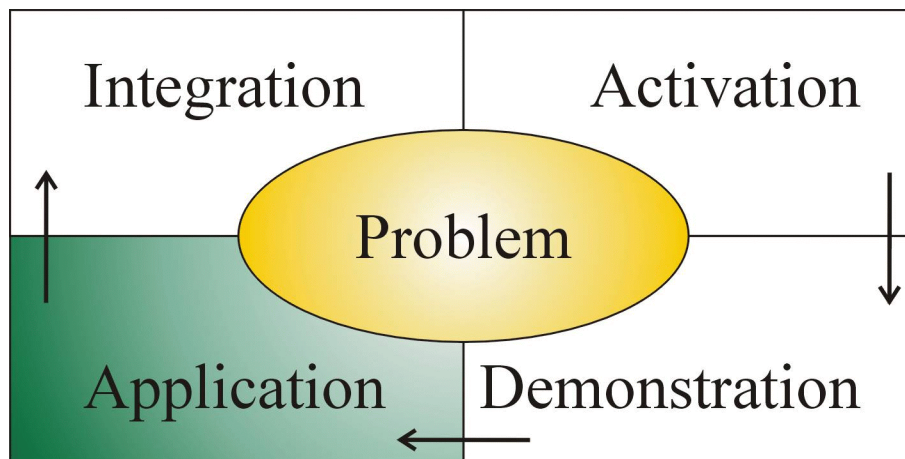# Chapter 4 - Application

"**Learning is best when there is a series of problems to solve and when coaching is gradually withdrawn for each successive problem.**"

(Merrill, 2001, p.7)

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Chapter 4

Chapter 4 – Application

4.1 Introduction

This chapter provides an overview of the formative evaluation of the multimedia program for Nutritional Assessment. The aim of the evaluation was to obtain feedback from students and the course lecturer about the program and to obtain answers to the following research questions:

1. What is the role of a real-life **Problem** in a digital learning environment?
2. What is the importance of **Activation** of relevant experience or existing knowledge?
3. How successful can **Demonstration** be in a digital learning environment?
4. How significant is the **Application** of the new knowledge under guidance in a digital learning environment?
5. Is effective **Integration** of new knowledge possible in a digital environment?

4.2 Summative versus Formative Evaluation

Regardless of the design model or design process used, instructional software should be evaluated and tested before it is used in a classroom situation.

According to Lippert, the evaluation stage in the design and development process appears to be one of the most neglected facets of the instructional design and development process (as quoted in Strehler, 1994, p. 96).

4.2.1 Summative evaluation

Summative evaluation is the evaluation done at the end of the program development after all revisions are completed. It is by no means the final step in the development of a program. After the implementation of any instructional software, user feedback should be obtained and the program revised. This form of evaluation falls outside the scope of this project.

4.2.2 Formative evaluation

Formative evaluation, also called pilot testing, field testing or usability testing, is the evaluation of the program using representatives of the target population, while it is still being developed. While members of the target population use the program they are being supervised and observed by both the developer and designer, or by one of the two. The observers search for answers to questions like "What is working?, What needs to be improved? and How can it be improved?" (Worthen and Sanders, 1987, as quoted by Reigeluth, p. 636)

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According to Alessi and Trollip (Alessi & Trollip, 1991, p.379) pilot testing is a seven-step process:

Step 1 - Select the helpers
Step 2 - Explain the procedure to them
Step 3 - Find out how much of the subject matter they already know
Step 4 - Observe them through the lesson
Step 5 - Interview them afterwards
Step 6 - Assess their learning
Step 7 - Revise the lesson

4.3   Quantitative versus Qualitative Research

From Alessi and Trollip's steps it is fairly clear that the formative evaluation process relies heavily on observation and on the individuals who take part. It is therefore a qualitative rather than a quantitative process. The distinction is explored by McMillan and Schumacher,

At one level, quantitative and qualitative refer to distinctions about the nature of knowledge - how one understands the world and the ultimate purpose of research. On another level of discourse, the terms refer to research methods - how data are collected and analysed - and the type of generalisations derived from the data.

(McMillan & Schumacher. 1993. p. 14)

In table 4.1 an attempt is made to place the methods used in the study into the research categories, as defined in McMillan & Schumacher (1993. p. 14).

	Category	Quantitative research	This project	Qualitative research
1.	Assumptions	Assumes that there are **facts** that can be separated from feelings and the beliefs of individuals.	Assumed that each individual student would experience the multimedia tutorial in her own way.	Assumes that there are **multiple realities** that are defined by individuals and cultures.
2.	Research Purpose	Tries to explain causes and establish relationships.	Tried to explain the responses of the students to the tutorial.	Tries to understand social phenomena.
3.	Research Methods	Has established steps and procedures.	Used more than one method of data gathering.	Offers great flexibility in methods.
4.	Typical Studies	Uses experimental or correlational designs to reduce bias and error.	Took into account the subjectivity of the target group that was observed.	Tries to control bias through design and takes into account subjectivity in data analysis and interpretation.
5.	Researcher Role	Needs a detached observer.	Made use of disciplined subjectivity.	Makes use of disciplined subjectivity.
6.	Importance	Attempts to establish universal context-free generalisations.	Developed context-bound generalisations.	Develops context-bound generalisations.

Table 4.1 - Differences between quantitative and qualitative research

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The differences between quantitative and qualitative research are summarised in table 4.2 below.

Quantitative research:	Qualitative research:
• aims to test theories; • determines facts; • needs a representative sample; • results are statistically analysed; • demonstrates relationships between variables; • aims to fulfil predictions; • seeks to establish relationships and explain causes of changes; • uses established set of procedures; • controls for bias through design; • collects data using an instrument; • tries to establish universal context-free generalisations.	• aims to develop theories; • aims to facilitate understanding; • increases insight; • promotes better self-understanding; • aims to understand the social phenomenon from a particular perspective; • does not need a representative sample; • uses flexibility in methods and in the research process; • takes into account subjectivity in data analysis and interpretation; • data needs to be collected by skilled, prepared persons; • develops context-bound generalisations.

Table 4.2 - Quantitative research vs qualitative research

4.4 Collecting the Data

Step 1 - The helpers

The target population for the final program are the dietetics students enrolled for the Nutritional Assessment modules (NTA 311, NTA 312, NTA 321 and NTA 322). The students enrolled for the courses Nutritional Assessment courses (DTE 310 and DTE 321) in 2001 were chosen for the formative evaluation. These 25 students had completed the course, but had not yet written their final examination in the two courses. All were female, the average age was 22 years (the youngest of the group 20 years old, the oldest 30 years) and most of them were Afrikaans-speaking.

Step 2 - The procedure

It was explained to the students that their testing of the program was a formative evaluation of the program, i.e. the development of the program was not yet complete; some pages, photos and videos were still missing and there might be technical problems.

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The procedure was as follows:

- The program was installed on the computers in the computer laboratory on the medical campus.

- The students had to sign a consent form to participate in the evaluation (Appendix C).

- The students were then given an hour to test the program.

- After an hour they were given a questionnaire to complete (Appendix D).

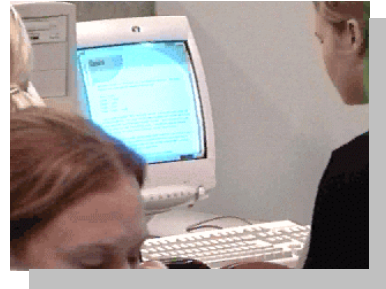- The evaluation was concluded with a group discussion.

Figure 4.1 - Students in the computer lab

Step 3 - Knowledge of subject matter

Since the program was tested about two weeks before the final examination of the students, their knowledge of the subject matter was assumed to be good.

Step 4 - Observation of the students during their testing of the program

Ms Friede Wenhold (the lecturer and the subject matter expert), Ms Henriëtte Wolmarans (the designer) and Ms Helga Nordhoff (the researcher) observed the students while they were using the Anthropometry tutorial. All three observers were available to answer questions and to assist students as required. The students were requested **not** to ask for help from their fellow students so that the observers would be aware of all problems encountered.

Step 5 - Interview afterwards

The opinions of the students was gathered through a questionnaire (Appendix D) and after that they had an opportunity to share their views and express their opinions in a group discussion. The group discussion was captured on video for record-keeping purposes and to enable the observers to review the opinions expressed by the students.

Step 6 – Assessing the learning

No formal assessment of the learning was done, since it was assumed that the students knew the course material. The researcher accepts Clark's (1994) conclusion that media do not influence learning and Russel's (1999) contention that there is no significant difference between the performance of students who use different media. The students were however asked two questions about their own learning in the questionnaire.

Step 7 – Lesson revision

No lesson revision was done. The students who used the prototype had completed the course and it was assumed that they were familiar with the content of the course. Further testing was beyond the scope of this study.

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4.5 Discussion of the Findings

The designer concentrated her observations on the technical problems of the program, i.e. on navigation that did not work, on places where the program failed, and on why students needed assistance. During the evaluation she mentioned that she never realised how much could be learned from just watching students use a program.

The lecturer concentrated her observations on content-related problems experienced and answered questions in this regard.

The researcher observed both the technical problems and the content-related problems, as well as the interaction between the students and between student and program.

Although the students were requested to refrain from asking their fellow students for help, most of them checked what their neighbours were doing or tried to find out from a neighbour how to get to a certain screen. After approximately 45 minutes, the students started to get restless; they talked to their neighbours and a few quickly checked their e-mail. This was taken as an indication that they wanted to continue with the more formal part of the evaluation and the questionnaire was handed out.

Figure 4.2 - Students using the prototype

The questions in the questionnaire were grouped to supply answers to the following:

- The student's impressions about the "look and feel" of the program.

- Navigation within the program.

- The student's impressions about the subject matter in the tutorial.

- The possible use of the program.

- General opinion about the program.

- The computer literacy of the students.

Questions 41 - 44 were open questions giving the student the opportunity to mention something that she liked or disliked, which might not have been addressed by any of the other questions.

The number of responses to each question is given together with the question in Appendix D.

The findings are discussed below under the **Problem** and Merrill's four phases of instruction, **Activation**, **Demonstration**, **Application** and **Integration** and under the subheadings: Observations, Questionnaire, Open questions and Group discussion. The figures that follow give graphical representations to relevant answers from the questionnaire.

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For most questions the students had four choices:

'I strongly agree', 'I agree',

'I disagree' and 'I strongly disagree'.

The legend for the graphs is shown in the figure on the right.
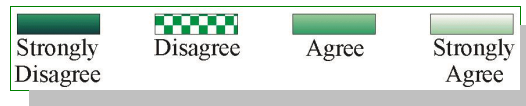
Figure 4.3 - Legends for graphs

4.5.1 Problem

From the observations

Only a few students attempted to solve one of the two case studies in the program because most did not read the introductory screen and did not know what was expected of them.

From the questionnaire

The two case studies presented in the program were perceived as real-life problems. Nineteen of the 25 students (76%) that indicated that they would like to have more case studies in the program. Seven felt strongly about this, although only a few students actually attempted to solve one of the two case studies given.
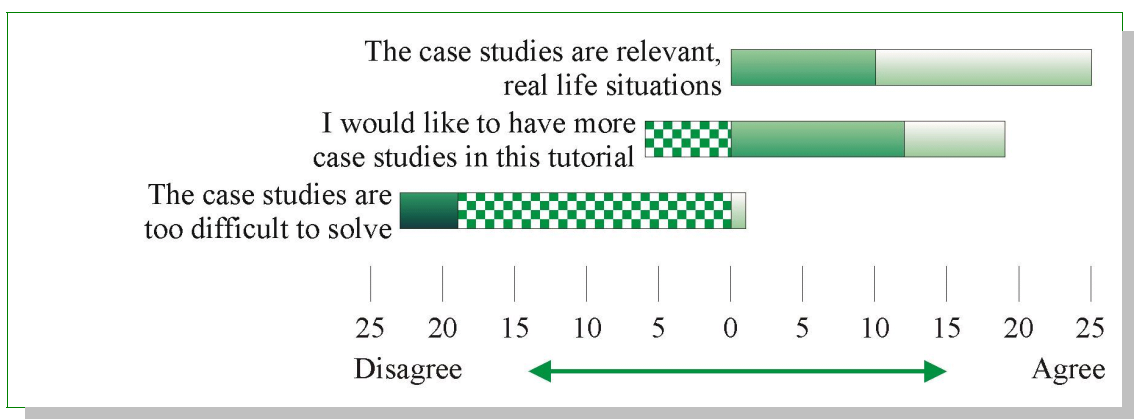
Figure 4.4 - Answers to the questions about the case studies in the program

4.5.2 Activation

The findings about the activation of pre-knowledge as well as the navigation within the program will be discussed, although navigation problems influenced the activities in all four of Merrill's phases.

From the observations

After the first five minutes it was clear that none of the students had opened the Introduction screen of the tutorial. The basic working of the program is explained in the introduction and since they could not get back to the first screen, most of them did not know what to do. It took a while before they realised what was expected of them.

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From the questionnaire

First impressions and the look and feel of a program form a valuable part of the gaining of attention and activation of existing knowledge phase. Most of the students (84%-96%) liked the colour scheme and thought that the quality of the photos and videos were good (96%). Their responses are summarised in the graph below.

The prototype had no sound, since it is easy to add later and the designers were under severe time pressure to get the prototype ready for the date set for the formative evaluation.

Interestingly, nearly half (44%) of the students indicated that they would not like any background sound, but 64% expressed a preference for some verbal explanations.
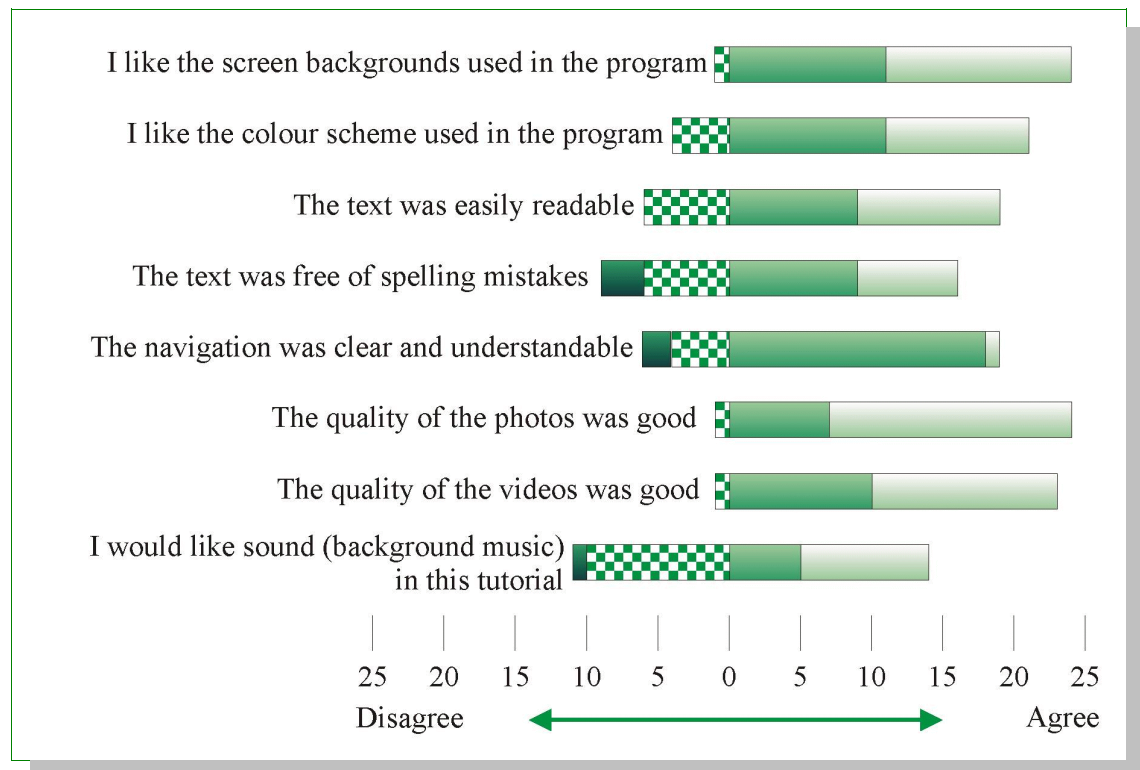
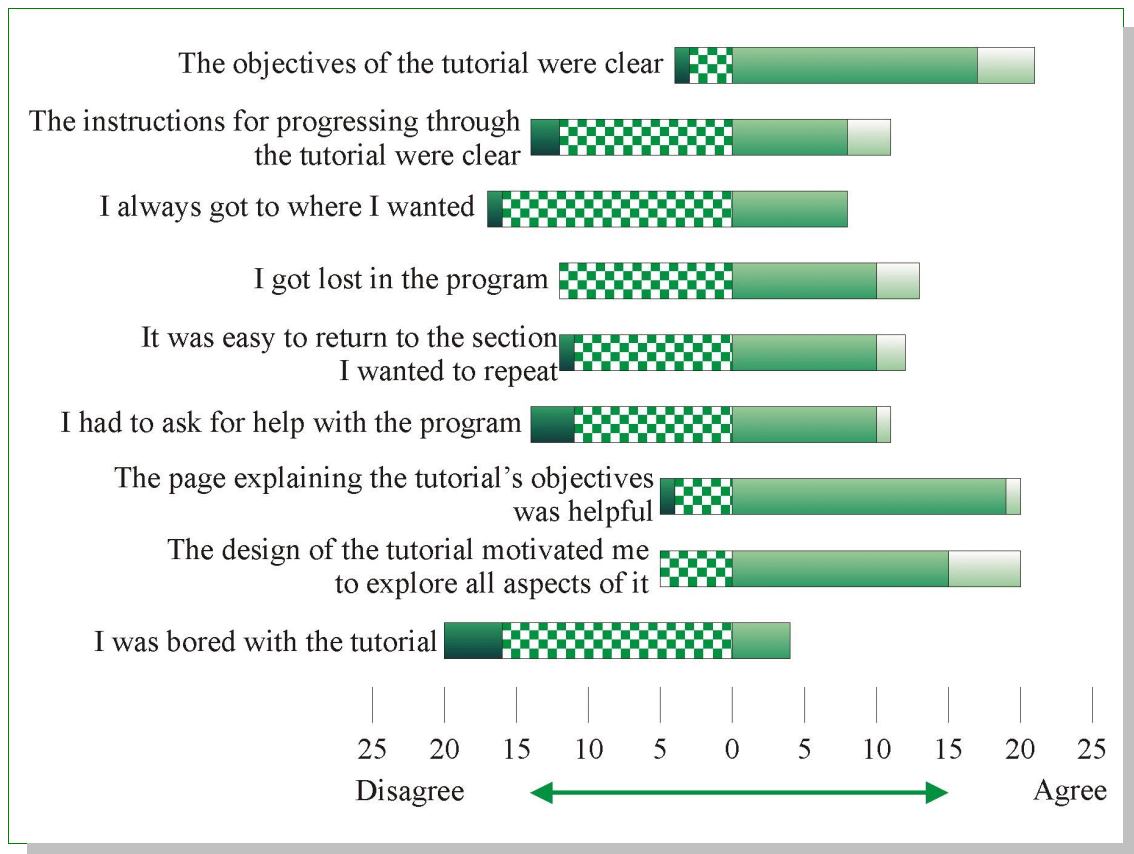Figure 4.5 - Responses of students to questions about the look and feel of the program

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Figure 4.6 - Responses of students to questions about the navigation within the program

From the open questions

The main complaint about the program was that the navigation was not clear, that they got lost or could not go back to where they wanted to be (50%).

From the group discussion

It became clear during the group discussion that the students thought that the navigation in the program should be improved. They particularly requested a more web-like navigation as well as a search facility and a hyperlinked index.

4.5.3 Demonstration

From the observation

The students seemed fascinated by the photos and videos, which explained the different measuring and evaluation techniques and attempted to fill gaps in their own existing knowledge about the measuring techniques.

While observing the students the lecturer realised that there were mistakes in some of the photographs showing measuring techniques. Some students noticed this as well and remarked that now that they had seen the incorrect procedure they understood how it should not be done.

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From the questionnaire

Generally the students responded positively to questions about the content, amount and quality of information. As mentioned above, they were particularly impressed with the photos and videos which explained the different measuring techniques as well as the fact that most of the resources they needed were available in the program. Since the students had just completed the course, they were in a good position to evaluate the content as well as the amount of information presented in the tutorial.
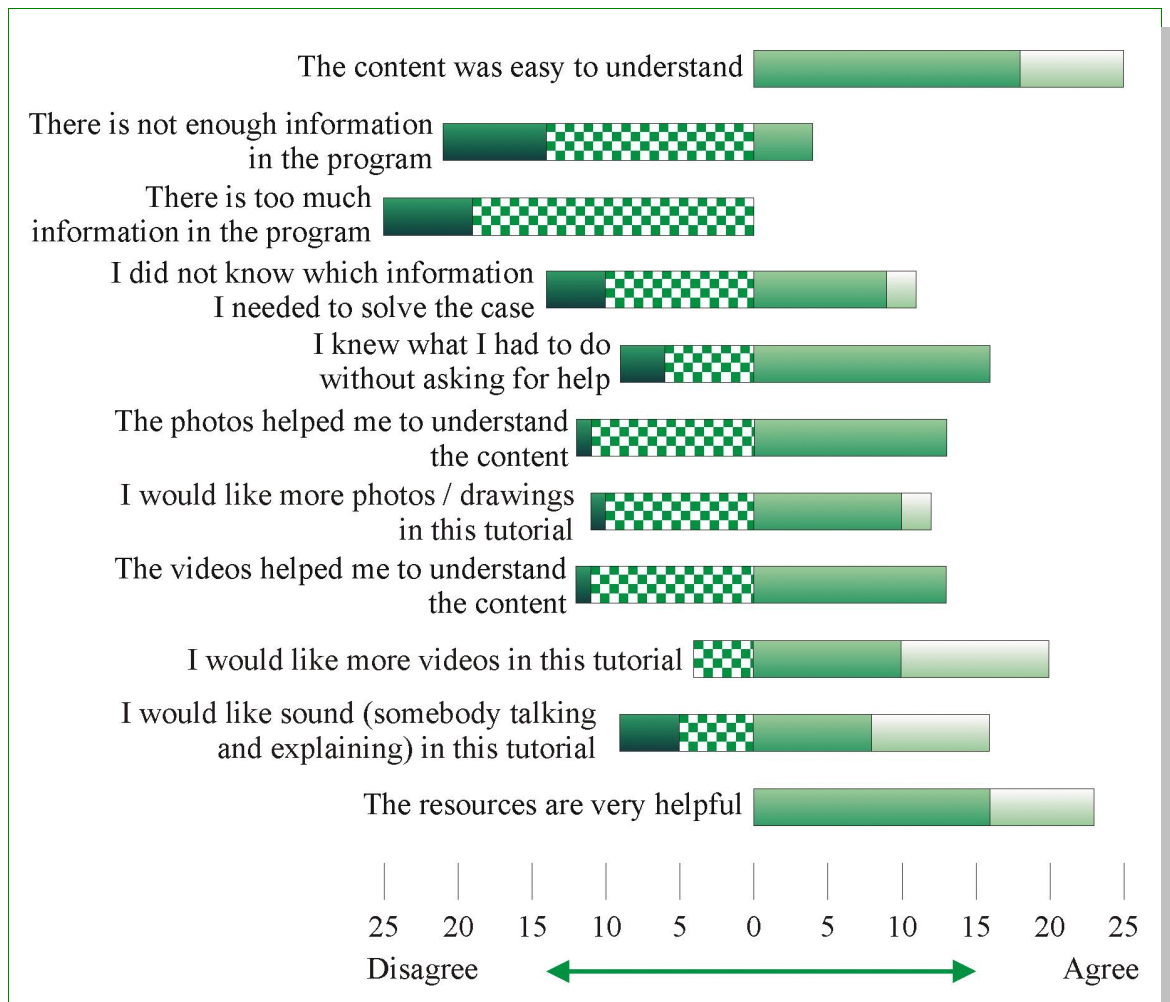
Figure 4.7 - Responses to questions about the content of the tutorial

From the open questions

Sixty percent of the student said that the photos and videos and the way the measuring and evaluating techniques were described were the best feature of the program. Six students thought that the best feature of the program was the fact that all the Anthropometry resources (such as charts, tables and graphs) were together in one place.

From the group discussion

During the groups discussion the students remarked that they wished they had had the program during their practicals to use as reference source.

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4.5.4 Application

From the observation

Few students attempted to solve the case studies in the program. Their own problems were more important than the real-life case study supplied by the lecturer. One student even took out a ruler to check the procedure to measure knee-ankle length.

From the questionnaire

Encouraging for the future implementation of the program is the fact that **only one** student would not like to use the program again. This student, however, indicated that she is afraid of the computer. Three students said that they would not recommend the program to others; one of these students is afraid of computers and another one indicated that she does not like to work on the computer.

Thirteen students (52%), all with Afrikaans as home language, indicated that they would prefer to have the program in Afrikaans.
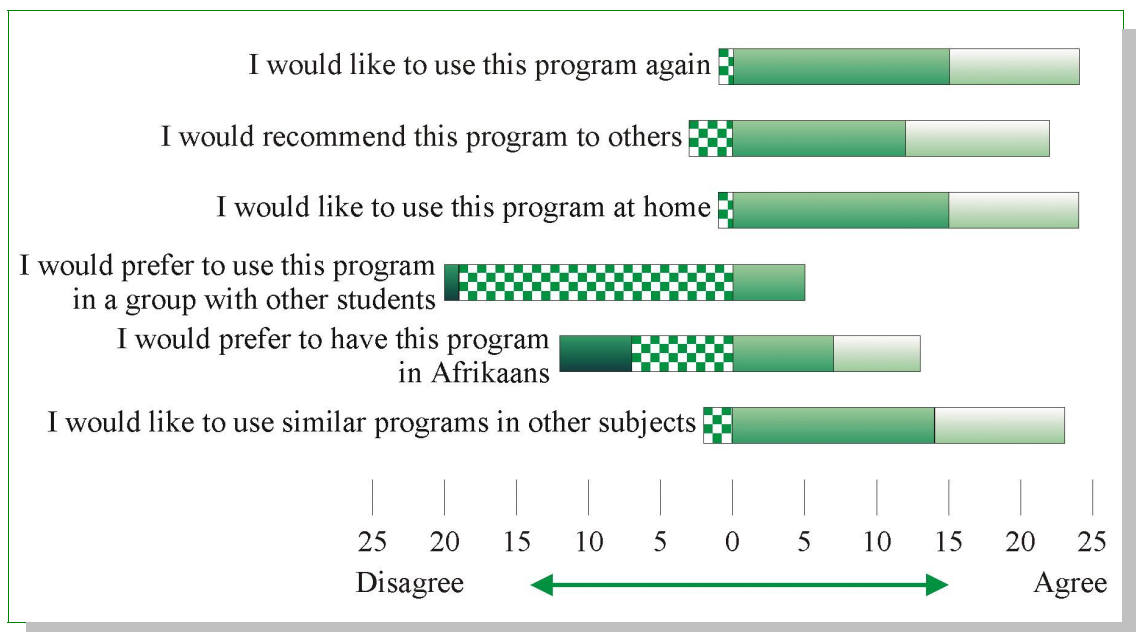

Figure 4.8 - Responses to questions about the future use of the program

From the group discussion

During the groups discussion the students remarked that they wished they had had the program when they started the course.

4.5.5 Integration

The final integration of new knowledge with existing knowledge was not planned as part of the program. This should take place in the skills lab where the students get the opportunity to practise on each other.

From the questionnaire

The fact that 64% of the students said that they learned something new from the tutorial during the 50 minutes of testing the program is a good indication that the program has value as a teaching tool. Merrill says that, "If a product does not teach, it has no value" (Merrill, 1997). The response to question 34 is even more important, where 92% of the students indicated that they thought they could apply what they had just learned in a practical situation.
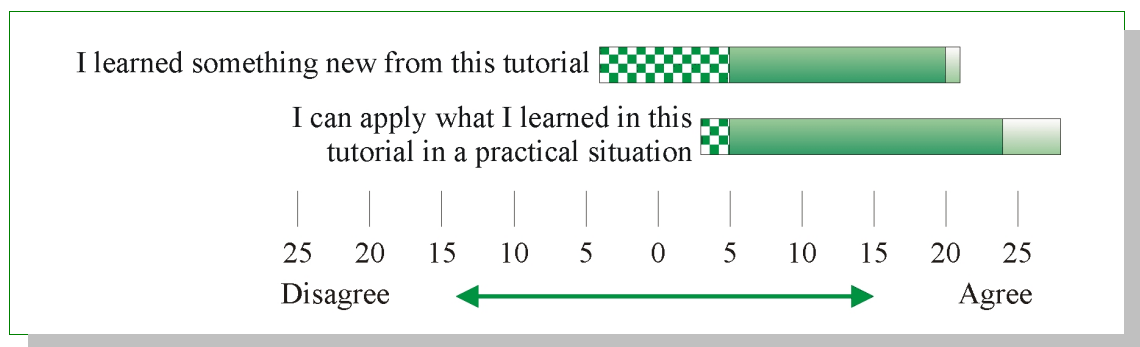

Figure 4.9 - Responses to questions about their own learning

From the open questions

Most (11) students would not like to receive computer-based instructions (CBI) **in the place of** lectures or practicals, **but as additional tuition**. Five students did, however, say that they would prefer CBI to lectures since it allows them to learn in their own time.

From the group discussion

The students expressed their disappointment that a similar program had not been available for them to use when they started the Nutritional Assessment course at the beginning of the year. There was general agreement that the computer-based course should not replace any of the existing lectures or practicals. It was suggested that the lecturer use the program during her lectures to illustrate the measuring techniques more effectively. The students also indicated that they would like to have the program at home for practice and revision.

4.5.6 Students' computer literacy and Internet access

The students considered themselves computer literate; this was supported by the fact nearly half of them (48%) use the computer daily and the most of the others (44%) at least once a week. None of them, however, thought to use the Alt-Tab keys to get to the calculator or NotePad window that had disappeared, indicating that they were not too familiar with keystroke shortcuts.

Questions 45 - 61 were asked to determine the computer literacy of the students as well as their access to and reason for using the Internet. These questions were asked to investigate a possible correlation between their ease of navigation in the program and level of computer literacy.

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4.5.7 Students' language preferences

Although 15 students (60%) gave Afrikaans as their home language, less than half of them (44%) prefer to receive the instruction in Afrikaans. Twenty-eight percent prefer it in English and 20% in both languages. During the group discussion some students indicated that they had language problems when interpreting the case studies.

4.5.8. Suggestions by students

Suggestions by the students to improve the program included:

- A better overview of what is available on the CD and easily accessible menus or a clickable index (36%).

- The facility to view the case study while doing a calculation or reading values off a chart (16%).

- Improved quality of the scans or re-typed tables.

- More photos and colour, added sound, formulae explained and more words in the glossary.

4.5.9 Feedback from the Statistician

Ms Hermi Borraine, a statistician in the Department of at the University of Pretoria, analysed the data from the questionnaire and looked for possible correlations. Since the group of students was very homogeneous no correlations were expected and the few correlations that were found only confirmed that the answers to the questions were consistent.

4.6 Conclusion

The students' positive attitude towards the evaluation session was evidenced by the fact that they explored the multimedia program willingly and inquisitively. They openly discussed problems they encountered, gave valuable feedback and made positive suggestions for the improvement of the program.

Interestingly, the students liked those aspects that helped them most to learn new skills (photos and videos) or assisted them in solving the problem (all resources grouped together). What they liked least were mostly technical problems: navigation, text that was difficult to read, windows that closed or disappeared. These were perceived as obstacles preventing them from learning and acquiring new skills or solving a problem.

Encouraging for the future implementation of the program is the fact that **only one** student would not like to use the program again. This student, however, indicated that she is afraid of the computer. Three students said that they would not recommend the program to others; one of these students is afraid of computers and another one indicated that she does not like to work on the computer.

An attempt is made in the table below to apply Merrill's 'Stars' to the prototype program, taking into account the findings discussed above.

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4.6.1 Applying Merrill's five Stars

Stars (*) are a subjective, qualitative attempt at rating the success of the program.

1.	Is there **a Problem to Solve**? Yes. The case studies were seen as relevant, real-life situations.	★
2.	Is there **Activation** of existing knowledge? No, but according to the lecturer there is no relevant past experience or knowledge, expected from the students for this course. The program could be improved by a screen depicting a typical situation for a dietitian to achieve what Gagné calls gaining the attention.	
3.	Is there **Demonstration**? Is the student shown and is the demonstration consistent with the learning goal? Yes. The students were particularly impressed with the photos and videos explaining the different measuring and evaluation techniques.	★
4.	Is there **Application** of the new knowledge? Yes. The students had to solve the case given in the tutorial by doing the necessary calculations and writing a report in NotePad. The report would be available for evaluation by the lecturer at the end of the session or a multitude of sessions.	★
5.	Is there **Integration** of the new knowledge Real integration was never planned for this program. The first integration of the new knowledge is planned for the skills lab where the students practise on each other and then ultimately in the hospital when they have to assess their first patient under the guidance of the lecturer.	

Table 4.3 - Applying Merrill's Stars

According to this, the prototype was rated at three Stars.