CHAPTER THREE

THE DEVELOPMENT OF THE WEB-BASED PACKAGE

This chapter discusses the development of the package, and the model used to guide the development process. The development model used in this research incorporated four of the five stages (goal planning stage, establishing the context stage, design stage, production stage and the implementation stage) in a model suggested by Sanders and Linkonyane (2001), with an additional stage (preparation stage) included by the researcher.

3.1 THE DEVELOPMENT MODEL USED

The model of stages in developing the package included the following;

STAGE 1: Plan goals

This stage involves specifying the aim of the package to be developed. The purpose of planning goals is for researchers to formalize what they want to achieve. Patton cited by Sanders (1987) points out that *"if you don't know where you are going, you will have difficulty figuring out how to get there, and you won't know when you have arrived".* Formalizing goals in the design of instructional materials is important so that researchers do not go off track during the development stage. The stated aims act as a target which directs the design. Importantly, Sanders (1987) states that *"if you know what you are trying to do, you are more able to make rational decisions on how to get there".* Therefore, if designers know what they are trying to achieve, it increases their chances of selecting the appropriate methods for achieving their goals.

The goal for the development and evaluation of the package was suggested by the supervisors who had much knowledge in the field of instructional materials. The supervisors from their experiences and from what was going on in the educational transformation of the country, were aware that there was need to develop instructional materials for teachers who are implementing the new curriculum. The researcher constantly consultated with the supervisors for clarity on the goal of the package from the beginning of the course. The purpose of the package was to "help teachers use an science-technology-society approach to teaching about human population issues". Looking back at it, this goal was perhaps inadequately formalized, a limitation discussed in Chapter Five under the section on limitations of the study.

STAGE 2: Preparation stage for developing the package

This "preparation stage"is the additional stage added to the development model outlined by Sanders and Linkonyane (2001). The preparation stage involved the researcher going through a number of steps in preparing herself in order to gain the necessary knowledge and skills that are required to produce good quality instructional materials, especially computer-based ones. This was done in two ways, reviewing the literature and attending a course (Educational Technology in Science Education). This stage was important so that the researcher could use the advice thus gained when designing the package. Below are some preparations that the researcher went through.

i. ***Thinking about how computers can be used in improving the teaching process.*** This included what computers **can be used for** as well as the **benefits of using computers** (as a teaching and learning approach). These two have been discussed in detail in Chapter Two (section 2.2) on pages 14-19. The aim of doing this was to promote awareness and understanding of the importance of educational technology and its role in the teaching and learning science. Two broad questions were considered.
   - for what purposes can teachers use computers?
   - for what purposes can learners use computers?

   One particular use of computers was later utilized in the package that graphs developed in spreadsheets can be manipulated to instantly visualize changes in the spreadsheet data, so computer users can instantly see changes in relevant variables. The package used a spreadsheet (for simulation and visualization purposes) to explain the process of population decrease due to the AIDS/HIV disease in South Africa. This allowed teachers to visualize the drop or increase of the population on a chart whenever the figures in the table were changed. Therefore, teachers were able to visualize complex processes which are not possible with educational aids such as a whiteboard or an overhead transparency, which are two-dimensional and static.

ii. ***Designing a personal web page in order to master skills involved in designing web-based software***, including understanding the nature and use of Hyper Text Markup Language (HTML). This was an important stage which introduced the researcher to one of authoring package (DreamWeaver) used for designing the instructional materials. The researcher learned different skills (i.e. technical aspects) needed to design web pages. Other skills included planning on paper the layout of the package before it is developed, designing and the actual developing of the package. The type of skills learned in this course included;
   - creating folders and sub-folders in Dreamweaver 4
   - knowing how to make links and thumb nails to an internal and external source (e.g from one file within a package to another)

- saving files and sub-files in folders
- finding and saving clipart from copyright-free web sites
- modifying and inserting graphic images using Corel Photo House, Wordperfect etc
- drawing and inserting HTML-based mind maps
- designing an effective navigation system
- using frames in web design

iii. ***Designing an interactive learning experience using spreadsheets.*** The purpose of this part of the course was to get students doing the course thinking carefully about one way of making teaching and learning material more interactive by using spreadsheets exercises. This exercise involved,

- identifying a suitable topic which lends itself to using spreadsheets, that is, a topic which involves tables of data, requires calculations to be done and requires graphing activities.
- providing a written lesson plan which included,
  - describing the target group for the programme, for instance, age or grade, subject area, topic, concepts, time allocation etc.
  - indicating the learner outcomes (what learners will be able to do, or attitudes they will develop after completing the learning activity).
  - listing items the teacher needs for the lesson.
  - explaining how the computer/activity will be used in the lesson, which included the role of the teacher (e.g how teachers might introduce or conclude the lesson).
  - describing what the learners will be doing in the lesson.
  - timing for various parts of the lesson and the total duration.

iv. ***Designing instructional software.*** The purpose of this part of the course was to introduce important basic concepts which impact on how computer-based instructional software should be designed. The aspects looked at included:

- considering the steps a designer needs to go through when planning and designing instructional software.
- considering the guiding principles of an instructional designer such as,
  - what can be learned from learning theories about how the software should be designed for effective learning (discussed in more detail in Chapter Two, section 2.3.1, pages 20-26).
  - what can be learned from research on teaching and learning about effective education.
  - what can be learned from research on interface design of computer-based materials, or from research done on effective design of computer-based instructional software.
  - guidelines to instructional design one should bear in mind when designing computer-based courseware.

The researcher then used this information to construct guidelines for a beginner instructional designer that need to be taken into consideration in order to design good materials. The

importance of this was to find out how effective learning and teaching happens which could be applied to the design of the package. The guidelines to instructional designers was necessary for the researcher to know what aspects need to be considered in order to produce a good quality package.

V. ***Evaluating educational software .***

The Practice: The purpose of this part of the course was to evaluate computer software. This involved looking for good-quality evaluation tools/instruments or examples of good and weak designs so as to get ideas and to know what to avoid.

The researcher reviewed a range of programmes to see the sorts of criteria to consider when judging the worth of software. This involved locating some suitable evaluation instruments, critically assessing how useful they would be for examining the quality of software, and then modifying them so that they meet the researchers' needs, and then using them to evaluate two packages. This was important so that the researcher could recognise good and bad courseware, and be able to select and incorporate good practices into her own package.

STAGE 3: Know the teachers and the learning situation

This stage involves analysing the context in which the courseware to be developed will be used (i.e analysing the whole context situation). This is important in order to identify what the problem is and the necessary needs to be meant. Sanders and Linkonyane (2001) point out that it is difficult to design appropriate instructional materials without conducting a situational and a needs analysis.

The situation analysis involves looking at the current state of affairs with teachers and their teaching practices as well as identifying any problems which might exist. This is usually done by means of a survey so that the researcher can go out in the field to interview the intended users of the instructional material so as to find the problems being experienced. Because of the need to limit the scope of this study, the situation and need analysis was done by means of a literature review of publications and research relating to *Curriculum 2005* and the teaching approaches used in teaching biology and geography in South African schools. The designer looked at literature about what is going on in schools (such as the demands of the new curriculum) and if teachers are meeting them.

The situation analysis in this study involved looking at the current situation in South African schools in terms of teaching human population dynamics in biology and geography and what kind of demands the new curriculum makes. The researcher reviewed literature about

- current approaches to teaching human population dynamics with a special emphasis on problems identified by educators and researchers (discussed in section 1.2 in Chapter One).
- demands of the new curriculum . The requirements of *Curriculum 2005* are discussed in more detail

in Chapter One (section 1.4) on pages 3-4.

- how teachers were coping with implementing the new demands.
- the provision of support for teachers to help them cope with the changes and new demands.

A needs analysis involves looking at what the users need, either by doing a survey or asking people involved. The needs investigate include aspects such as physical and setup provisions, school management etc. This is important so that the designers of instructional material tailor the package to the specific needs of the people using it. Zammit (1992) carried out a study with 352 teachers in order to investigate which factors were perceived to facilitate or hinder the use of computers in teaching. In her study she found that teachers were less likely to use computers if they felt the software was not suitable for their purposes. Some teachers thought the available programmes were unsuitable, because they were either too narrow, too basic, too difficult, too inflexible, or emphasised rote-learning (which these teachers would like to avoid). Most of these teachers were looking for software that fitted into their curriculum and that complemented and extended the work done in class.

Such findings are very important and applicable in South Africa. For instant, Sanders (2001: 15) points out that her experience *"in South African schools suggests that this has been the major problem preventing teachers from using learning materials made available to them because they are never suitable to what the teachers want"*. Such problems can be avoided by doing a needs analysis because the developers of instructional materials would be aware of what the users want or are in need of. According to Draper, cited by Sanders (2001: 16), *"the most successful instructional software is that which closely fits the niche in which it is being used"*.

In order to take this into consideration, the researcher reviewed the literature on the demands of *Curriculum 2005* because teachers had to meet these requirements. From the situation analysis, it had been noted that there was a problem in the way human population dynamics was taught in schools, because teachers based their teaching on a teacher-centred approach instead of a learner-centred approach. However, the demands of the new curriculum required teachers to make lessons relevant to the learners' lives, actively engage learners in activities, develop a variety of skills and assess the learners continuously as discussed in Chapter One.

STAGE 4: Design stage

This stage involves the process of planning and writing down the structure and the content of the package (Phillips, 1997). It is important that the designers put everything on paper and create a storyboard of all the content of the package in order to produce good quality instructional material. Phillips recommends that the instructional designer conducts a brain-storming session with various experts who have a range of experiences, when starting to design the package. This is important in order to clearly define the

functionality and scope of the study. It is after brain-storming that the designer develops a description of the content of the package. This stage is importance because the designer can discover problems and rectify them at this early stage rather than doing it in the production stage. In so doing, Phillips (1997) claim that time and effort can be saved, and costly mistakes avoided.

The purpose of writing down on paper for the researcher was to,

- help plan on paper what will go into the package, that is making a hierarchical layout of folders and files
- help organise thoughts,
- help avoid losing files since it affects creation of links
- help think about how to organise the screens into specific areas

Consultations with experts

It is important to talk to the experts when designing materials so that they could guide and advise the designers. The details on responses obtained about the package from expert reviewers are discussed in Chapter Four (research findings). Three expert reviewers (an STS lecturer and two instructional designers) were consulted during the design stage.

The STS lecturer was asked to;

- check the suitability of the STS teaching approach being used and whether the package is really using it.
- check the accuracy of the content (to check if the content is factual and based on the topic "human population dynamics")

The instructional designers was asked to;

- check if the navigation system proposed would be easy for teachers to understand and follow.
- check if the layout and format of different screens were suitably designed

STAGE 5: Production stage

The production stage involves working in a cycle which includes developing and evaluating the instructional material and if necessary going back to redesign certain aspects which are not working out (Phillips, 1997). It is at this stage that the actual programming work is done. The major task at this stage is to make sure that everything outlined in the design stage is working. The evaluation or testing of the package is therefore vitally important at this point. The package is tested through a number of development cycles so that any faults noted can be fixed. However, if the design stage was properly done, fewer problems are likely to arise at this stage, because these will have been resolved during the design process (Phillips, 1997). This stage depends on the previous stage because any changes made to the package may affect other screens which may also cause problems with other parts of the package.

For the package investigated in this research report, this stage involved working on the actual package and ensuring that all the aspects discussed in stage four were functioning. The researcher

- checked if the navigation cues (mind map, buttons) and links were working
- checked that graphics which had some movement eg the clock were functional
- made sure that the spreadsheet (chart) used in the package could change when the numbers in the table of HIV/AIDS figures were changed.
- made sure that all the exercises designed in Microsoft word were protected to prevent the users changing the content of the package when they typed their answers into the worksheet.

Whilst designing the package described in this research report the following design steps were followed, and expert checks done. While designing the package, there is need for experts to check if the designer is working towards the development of a good quality package which meets the stated aims. Below is a table showing the advice that the instructional instructors of this course gave, and the modification made thereafter.

Table 5: Questions, feedback (three experts) and modification of the package.

Initial development: conducted whilst doing the course work		
Question	**Feedback from three "experts" who reviewed the package**	**Modification to the package**
Is the purpose of the package well explained to the users	• The STS expert reviewer was concerned that the package seemed to be for teachers who have computers at home only. She suggested that this should be changed. • Two experts were concerned that the package was resource material for learners instead of teachers. This was a major problem identified as the package was intended for teachers and not for learners. They advised that this should be changed.	The purpose of the package was re-worded to state that the package was a resource for teachers to use in their teaching.
Are the outcomes of the package well indicated?	• All the three experts said that most of the outcomes of the package are not stated as outcomes (e.g "experience an alternative approach", "see how STS places science in a relevant context" .)	The outcomes were re-worded as what teachers where supposed to be able to do at the end of the package (i.e using action words).
Is the package logically structured for teaching to take place?	• All three experts noted that the section on STS was very long. • The expert in instructional materials wondered if the first thing that teachers should look at be the STS approach to teaching, and not the content of lessons for learners. This is because the researcher is trying to teach teachers an STS approach to teaching.	The sequence of pages was changed to start with a home page (content of the package), outcomes, STS approach, population dynamics content and lessons.

Is the language clear enough for teachers to understand?	• Two experts said that some wording of sentences was not clear and well structured, and language problems existed. • Two experts said that some sentences were not addressed to teachers, but seemed to be for learners. • The expert for instructional materials warned that the researcher should be careful, avoid technical words and explain terms that the teacher might not understand. • Two experts suggested that the researcher should word some claims more carefully because they were not always true as stated.	• Instructions were written in simply English that teachers would understand. • Technical terms were explained.
Are the outcomes for each lesson indicated?	• All three experts emphasised that the researcher should include learning outcomes on all lessons. • All three experts emphasised that the researcher should state outcomes as what learners should be able to do at the end of the lesson.	Included outcomes for each lesson.
Are the activities interactive and clear enough?	• Two experts said that even though most activities were interactive, most of them were not clear and needed a bit of explanations. • The expert in instructional materials said that the researcher should clearly say where the materials for learners are to be found. • Two experts said that we want learners to actually do, not find out if they can.	• The structure of questioning and sequence were changed to engage learners in activities. • Activities were explained clearly to the teachers (what teachers and learners had to do). • The location of some materials and where learners had to write was explained.
Are the teaching lessons well structured?	• One expert said that the logic of some activities is confusing. • Two experts said that some articles included were not relevant to the issue of population increase. • All three experts said that the lessons seemed to be for learners rather than the teachers. • Two experts said that the topic (AIDS/HIV) is a very sensitive issue. Many people do not feel comfortable discussing it openly. The researcher had asked learners to give the number of their members of their families who had died of AIDS/HIV. The experts suggested that the wording should be changed. • One expert suggested that the researcher should include some lesson materials for learners to avoid scrawling up and down a screen to read the notes and then do the activity. • Two experts said that the teachers should be provided with as much information as possible for them to understand how to teach using an STS approach. • All three experts said that the researcher should allocate the time needed for the activities. • One expert said that the researcher should provide help on how teachers could answer some questions.	• Activities were re-written to include aim/purpose, time, materials needed, how to get the lesson started and how to conclude the lesson. • Instructions for teachers and learners were separated. • Sensitive topics like AIDS included questions that were meant for reflection only and others which were less sensitive were suggested for discussion. • Cut down on instructions for learners to hand-outs (lesson materials). • Questions were re-worded to provide much help for learners.
Is information up-to-date?	• The STS expert said that most articles were not up-to-date. She suggested that the researcher should try to get recent ones either from the Internet or newspapers. • The expert in instructional materials said that no background knowledge is provided for the teachers.	• Used articles from 1995 onwards.

Are the questions in lessons well structured?	• The expert for instructional materials suggested that the researcher should include questions for teachers to get the learners to say what they are doing with the figures on AIDS/HIV.	Questions were re-worded to get more information from the learners.
Are the instructions clear enough to understand?	• Two experts said that no instructions were given about where learners are supposed to write their responses. They suggested that the researcher should say if learners have to write into the worksheet given in Microsoft Word or in their books. • The expert in instructional materials said that some instructions were too vague.	Re-worded instructions.
Are references included to support statements made?	• The expert of instructional materials said that some statements were not backed up and that some articles did not have references. • One expert said that some claims were not scientifically correct. • The expert of instructional materials said that sources of diagrams needed to be acknowledged to avoid accusations of plagiarism.	All statement were backed up by references which where given in full on a separate page. References were added for all artwork carried from the sources.
Is the navigation of the package well designed?	• One expert said that the navigation should be changed , rather than using buttons, a mind map should be used on the first screen. • One expert reviewer said she was very confused, did not know where to start or what was in the package.	The navigation system was explained from the first page, thereafter the users where directed to make a selection of topics from the home page.

STAGE 6: Implementation stage (incorporate summative evaluation)

This is the last stage listed by Sanders and Linkonyane (2001), and involves the implementation of the finalized revised package. It often involves a summative evaluation as discussed in Chapter Four (section 4.1.2). This stage was not incorporated in this research as the scope of the study had to be delineated for the Masters degree. It is hoped that this stage will be followed up on later, as it is believed that the package will be valuable for teachers of biology and geography in this country.

3.2 USER INTERFACE

When considering the user interface, it is important to remember that the principal objective of user-centred design is to develop a programme that is so self-explanatory and easy to use that the need for manuals, on-line help or training is minimised or avoided (Hugo, 1996). Therefore, the user should be able to just look at the interface and immediately know what to do and it should be attractive and enjoyable to use. *It is essential to remember that the effectiveness and usability are the key success factors of a programme, and that tools alone do not guarantee a successful product* (Hugo, 1996: 127). The user interface must be effective since it determines the way in which a user will interact with the package. Below are some user interfaces that were considered in the design of the programme and the reasons why it was important to take them into consideration.

Table 6: Interface design

Area	Principle	Reason	Advice
Navigation and orientation	. Ability to move through the contents of a programme in a n intentional manner (Reeves, 1993). . Provide a user-friendly way of navigation through the programme.	. Users should know where they are, have been and where to go (Reeves, 1993). . Links should provide users cues for further exploration (Kennedy and McNaught, 1997). . Links should inform users about page organization and structure.	. Design a programme that is free of stressful navigation so that the users should not get lost (Reeves, 1993). . Use navigation tools such as table of contents, mindmaps, hyperlink buttons or indexes.
Links/buttons	. Navigation through the programme should be visible, clear and functional.	. To avoid users getting lost or getting frustrated (Kennedy and McNaught, 1997).	. Underline all links for visibility. . Be consistence with the position of the links/buttons. . Have links/buttons on all screens or direct users to the home page to make a selection.
Font/text	. Font or text should be clear, simple and consistence. . Font or text should be readable and brief to avoid scrolling through the screens.	. To enhance visibility and achieve best possible reading speed. . To avoid scrolling continuous text which may confuse, distract or irritate the user.	. Avoid the use of italics, all caps or bold letters which is difficult to read (Van Reenen, 1994 and Pellon, 1995). . Do not decorate font face for running text as it is difficult to read.
Layout and appearance	. Layout of information should be uncluttered, clean, short and consistence.	. To keep users interested in reading short information which is not displayed like a textbook full of continuous running text.. . To be consistence so that users do not have to adapt to new forms of text display on each screen as they are viewing the programme. . To avoid text being stretched out making it difficult to read.	. Avoid text layout which stretch out making the information difficult to read. . Avoid using different forms of text layouts which may confuse the users.
Images/graphics	. Graphics should be meaningful, have a specific function to that information and be of appropriate size.	. Graphics can motivate, retain attention or supplement understanding even when verbal text is straightforward. . Graphics provide an alternative mode for explaining and transmitting information (Pellon, 1995). . Large graphics takes longer to load frustrating the users (Williams, 2000).	. Graphics must support and enhance the written portion of the information (Burke cited by Pellon, 1995 and Smith, 1997). . Reduce the graphic sizes and save in a format that is easy to download.