234	TAEBO	M	E	5	12	7	C
235	THAABIET	M	E	6	13	7	C
236	TSIDOSO	M	XH	2	12	10	C
237	WALEED	M	E	4	7	3	C
238	WOOD	M	E	8	15	7	C
239	XANDER	M	E	11	16	5	C
240	YAGHYA	M	E	3	7	4	C
241	YASEEN	M	E	4	14	10	C
242	ZAHID	M	E	6	11	5	C
243	ZAHIER	M	E	2	6	4	C
244	ZAHIR	M	E	4	5	1	C
245	ZANDIZILE	M	XH	8	11	3	C
246	ZAP	M	E	6	14	8	C
247	ZIYAAD	M	E	4	10	6	C
248	ZUHER	M	E	6	14	8	C
249	ZUKO	M	XH	4	13	9	C
250	ZUNAID	M	E	3	10	7	C
251	AR	M	E	6	15	9	P
252	Ashraf	M	E	0	7	7	P
253	Bardien	M	A	2	6	4	P
254	BHAM	M	E	6	14	8	P
255	Bonga	M	XH	6	14	8	P
256	Bongoni	M	E	5	9	4	P
257	BUNNY	M	E	3	16	13	P
258	Denroy	M	E	2	2	0	P
259	ICE	M	E	4	16	12	P

260	Warren	M	E	3	6	3	P
261	ZIYAAD	M	E	4	14	10	P
262	ZUBEYIR	M	E	4	10	6	P
263	A. KADER	M	E	8	14	6	T
264	A. RAHMAN	M	E	2	11	9	T
265	ADAMS	M	E	1	6	5	T
266	ADIEL	M	E	5	11	6	T
267	ALLIE	M	E	2	12	10	T
268	ALUES	M	E	0	8	8	T
269	ASHRAF	M	E	3	7	4	T
270	BAIU	M	E	8	16	8	T
271	BIELA	M	E	7	12	5	T
272	BOLTMAN	M	E	2	7	5	T
273	BONES	M	E	9	13	4	T
274	CHARLIS	M	E	6	6	0	T
275	DERYL	M	E	5	8	3	T
276	DOPEY	M	E	14	16	2	T
277	ELAS	M	E	3	8	5	T
278	EMRA	M	E	0	7	7	T
279	ESSACK	M	E	9	10	1	T
280	JOHN	M	E	8	15	7	T
281	KARIEM	M	E	7	10	3	T
282	KHALIL	M	E	5	9	4	T
283	LORGAT	M	E	6	13	7	T
284	LULE	M	E	1	9	8	T
285	MAHDI	M	E	8	16	8	T
286	MUAZZAM	M	E	3	14	11	T
287	RAEEZ	M	E	7	8	1	T
288	RIFAAD	M	E	4	14	10	T
289	RIYAAZ	M	E	5	11	6	T
290	RYADH	M	E	6	12	6	T
291	SALIEGH	M	E	6	12	6	T
292	SHAIL	M	E	9	16	7	T
293	TA YU	M	E	4	16	12	T
294	TINY	M	E	6	11	5	T
295	TRVINE	M	E	6	12	6	T
296	WAJDIE	M	E	6	8	2	T
297	WASEEM	M	E	6	12	6	T
298	YASEEN	M	E	1	5	4	T
299	YUSUF	M	E	6	15	9	T
300	ZAHIR	M	E	5	13	8	T
301	ZUBAYIR	M	E	6	15	9	T
302	C. FEYNE	M	E	6	12	6	T
303	ANDLE	M	XH	7	16	9	C
304	DUMISA	M	XH	5	9	4	C
305	GLADWIN	M	XH	3	7	4	C
306	LANWOBA	M	XH	4	12	8	C
307	LELILE	M	XH	5	11	6	C
308	LUZOKO	M	XH	2	10	8	C
309	MAKELERA	M	XH	6	14	8	C
310	MDMULULI	M	XH	3	8	5	C
311	PERCY	M	XH	3	11	8	C

312	SEAN	M	XH	8	12	4	C
313	SIVUYILE	M	XH	8	15	7	C
314	T.BOSE	M	XH	7	16	9	C
315	TSIDOSO	M	XH	2	12	10	C
316	ZANDIZILE	M	XH	8	11	3	C
317	ZUKO	M	XH	4	13	9	C
318	Bonga	M	XH	6	14	8	P
319	Oxowea	M	XH	3	9	6	P
320	Theletlo	M	XH	6	10	4	P
321	BULELANI	M	XH	8	14	6	T
322	JOG	M	XH	8	16	8	T
323	MALALI	M	XH	7	12	5	T

APPENDIX C

Name or Nickname	ZARINAH MOHAMED
Are you male or female	FEMALE
In which school and which grade are you currently registered	ISLAMIA COLLEGE GR 10
What is your home language (English, Afrikaans, Xhosa, etc.)?	ENGLISH

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Torso, I enjoy studing biology when you I can have the plastic model to study from. It is as if you are studing from a real body and is much more interesting as the parts are movable enabling you to see everying, whereas with pictures you have to look at side viewls in order to see properly.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was very interesting and educational. I have learnt many new things.

2- It was enjoyable.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- I don't think it needs improvements.

2-

Name or Nickname	Sumaya Sayed
Are you male or female	Female
In which school and which grade are you currently registered	Islamia College
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Torso. I find it easier to learn with models which represent the topic being studied.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- ~~It proved to me that if~~ It was interesting and showed me that learning can be Fun.

2- I learnt ~~at~~ things quicker than what I thought I would.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- I am satisfied.

2-

Name or nicname	Gretchen Alexander
In which school are you currently registered	St Georges Grammar
Are you male or female	Female
What is your home language (English, Afrikaans, Xhosa, etc.)	English
Choice of the programme (Torso, Pictures, Computer)	Torso.

COMMENTS ON THE TEACHING METHOD

A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was wonderful because at first I got confused out the body parts now I got a better view of it.

2- It looks real. It helps you to understand better.

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- By explaining in detail.

2- It's fine - I think for everything you want to explain you should show us a Torso so that we will understand more clearly

Name or Nickname	BADRUNNISA HARNEKAR
Are you male or female	FEMALE
In which school and which grade are you currently registered	ISLAMIA COLLEGE, GRADE 10:E
What is your home language (English, Afrikaans, Xhosa, etc.)?	ENGLISH

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

The picture because I find it easier to grasp and learn from it.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- I like the fact that I can see the pictures clearly and at the same time I am able to see to name of specific organ/part.

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- I think that the programme should have more than one model to avoid congestion amongst the learners.

2-

Name or Nickname	Zandisile N Bonanga
Are you male or female	Male
In which school and which grade are you currently registered	Thandabantu Grade 11
What is your home language (English, Afrikaans, Xhosa, etc.)?	Sotho, Tswana, Zulu

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Because computer is good for me
I learn very fanter

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- I'm so happy because I wrai only
known teeth and stomach and tounge

2- now I known some part of my
Body and if you have much time

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- If you can give much more
time in computer.

2-

Name or Nickname	Lyle
Are you male or female	Male
In which school and which grade are you currently registered	Birdlands; Grade 9
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

I chose the computer because I thought it would be quite a wonderful experience learning from it.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- I learned more about the human digestive system.

2- I learned that it is quite nice studying from computers.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1-

2-

Name or Nickname	Pinky
Are you male or female	female
In which school and which grade are you currently registered	COSAT (10)
What is your home language (English, Afrikaans, Xhosa, etc.)?	Xhosa

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer. You find more interesting things and you don't get bored, unlike being in class with a teacher taking too much

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It's educating and you get to think faster.

2- I just like it.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- [illegible]

2- [illegible]

Name or nicname	Nuraan Jacobs
In which school are you currently registered	St Georges Gamma
Are you male or female	~~Female~~
What is your home language (English, Afrikaans, Xhosa, etc.)	English
Choice of the programme (Torso, Pictures, Computer)	Pictures.

COMMENTS ON THE TEACHING METHOD

A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was simple and very efficient. We taught ourselves and learnt by our mistakes.

2- The visual stimuli worked well as facts are easier to remember if they

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS

1-

2-

Name or nicname	Xuidoi
In which school are you currently registered	St George Grammar Sch
Are you male or female	Female
What is your home language (English, Afrikaans, Xhosa, etc.)	English
Choice of the programme (Torso, Pictures, Computer)	Pictures

COMMENTS ON THE TEACHING METHOD
A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME
1- It was much (easier) to understand where each part of the digestive system is located.

2- The visual aid made it easier to remember because all I had to do when answering the questions was visualize the digestive system.

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS
1- No, I find the teaching materials to be appropriate.

2-

Name or nicname Warren.	
In which school are you currently registered	St. George's Gramma.
Are you male or female	Male
What is your home language (English, Afrikaans, Xhosa, etc.)	English
Choice of the programme (Torso, Pictures, Computer)	Pictures

COMMENTS ON THE TEACHING METHOD
A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME
1- It didn't ~~req~~ require much interaction. It was quick and relatively effective.

2-

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS
1- Those work alone in solitude. Perhaps with the aid of video material.

2-

STD 10A / 12

Name or nicname	NOluthando
In which school are you currently registered	OSCAR MPETA High
Are you male or female	Female
What is your home language (English, Afrikaans, Xhosa, etc.)	Xhosa
Choice of the programme (Torso, Pictures, Computer)	~~COMPUTER~~ PICTURE

COMMENTS ON THE TEACHING METHOD
A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME
1- I like this ~~histo~~ instructional programme because I see something I do in class practically that's what I like about this programme.

2- It (teach) us (quick ~~understanding~~ about things we

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS
1- I suggest that the Teaching materials give by self to understand quickly

2- Giving myself to prove that I am a brilliant person.

→ I Choose the picture because I do like see something practical when I do not understand something.

Name or Nickname	Rukayya. Samsodien
Are you male or female	female
In which school and which grade are you currently registered	Islamia College Gr. 10.
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or ~~Picture~~) and WHY?

Picture. I chose it because it was clear and colourful. Also because it ~~was~~ is much more exciting than computers (I think!)

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- ~~It taught me the helpful~~ It reminded me about the helpulness of studying from pictures

2- It taught me how to learn info. more effectively and long-term.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Maybe have more than one item of each. Having only one causes crowding ~~or~~ around items. ✓

2-

Name or Nickname	Sunny
Are you male or female	male
In which school and which grade are you currently registered	Islamia College Gr 11A
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Picture → Much easier to learn labels, observe better, can distinguish between different parts better

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- A recap on what we done or learn ~~earlier~~ earlier in the year. ~~Term~~ ~~year~~

2- Revision

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Should use different colours for each part
Use bigger pictures

2-

Name or Nickname	Ecc
Are you male or female	Male
In which school and which grade are you currently registered	Islamia Gr 11
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Picture ; I find Biology easy when studying with pictures.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- One was free to choose which practical to take. Thus you were free to take part in the activity you most enjoyed.

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Pictures presented by teachers, lecturers should be visually clear and as life like as possible.

2-

Name or Nickname	Mohammed Bham
Are you male or female	Male
In which school and which grade are you currently registered	Islamic College Grade 11A
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Picture because it can give detailed info ~~[illegible]~~.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It shows us the different methods one can use to learn.

2- It was interesting to know that people try to find or study methods of teaching

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- In computers you could use sound and on pictures you should use colour.

2-

Name or Nickname	M·M
Are you male or female	FEMALE
In which school and which grade are you currently registered	ISLAMIA / GRADE 10.E
What is your home language (English, Afrikaans, Xhosa, etc.)?	ENGLISH

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

PICTURE - BECAUSE I FIND IT EASIER TO LOOK WITH PICTURES. It colourful & easier to REMEMBER.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- THE BEFORE AND AFTER TEST - it makes you realise that you've learned something.

2- IT WAS INTERESTING & SOMETHING NEW.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- NOTHING, I THINK IT WAS EXCELLENT.

2-

Name or Nickname	R.B
Are you male or female	female
In which school and which grade are you currently registered	Islamia College, grade: 10.E
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Picture : It was colourful and easy to memorize.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was interesting and a change from our normal everyday lessons

2- The pre & post test was nice. It is interesting to see when one does wrong and to correct oneself is better and by correcting yourself you won't often forget.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- It was very good, no need to improve

2-

Name or Nickname	Fazlin Vulley
Are you male or female	F
In which school and which grade are you currently registered	Islamia Gr 10E
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Picture. because it was clear and that other thing would not distracted me from learning.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was clear easy to learn and its was in colour

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- I saggest that it should the labels sould be put in different- coburs.

2-

Name or Nickname	Iooda
Are you male or female	female
In which school and which grade are you currently registered	Islamia College Gr:10E
What is your home language (English, Afrikaans, Xhosa, etc.)?	ENGLISH

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?
PICTURE :
It is easier to grasp.
The more confused the better it is to learn and memmorise.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME
1- Fun, exciting and good learning experiance.
2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS
1-
Teaching materials are good enough.
2-

GRADE 10 F

Name or nicname Mbadu Mnwabisi	Mbadu Mnwabisi
In which school are you currently registered	OSCAR MPETHA
Are you male or female	Male
What is your home language (English, Afrikaans, Xhosa, etc.)	XHOSA
Choice of the programme (Torso, Pictures, Computer)	Torso

COMMENTS ON THE TEACHING METHOD
A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME
1- I like Torso because it shows all the parts of the body. I like the way that they teach, they make it very understandable.
2- They teach very quickly but they make sure that you can understand

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS
1- I suggest that they improve the other Materials not only Registire System
2-

→ I choose Torso because it shows all the parts of the body and you can see it very well.

Name or Nickname	Jihanni Versace (Edwards)
Are you male or female	Female
In which school and which grade are you currently registered	Gr. 10. E Islamia College
What is your home language (English, Afrikaans, Xhosa, etc.)?	English, Afrikaans.

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer, I enjoy working with a computer since I dont have one of my own. So when I have the opportunity to use one, I make the most of it.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It prepared me for my exam. It put me back into that study mode.

2- I learnt a few new parts of the human body which I haven't learnt yet. This programme was enjoyable and the order in which the programme took place, will make me never forget the Digestive System.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- I don't think that any of the teaching material needs improvement, so I dont have suggestions.

2- I would like to request that we have more of these programmes at our school. As a student I think I would have learnt the 'Digestive System' in a longer period of time, than I did today i.e. 15 minutes.

Name or Nickname	SUMAYA
Are you male or female	FEMALE
In which school and which grade are you currently registered	ISLAMIA COLLEGE GR 10C
What is your home language (English, Afrikaans, Xhosa, etc.)?	ENGLISH

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

COMPUTER, BECAUSE I LOVE WORKING WITH COMPUTERS. THEY (COMPUTERS) INSPIRE ME BECAUSE OF THE AMOUNT OF KNOWLEDGE THEY POSESS AND BECAUSE I HAVE ALWAYS BEEN AMAZED BY COMPUTERS.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- FIRSTLY A COMPUTER HELPS ME TO REMEMBER EASILY BECAUSE I LOVE WORKING WITH COMPUTERS.

2- Secondly because I love using colour and a computer provides me with that. Colour helps me to remember.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- I suggest that students must be taught how to become computer literate firstly.

2- Thereafter at you can move on to working on the computer and helping to educate yourself.

Name or Nickname Shalicia	Shalicia
Are you male or female female	Female
In which school and which grade are you currently registered	Islamia College, Gr. 10
What is your home language (English, Afrikaans, Xhosa, etc.)?	English ; Afrikaans.

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer, because it is an advanced method in learning

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It guided me in detail and really was very informative.

2- The graphics used was also very good and the facts that was in colour made it exciting.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Much more advanced equipment. Also not using the same sources every time.

2- Teachers should also understand their equipment and sources fully so that they can explain better

Name or Nickname	Ashraf
Are you male or female	Male
In which school and which grade are you currently registered	Islamia College, Gr. 11B
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer, I love computers; It makes learning more interesting.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- Easy to operate, interesting.

2- Very informative, colourful

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Have sound on the computer, bigger screen.

2-

Name or Nickname	Angela Every
Are you male or female	F
In which school and which grade are you currently registered	UCT
What is your home language (English, Afrikaans, Xhosa, etc.)?	Eng

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer it was the most appealing I didn't use one at school we had charts and Torso

B- WHAT DID YOU ~~LIKE~~ ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was (quick) to the point & ~~to~~ ~~the~~ it gave the information (quickly)

2- I found (test) myself & guess

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Nothing the computer was great

2-

Name or Nickname	Suleiman Black
Are you male or female	male
In which school and which grade are you currently registered	Islamia college 11B
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer. I am used to working with computers and find it to be easier and more interesting than pictures

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was very easy to operate and user Friendly

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- There should have been sounds to make the learning experience more enjoyable and educational

2- It should be more of a 2 way communication with the computer. ie we should have typed in labels

Name or Nickname	Jacquie
Are you male or female	Female
In which school and which grade are you currently registered	U.C.T.
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer - it seemed interesting and original, I'm not used to such things (laptop)

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was excellent - the pre- + post-tests were very effective
The choice of learning resources was also excellent, it allowed for personal choice
2- The computer was colourful + bright, it was bright, I could go at my own speed (no pressure), could test myself afterwards. Neat, attractive presentation.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1-

2-

Name or Nickname	BABY
Are you male or female	FEMALE
In which school and which grade are you currently registered	ISLAMIA COLLEGE GRADE. 11-C
What is your home language (English, Afrikaans, Xhosa, etc.)?	ENGLISH

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

COMPUTER. It is a more explained sort of teaching. It's easier and you are able to make your own notes in your head and not listen to something someone else is telling you.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- You learn very quick and you are able to memorise biology from any sort of model, chart, or computer.

2- Very interesting

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Everything is fine thanx.

2-

Name or Nickname	AYESHA
Are you male or female	FEMALE
In which school and which grade are you currently registered	ISLAMIA COLLEGE
What is your home language (English, Afrikaans, Xhosa, etc.)?	ENGLISH

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

I choose the computer because it is very fascinating to see what people can learn with new modern technology.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- We learnt alot about the body

2- I remembered most of the things

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Nothing, since every person has a different way of teaching someone else.

2-

Name or Nickname	Zuber
Are you male or female	male
In which school and which grade are you currently registered	Isikumia College 8B
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer, It is easily to understand programes and easy to find notes on it.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was interesting to know things which are in our/my body which I did not know before.

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- They should tes let us work on computer instead of books as school and for teaching material should be ~~more~~ much more better of learning all our subject especially Science and Grammer

2- Spelling.

Name or Nickname Farzanah Allie	
Are you male or female Female	
In which school and which grade are you currently registered	Islamia College 11D
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer - Because technology is more advanced and it seemed more exciting.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- Everything was clear and summarised for us to understand better.

2- It was colourful and caught my attention

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- TO GET COMPUTERS FOR US TO BE MORE ANXIOUS TO LEARN AND BECOME SOMETHING.

2- TO USE MORE COLOUR.

Name or Nickname فرزانه (Farzaanah)	
Are you male or female female	
In which school and which grade are you currently registered	Islamia College : Gr 11
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer, I never did biology on computer before. It was exciting & (fun) & from my results you can see that I did learn.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was (colourful & clear)

2- It was to the point, (no unnecessary information)

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- More practical : hands-on exercises.
More graphic.

2- Materials where we are able to use all our sense

Name or Nickname	GOOGA
Are you male or female	FEMALE
In which school and which grade are you currently registered	ISLAMIA COLLEGE GRADE 11 D
What is your home language (English, Afrikaans, Xhosa, etc.)?	ENGLISH

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

COMPUTER – it is (easier) and the computer can tell you what it is and then they ~~or~~ tell you to write it in after words

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- That it was (interesting)

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- That the teachers should not ~~set~~ (talk) whole period because then they make the subject very (boring)

2- And maybe ~~our~~ they can put some work on the computer and can explain from their.

Name or Nickname	Shakir Solomon
Are you male or female	male
In which school and which grade are you currently registered	Islamia College, Gr 8B
What is your home language (English, Afrikaans, Xhosa, etc.)?	English.

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computers, The reason I did it was, throughout my life I was associated with computers, and also because my father bought a Pentium III 450 mhz computer.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was interesting and provided a lot of information in such a short time period.

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- ~~Using a better monitor~~ using a number of monitors connected to one computer or maybe each child with his own computer.

2-

Name	Rowena
Surname	Stobie
In which school are you currently registered	—
Are you male or female	F
What is your home language (English, Afrikaans, Xhosa, etc.)	English
Choice of the programme (Torso, Pictures, Computer)	Computer

COMMENTS ON THE TEACHING METHOD

A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME

1- The computer program took you thru' the naming of the parts in a logical fashion.

2- Good, interesting pictures, nice presentation.

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- That the 2 different presentations are reversed so that on the first one you learn the names and the second time you can test yourself.

2-

Name or nicname	Gloria
In which school are you currently registered	U.W.C
Are you male or female	female
What is your home language (English, Afrikaans, Xhosa, etc.)	Xhosa
Choice of the programme (Torso, Pictures, Computer)	Computer

COMMENTS ON THE TEACHING METHOD
A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME
1- Computers are much easier to learn with, because you just click on Enter and there it gives you an answer. I think this method of teaching is the one that can excite the students learning process, because its more active learning.
2- Technology is mostly used in schools, because teachers construct in a way that it should be content-based and be more interest with graphics for the students.
B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS
1- Although computers are good, but the student also have to do the exercise over and over again in order access the information properly.
2-

Name	Neville
Surname	Zeeman
In which school are you currently registered	Star Highschool
Are you male or female	male
What is your home language (English, Afrikaans, Xhosa, etc.)	English, Afrikaans
Choice of the programme (Torso, Pictures, Computer)	Computer

COMMENTS ON THE TEACHING METHOD

A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME

1- I like computer, because it is people use it every day.

2- Computers can learn you lots of things and there are many things to learn about computers.

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- The 3d teaching materials is good.

2-

Name or Nickname	Pummy
Are you male or female	Female
In which school and which grade are you currently registered	Grade 10 (COSAT)
What is your home language (English, Afrikaans, Xhosa, etc.)?	Xhosa

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer, because in a computer you can check your spelling mistakes and you can search some more information without wasting your time.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- I like it and I found it more interesting.

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- I think they should use a computer for all subjects because learning by a computer I found it too interesting and absolutely not boring

2-

Makelane

Name or Nickname Makelane	
Are you male or female Male	
In which school and which grade are you currently registered	LBAT College
What is your home language (English, Afrikaans, Xhosa, etc.)?	Isizulu & Sotho

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer. ∵ Learning with computer increase my performance.
It is interesting to learn with computer.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- Computer is a good equipment to teach with.

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- I THINK each and every school, there must be computers, because computers facilitate the standard of education

2-

Name or Nickname	lonwABO
Are you male or female	male
In which school and which grade are you currently registered	
What is your home language (English, Afrikaans, Xhosa, etc.)?	Xhosa

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (~~Computer~~, Torso or Picture) and WHY?

Computer: Because it make you concentrate easily so that it can be easy for you to learn and write

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It doesn't take long for you to realize that you can learn fast with this program.

2- You get answers and then you get questions. so this type of programme is easy and everyone can learn it easy

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- I think to make things easier Computers should be allocated to many schools so that they could be beneficial through this program.

2- People should buy themselves computers and place all their studies in the computer. I think every body would be privileged by this kind of information.

Name or Nickname	THERESA
Are you male or female	FEMALE
In which school and which grade are you currently registered	UCT
What is your home language (English, Afrikaans, Xhosa, etc.)?	SESOTHO

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Computer because nowadays learning is ~~shifted~~ mostly on using computers and I find computers quite exciting; hence nice to work with.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- Not sure; can't really say.

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Extensive use of computers and any other models to help pupils understand what they read from books.

2-

Name or Nickname	Arshiya Ismail
Are you male or female	female
In which school and which grade are you currently registered	Idamia College gr 10.C.
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Picture - It was (big) and had to be ~~more~~ clear
The (colour) also attracted me
It was (not very complicated).
It was already (labelled) not like the Torso.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- (colour)

2- (Clarity / Size)

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- ~~Add~~ colour and enlarge for better clarity

2- It is better to be able to see things that are being taught.

Name or Nickname	Tazz
Are you male or female	female
In which school and which grade are you currently registered	Idamia College 10E
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Picture because it helps me remember all the parts so I can explain everything about it.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- The lecture and the diffrent ways to learn.

2- It was fun and enjoyable.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- wine should have diffrent ways to do the task eg: computer, Torso and Pictures.

2- when we get work we should learn and then be given a test.

Name or Nickname Taz (1)	Taz (1)
Are you male or female	Female
In which school and which grade are you currently registered	Islamia College
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

I chose the Picture Programme, because the labels were large and the drawing was very clear.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- There was no lecturing and no explaining, it was just straightfoward and enjoyable.

2- It was also enlightening.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- I suggest that learning should involve less explaining and more practical excercises.

2- Students should find out more about the subject, by going outdoors and exploring the actual subject.

GRADE 12 'A'

Name or nicname	GXOWA PHINDILE
In which school are you currently registered	OSCAR MPETA HIGH
Are you male or female	MALE
What is your home language (English, Afrikaans, Xhosa, etc.)	XHOSA
Choice of the programme (Torso, Pictures, Computer)	PICTURES

COMMENTS ON THE TEACHING METHOD

A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME

1- The picture is not specifically clear but the lecturer explained everything.

2- It tries to teach us to be quick understanding the parts of the body.

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Giving myself a chance to concentrate on it and try not to rush when I'm studying each part and try to make sure that before I pass each section I clearly understand it.

2- Asking if I don't understand will help the teaching and also expecting to see more pictures so that I should be clear eg I might have a problem with human structure but need to concentrate on the stomach. I need the stomach picture.

→ It gives me enough information on what I am learning.

Name or nicname	Zanele
In which school are you currently registered	Oscar Mpetha
Are you male or female	female
What is your home language (English, Afrikaans, Xhosa, etc.)	Xhosa
Choice of the programme (Torso, Pictures, Computer)	Pictures

COMMENTS ON THE TEACHING METHOD
A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME
1- I like it because it teach us about our body and it give us information about our parts of digestive system now we know what is in our body

2-

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS
1- To give the information to the people that they dont know about it to the school or outside of the school toal studen that they dont understand the biology mayke it will improve that way

2-

→ I choose the Picture because it is the easy way to me to know about it in picture I see clear..

Name or Nickname	Ismail
Are you male or female	male
In which school and which grade are you currently registered	Islamia grade 8
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Picture: why I've chosen this was because it looks more clear than a computer or model. an was the largest to look at.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- The teacher and what he taught us and was very educational.

2- It was a free period

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Teachers must take more interest in their students and give equal attention.

2-

Name or Nickname ~~Ke~~	Katie
Are you male or female	Female
In which school and which grade are you currently registered	U.C.T
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Picture ~~not too confusing~~, easy to make out body parts.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- Good general knowledge! Important to know about the digestive system too.

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Nothing – they were very appropriate.

2-

Name or Nickname	SUNFLOWER
Are you male or female	FEMALE
In which school and which grade are you currently registered	ISLAMIA COLLEGE IN GRADE 8
What is your home language (English, Afrikaans, Xhosa, etc.)?	ENGLISH & [redacted].

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

I choose the Torso because it is more interesting. You get to pull out the body ornaments which was so cool.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was not for marks.

2- ~~We~~ They used models to show us how it really looks inside, etc.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Teaching should be fun.

2- Teachers should use models.

Name or Nickname	Suhail (Tama Bham)
Are you male or female	Male
In which school and which grade are you currently registered	Islamia Grade: 8C
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Torso Because it shows the exacte way the organs are and which one's they lead into and way it is situated. And 3D is more comfortable for me.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- The teacher, the way he taught first we wrote what we generally knew then from our mistakes we learnt.

2- It was intresting and educational and it gave us a more of a intresting look at the digestive system.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- The Take children to live clinic and actually show them how it functions and how it moves and works.

2- Let us communicate to the teacher and other students to tell them what you have learnt and if they think you must still study further then you should do so.

Name or Nickname	Mahdi
Are you male or female	male
In which school and which grade are you currently registered	Islamia College : 8c
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Torso, because you can understand the plastic organs if the teacher explains it to you and you can in reality know where the organs come in.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- The teacher, he explained it accurately and we learned alot by our mistakes

2- The model with the plastic organs is really realistic with the organs and all.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- To get more teachers to know about the internal organs. The Teachers should talk more about the subject.

2- To get more models for the teachers to explain. Their should be research done by the students.

Name or Nickname	Naseema Dhansay
Are you male or female	Female
In which school and which grade are you currently registered	Salamia High School Gr. 8.
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

I choose because there is more physical involvement in the programme.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- I've learnt something new today. Hardly knew anything about the digestive system. because I

2- I've also learnt about the different parts in the system.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Go into detail with the explaining. Describe each part in the digestive system whole individually which will broaden our knowledge.

2- —

Name or Nickname	Farzaanah Ahmed
Are you male or female	Female
In which school and which grade are you currently registered	Islamia College (8E)
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Torso, It was much easier because you could touch lift and visually see the shape and size of the particular parts of the body

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was nice to be able to seperate the diffient sections of the body.

2- It was nice because it was something diffient and interesting.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- They could use Book material as a guide for some pupils.

2- Movie videos where they fisically seperate the individual parts of the body.

Name or Nickname	MILKY
Are you male or female	FEMALE
In which school and which grade are you currently registered	ISLAMIA COLLEGE, GRADE 8
What is your home language (English, Afrikaans, Xhosa, etc.)?	ENGLISH

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Torso because I could take out the different parts and feel it so I could remember it better.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was fun, we didn't just sit there and learn, we could take part in the learning.

2- It was nice to see how much you can learn in 1 period by just using more exciting methods

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- In the torso they could make the parts more real. eg. the heart could be squishy and the intestines soft e.t.c.

2-

Name or Nickname	Zahirah
Are you male or female	female
In which school and which grade are you currently registered	Grade 8
What is your home language (English, Afrikaans, Xhosa, etc.)?	English.

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Torso, because you can see where the certain parts of the body is situated eg. Behind or infront etc. of something

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- You learn more about your body.

2- What that certain part of your body does. What its functions are.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- To have things that we could touch & see & figure out for our selfs

2- To test use regularly & to see if we are learning.

Name	Taryn
Surname	Odaere
In which school are you currently registered	UCT
Are you male or female	Female
What is your home language (English, Afrikaans, Xhosa, etc.)	English
Choice of the programme (Torso, Pictures, Computer)	Torso

COMMENTS ON THE TEACHING METHOD

A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME

1- Hands-on (each part can be removed & put back

2- Three-dimensional model to teach with

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Labels should be small enough to pin on to each area perhaps.

2- May try starting with all parts dis-assembled & tell pupils to figure out how they fit together.

Name or nicname	Dopey
In which school are you currently registered	UWC
Are you male or female	♂
What is your home language (English, Afrikaans, Xhosa, etc.)	Eeengliish
Choice of the programme (Torso, Pictures, Computer)	Torso

COMMENTS ON THE TEACHING METHOD

A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME

1- (Great) model — shows (3-D) — much more meaningful / interesting than 2-D ~~+~~ closer to reality.

2- Good to share own ideas - 1st — sets up an interest in seeing what I've answered correctly

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- More time (& perhaps some motivation) to play around with the model/torso

2- Identify the parts on ~~a~~ own body too - See what parts are near the surface & where → links to real body — real life

Name or Nickname	"Shakes" (Shaakirah)
Are you male or female	Female
In which school and which grade are you currently registered	Islamia College (Grade 11d)
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Torso - I understand more about ~~the~~ the system because it is exciting and it definitly boosts up ~~my~~ ~~me~~ knowledge.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- Easy understanding and It is very educational. looking at a 3-dimensional structure.

2- It brings excitement in me and it makes me feel more enlightened and intellegent.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- There is enough improvement and nothing to suggest about the teaching materials

2-

Thank you
Mohamed.

Name or Nickname	Aaliyah
Are you male or female	female
In which school and which grade are you currently registered	Grade 11
What is your home language (English, Afrikaans, Xhosa, etc.)?	English

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Torso - I felt that I needed to know more about the body and where are different parts of the body situated made me more aware).

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- The torso the most as it was a model that you could touch and handle with ease and it was easily accessable

2-

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- That the torso should be a full body one then it will be more interesting and worth looking at to improve one's knowledge on how the body really functions.

2-

Name or Nickname	Hayleng
Are you male or female	Female.
In which school and which grade are you currently registered	Hamilton College
What is your home language (English, Afrikaans, Xhosa, etc.)?	English.

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

Torso: I learn (easier) from plastic structures.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- It was (interesting) and (informativ)

2- (It brings out your memorization skills)

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- Plastic structures should be mor used more often ;so that learn can be fun and not boring.

2- The school should purchase more teaching materail

GRADE 12(C)

Name or nicname	Nosibho
In which school are you currently registered	Oscar Mpetha
Are you male or female	Female
What is your home language (English, Afrikaans, Xhosa, etc.)	Xhosa
Choice of the programme (Torso, Pictures, Computer)	Torso

COMMENTS ON THE TEACHING METHOD

A- WHAT I LIKED ABOUT THE INSTRUCTIONAL PROGRAMME

1- I like the the way they teach. They are teaching us to know the thing at the same time. We leaned to be quick and write the things you know. I liked their pictures and Turso.

2- I enjoyed the everthing they were teaching us.

B- WHAT I SUGGEST TO IMPROVE THE TEACHING MATERIALS

1- They must go to more school and have more material so that they can reach other students. We as student want to have more people and more material. But (I got learn now) I know the human body than I ever know.

why Torso?

2- I choosed Torso because It shows me an example and I can handle it an see what I want to see. The torso have some parts that can be removed so I can se exactly where the place is (as) abbendix, accending colon and the Anus.

Name or Nickname	RABIA MAZEMA (ANONYMOUS)
Are you male or female	FEMALE
In which school and which grade are you currently registered	ISLAMIA COLLEGE GRADE 10
What is your home language (English, Afrikaans, Xhosa, etc.)?	ENGLISH

COMMENTS ON INSTRUCTIONAL PROGRAMMES

A- WHICH PROGRAMME DID YOU CHOOSE (Computer, Torso or Picture) and WHY?

PICTURE - COLOURFUL PICTORAL GUIDES ALLOW ONE TO INVISAGE THE INTERNAL ANATOMY OF THE BODY, MORE EASILY THAN USING THE IMAGINATION.

B- WHAT DID YOU LIKE ABOUT THE INSTRUCTIONAL PROGRAMME

1- THEY WERE SIMPLE OR RATHER EASILY UNDERSTANDABLE YET STILL EXPLICIT.
THE VIVID COLOURS AND DETAIL AROUSED ENTHUSIASM.

2- THE INSTRUCTOR WAS A PLEASURE TO WORK WITH AND VERY PLEASANT.

C- WHAT DO YOU SUGGEST TO IMPROVE THE TEACHING MATERIALS

1-

2- NO IMPROVEMENTS NECESSARY - WELL DONE!

APPENDIX D

FEEDBACK "EVALUATIONS REPORTS"

No.1

1.1. Report of success (12. 11. 1998)

The pilot study was conducted with ten volunteer 11-12 years old pupils at St. Augustine's R.C. Primary School on Thursday November 12, 1998 using three instructional programmes for teaching the names of eight parts of the digestive system.

1.2. School:

St. Augustine's R.C. Primary School is a school with in the Department of Education and Training in Wynberg, Cape Town. The majorities of the pupils at St. Augustine's R.C. Primary School are from a lower socio-economic background and speak English, Afrikaans, and Xhosa as their languages. It is a mixed school with an enrollment of 850 pupils.

1.3. Sample:

A randomly selected 11-12 years old 10 pupils (N=10) from Mr. Valentine's classroom in the St. Augustine's R.C. Primary School; 5 of them were boys, 5 were girls, all English speaking.

1.4. Duration:

Administration of the pilot study took 40 minutes.

Pre-test time took 8 minutes. It was composed of eight completion items to label on a black and white picture of the human digestive system.

Orientation procedure time took 16 minutes.

Interventions:
Torso with eight labels: 5 minutes.
Coloured picture with eight labels: 3 minutes.
Computer graphic with eight labels: 8 minutes.

Post-test time took 4 min. It was composed of eight completion items to label on a black and white picture of the human digestive system.

1.5. Instructional methods chosen:

1- Picture of digestive system: One girl preferred the picture as the medium of instruction

2- Torso: 2 boys preferred the torso as the medium of instruction.

3- Computer: 4 girls, 3 boys preferred the computer graphic as the medium of instruction.

1.6. Procedure:

Firstly, Mr. Valentine, teacher of the pupils, introduced me to the pupils. We greeted each other and spoke about school. Mr. Valentine explained the importance of the study, but that it was not for marks.

I mentioned about the purpose and procedure of study (tests, instructions)

We gave the pre-test that consists of 8 items to label and we explained that they would label if they knew. If not, it didn't matter. They labeled the items themselves. It took 8 minutes.

After finishing the Pre-test, all pupils went outside the classroom to choose one of three instructional programmes on offer.

We organized the three instructional programmes separately on desks: torso, colour picture and computer graphic.

Pupils came inside in pairs, saw, and investigated the programmes, talked with each other, chose one of them. According to their choices, we organized pupils as groups.

According to their groups, I delivered instructions and then they practiced and labeled the eight parts of the digestive system themselves. They were excited about their participation in the exercise.

After finishing the instruction section, the pupils spoke about their achievements. They looked like very happy. It took 16 minutes totally.

Finally, We gave the post-test as re-test. They labeled the test. It took 4 minutes.

1.7. Results and Observations

This pilot study proved successful with the generous assistance and co-operation of the teacher, Mr. Valentine Nefdt, in the St. Augustine's R.C. Primary School.

Pairs of students were conducted through the experimental pre-test / orientation / instructional intervention / post-test programme which lasted for 40 minutes.

The pre-test took 8 minutes. It comprised eight completion items to be labeled on a black-and-white picture of the human digestive system. Pilot study pre-test scores averaged 2.8 out of 8.

Orientation of the participant students to the three different instructional intervention options available took 16 minutes.

Typically, the times taken for completion of the three different intervention treatments were:

Torso with eight labels: 5 minutes.
Coloured picture with eight labels: 3 minutes.
Pentium computer graphic with eight labels: 8 minutes.

The post-test duration was typically 4 minutes. It comprised eight completion items to be labelled on the pre-test black-and-white picture of the human digestive system provided.

To date the pilot study trial conducted with English / Afrikaans students in one economically depressed suburb of Cape Town found that 70% of the student participants chose the Pentium computer graphic as their preferred instructional method; 20% of the students opted for the Torso as their preferred teaching strategy; and only 10% of the sampled students preferred a hand-held coloured picture of the human digestive system as their instructional medium of free choice. All students who took part in, the exercise expressed excitement and eagerness to participate in the investigation, and all expressed pleasure in the final outcome, namely, that their pre-test scores all improved. Some students' achievement scores increased by one mark out of eight. Other students' scores increased by as much as six marks out of eight, e.g. from 2/8 to 8/8 using the Pentium, during the 40-minute period assigned for the experiment.

This pilot study served to identify and correct some of the problems when conducting the research, namely the need for clear instructions and the need for pupils to give their ideas about the working of study.

It also indicated that needed for another study using larger and mixed groups in order to be able to carry out statistical tests.]

No: 2

2.1. Report of success (17. 2. 1999)

The pilot study trial was conducted with five volunteer adult students at university of Cape Town on Wednesday February 17, 1999 using three instructional programmes for teaching the names of sixteen parts of the digestive system.

2.2. Sample:

A randomly selected adult students (N=5) from Prof. Rochford's science education HDE group at the school of education at UCT; 1 of them was boy, 4 were girls, all English speaking.

2.3. Duration:

Administration of the pilot study took 23 minutes.

Pre-test time took 9 minutes. It was composed of sixteen completion items to label on a black and white picture of the human digestive system.

Orientation procedure time took 9 minutes.

Interventions:
Torso with sixteen labels: 2 minutes.
Coloured picture with sixteen labels: 3 minutes.
Computer graphic with sixteen labels: 4 minutes.

Post-test time took 5 min. It was composed of sixteen completion items to label on a black and white picture of the human digestive system.

2.4. Instructional methods chosen:

1- Picture of digestive system: Two girls preferred the picture as the medium of instruction.

2- Torso: 1 girl preferred the torso as the medium of instruction.

3- Computer: 1 girl, 1 boy preferred the computer graphic as the medium of instruction.

2.5. Procedure:

Firstly, Prof. Rochford introduced me to the students and explained the importance and aim of the study.

I mentioned about the purpose and procedure of study (tests, instructions).

I gave the pre-test that consists of 16 items to label and I explained that they would label if they knew. If not, it didn't matter. They labeled the items themselves. It took 9 minutes.

After finishing the Pre-test, all students chose one of three instructional programmes on offer.

I organized the three instructional programmes separately on desks: torso, colour picture and computer graphic.

Students saw, and investigated the programmes, chose one of them.

According to chosen programmes, I delivered instructions and then they practiced and labeled the sixteen parts of the digestive system themselves. They were excited about their participation in the exercise.

After finishing the instruction section, the students thought about their achievements. They looked like very happy. It took 9 minutes totally.

Finally, I gave the post-test as re-test. They labeled the test. It took 4 minutes. At the back of post-test there was questionnaire about study. They filled the questionnaire and write their comments.

2.6. Results and observations

To date the second pilot trial conducted with students in Cape town found that 40% of the student participants chose the Pentium computer graphic as their preferred instructional method; 20% of students opted for the Torso as their teaching strategy; and 40% of the sampled students preferred a hand-held coloured picture of human digestive system as their instructional medium of free choice. According to their comments, all students who took part in the exercise expressed excitement and eagerness to participate in the investigation and all improved. And also according to their comments I changed procedure of application and instructions and also components of the digestive system, which I teach. Some students' achievement scores increased by three or marks out of sixteen. Some students' scores increased by much as ten or eleven marks out of sixteen, e.g. from 1/16 to 16/16 using the Pentium, during the period assigned for the experiment.

No:3

3.1. Report of success (10. 3. 1999)

The pilot study trial was conducted with 21 volunteer scondary school students at Star International High School on Wednesday march 10, 1999 using three instructional programmes for teaching the names of sixteen parts of the digestive system.

3.2. Sample:

A randomly selected secondary scholl students (N=21) from Mr. Inal' classroomin Star International high school; all of them were boys. It was boys high school in Athlone, some of them are English speaking , some afrikaans speaking.

3.3. Duration:

Administration of the pilot study took 80 minutes.

Pre-test time took 25 minutes. It was composed of sixteen completion items to label on a black and white picture of the human digestive system.

Orientation procedure time took 35 minutes.
Interventions:
Torso with sixteen labels: 14 minutes.
Coloured picture with sixteen labels: 11 minutes.
Computer graphic with sixteen labels: 10 minutes.

Post-test time took 20 min. It was composed of sixteen completion items to label on a black and white picture of the human digestive system.

3.4. Instructional methods chosen:

1- Picture of digestive system: 5 boys preferred the picture as the medium of instruction.

2- Torso: 10 boys preferred the torso as the medium of instruction.

3- Computer: 6 boys preferred the computer graphic as the medium of instruction.

3.5. Procedure:

Firstly, I divided students into two groups as ten and eleven.

I explained the importance and aim of the study.and not for marks.to each group.

I mentioned about the purpose and procedure of study (tests, instructions).

I gave the pre-test that consists of 16 items to label to each group seperately and I explained that they would label if they knew. If not, it didn't matter. They labeled the items themselves. It took 25 minutes totally.

After finishing the Pre-test, all students chose one of three instructional programmes on offer.

I organized the three instructional programmes separately on desks: torso, colour picture and computer graphic.

Students saw, and investigated the programmes, chose one of them.

According to chosen programmes, I delivered instructions and then they practiced and labeled the sixteen parts of the digestive system themselves. They were excited about their participation in the exercise. After finishing the instruction section, the students thought about their achievements. They looked like very happy. It took 35 minutes totally.

Finally, I gave the post-test as re-test. They labeled the test. It took 20 minutes. At the back of post-test there was questionnaire about study. They filled the questionnaire and write their comments.

3.6. Results and observations

To date the third pilot trial conducted with students in Cape town found that 28% of the student participants chose the Pentium computer graphic as their preferred instructional method; 48% of students opted for the Torso as their teaching strategy; and 24% of the sampled students preferred a hand-held coloured picture of human digestive system as their instructional medium of free choice. According to their comments, all students who took part in the exercise expressed excitement and eagerness to participate in the investigation and all improved. Some students' achievement scores increased by three or four marks out of sixteen. Some students' scores increased by much as ten or eleven marks out of sixteen, e.g. from 1/16 to 16/16 using the Pentium, during the period assigned for the experiment

The averages of post-test results according to students choices are like these: Computer: 4.33, Picture: 4 and Torso: 3.7

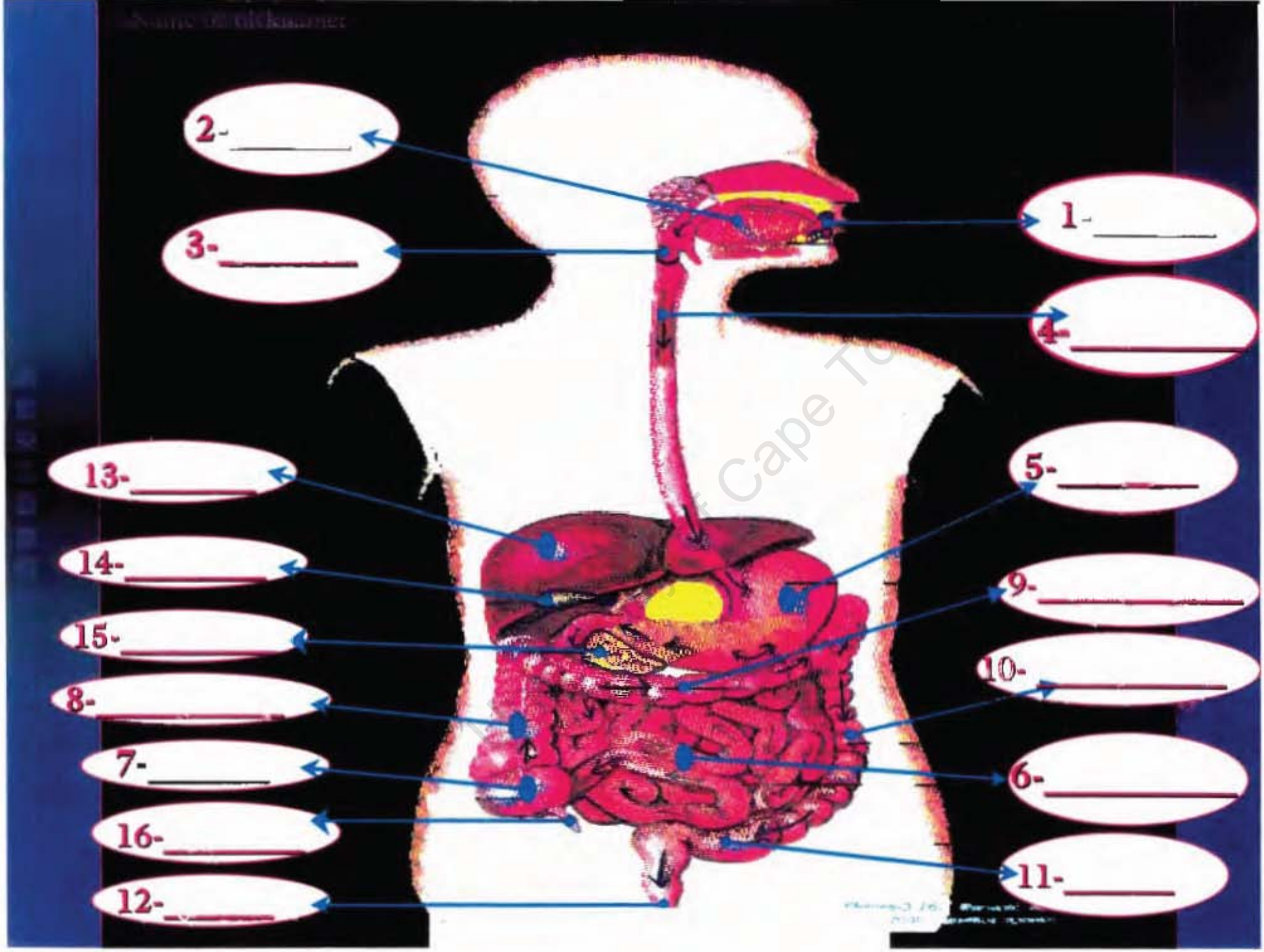
Actually it seems there is no significant differences in achievement scores but it obviously shows if carries out with larger samples there will be significant differences in their achievement scores on tests.

Conclusion

It appears, from pilot studies carried out, that there might be some significant differences in the students' test scores. Clearly this pilot study will produce results that are more definite if carried out with larger and mixed groups and also at different levels.

Trials of three samples of students in 1998 and 1999 indicate that it is successful in appreciably increasing students' scores on tests on human physiology; and the investigation is continuing with larger samples in Cape Town.

APPENDIX E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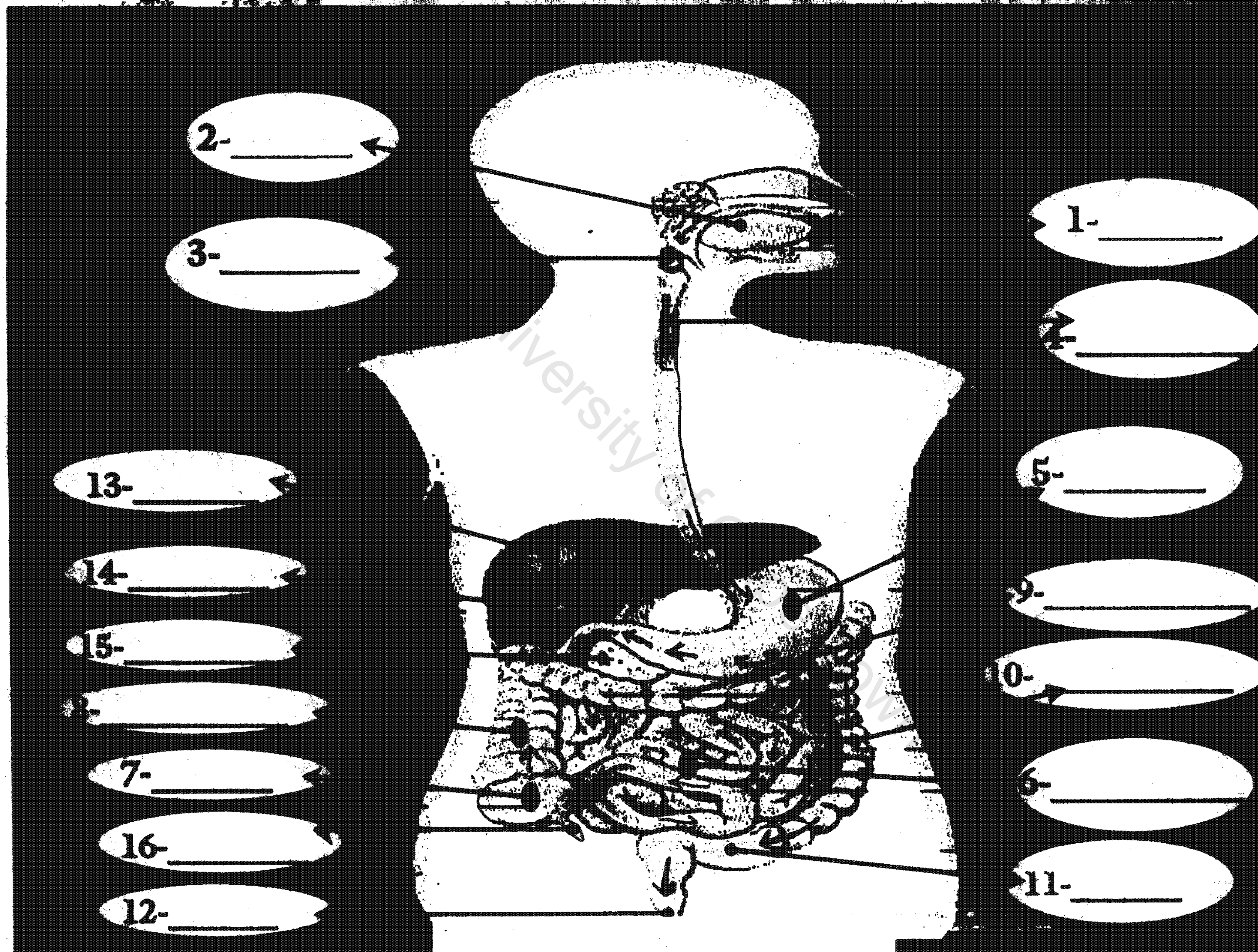
APPENDIX F



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