

CHAPTER FOUR

RESEARCH METHODS

A package on population dynamics was developed as a resource for teachers. This package consisted of the following :

- the aim of the package,
- a mindmap indicating the content of the package,
- learning theory on situated cognition, where theorists claim that effective learning occurs if knowledge to be learned is situated in relevant contexts,
- an outline of the STS approach which uses problems as the starting point in teaching,
- an outline on the human population dynamics content, and
- three lessons on human population dynamics

Teachers evaluated the package giving their views on the package and gave suggestions on how to improve it. Furthermore, two science educators reviewed the package after initial modifications were made from the responses obtained from the teachers.

4.1 EVALUATION RESEARCH

The principal aim of evaluation research is to collect information to support day-to-day decision-making (De Vos, 1998, Thornton and Phillips, 1997, and McMillan and Schumacher, 1993). Reeves and Hedberg (2001) argue that in developing interactive learning systems, there is a need to conduct various evaluation activities before making decisions. Evaluation means a judgement of merit or worth against a predefined set of standards or expectations (De Vos, 1998, Pham, 1998, Schumacher and McMillan, 1993, and Thornton and Phillips, 1997). They argue that the evaluation process is used to assign a value to the object being evaluated so that its worth or intrinsic value can be conveyed to others. The evaluation may include the review of draft scripts by the experts, observation of respondents using the package and subjection of the programme to thorough usability testing. However, Thornton and Phillips (1997) point out that the process of evaluating computer materials is not mainly to assign some intrinsic value to it, but rather to answer many questions that arise during the development and implementation of the computer material. For instance, the evaluation of the package in this study gave rise to many questions which were not earlier on formulated such as the design of lessons. The question that was often brought up was whether the package was intended for the teachers or the learners.

In evaluating instructional materials, most computer developers and users try to answer questions regarding how much better the developed programme is compared with any other approach to teaching. This is important because the computer developers are constantly looking for ways of improving the effectiveness of the teaching and learning processes. The feedback obtained from these questions, using various methods of data collection at various developmental stages, can be used to improve and further develop the materials. There are two ways of evaluating learning materials, formative evaluation and summative evaluation.

4.1.1 Formative evaluation

Formative evaluation is used in research to find out how a learning material can be improved. Schumacher and MacMillan (1993) define formative evaluation as the collection of data to modify or revise material in a developmental stage. Formative evaluation allows the identification of areas of the programme which require revision, and which can therefore be used to improve the programme. Thornton and Phillips (1997) argue that formative evaluation can be used to provide a rich source of data about what the users think and feel about the interface and design. It is the information obtained from different research instruments such as questionnaires, interviews, expert review or observations that will answer questions that arise during the design and prototype development phases. Formative evaluation involves the systematic collection of information during the trial of the interactive learning programme for the purpose of making decisions about improving the product (Flagg, 1990; Reeves and Hedberg, 2001). Reeves (1993) claims that formative evaluation is the essential lifeblood of the instructional development process and it deals with how the product can be improved from its earliest stages of planning through to the implementation stage. The developers of educational packages carry out formative evaluation while the package is still under development, in order to support the process of improving its effectiveness.

Reeves (1993) says that during this stage of evaluation, the developer is interested in finding out if the programme or design works, by considering some of the following;

- the effectiveness of the navigation system,
- whether the intended users enjoy using the programme,
- whether the approach used to deliver the information is intuitive,
- whether the screen designs are effective, and
- whether the programme works in the way it was planned to (Reeves, 1993).

Whilst Pham (1998) believes that there are three major elements of an educational multimedia (computer) system that exert profound effects on its quality:

- the knowledge content of the product,
- the ways knowledge and tasks are represented and organized, and

- the technical tools used for conveying and constructing knowledge.

In formative evaluation, these results may lead to a decision to revise the material, to extend the field testing to gather more data, or to abort further development in order not to waste resources on a programme that ultimately may be ineffective (Schumacher and Macmillan, 1993).

In evaluating the package, Reeves (cited by Thornton and Phillips, 1997) and Pham (1998) strongly argue for three primary principles of contemporary cognitive learning theory that have to be addressed;

- ▶ learning is a process of knowledge construction as opposed to knowledge absorption (constructivism),
- ▶ learning is knowledge-dependent and uses existing knowledge upon which to build new knowledge (meaningful learning), and
- ▶ learning is highly tuned to the situation in which it takes place (situated cognition).

These principles have been discussed in Chapter two.

4.1.2 Summative evaluation

Summative evaluations on the other hand are conducted once the programme is fully developed (Schumacher and MacMillan, 1993), and with the purpose of judging the worth of a programme as a whole. According to Thornton and Phillips (1997), summative evaluations attempt to obtain absolute measures of the key underlying variables involved in the learning process. This approach is often used to compare the effectiveness of two or more instructional approaches.

4.2 RESEARCH PARADIGM

During formative evaluation, the eclectic-mixed methods-pragmatic paradigm was used. This paradigm borrows methods from several paradigms to collect information in order to solve a problem. It uses mixed methods to provide multiple perspectives on a problem, to triangulate information and draw conclusions (Reeves and Hedberg, 2001). Questionnaires and expert review were used to triangulate information.

4.3 RESEARCH ETHICS

Cohen and Manion (1994) believe that researchers ought to find a balance between the demands placed on them as professionals in pursuit of truth, and their subjects' rights and values which are potentially threatened by research. MacMillan and Schumacher (1993) point out that ethics deal with beliefs about what is right or wrong, proper or improper, good or bad. There are guidelines to what is ethically correct in research where the issue of ethics becomes important and should be considered. Below are some ethics

that the researcher considered in the research.

- ▶ Told participants that their involvement in the research was voluntary,
- ▶ Gave a thorough explanation of the purpose and nature of the research before they participated giving the respondents a good reason for cooperating (Fraenkel and Wallen, 1993). This was done through a written note which explained what was being asked of the respondents and why. The purpose of this note was to motivate the respondents to fulfill the request.
- ▶ Participants remained anonymous and information was treated with strict confidentiality, as suggested by Bell (1987).

4.4 SAMPLE

Ten teachers evaluated the web-based package. These participants were selected purposively, by means of convenience sampling. The teachers were registered for an STS honours course at the University of the Witwatersrand and were invited to participate in the study. All were practising teachers registered for part-time studies, and all had taught at high school level before. Only volunteers were involved in the evaluation. However, only nine of the teachers returned their questionnaires. The sample size was small because the intention was not to make it representative of the whole teachers' population, but rather to evaluate the package developed and find ways to improve it.

Two science educators from the same institution also reviewed the package. One was an STS lecturer and the other one was an instructional designer.

4.5 METHODS OF DATA COLLECTION USED IN THE STUDY

Two main types of research instruments were used in this study to collect information from the participants, to provide multiple perspectives and to triangulate information. Phase one of the study involved teachers working with the package and answering a questionnaire. Phase two of the study involved expert review which required the STS lecturer and the instructional designer to talk-through the package and give criticisms and appreciation of the package.

4.5.1 Questionnaire

A questionnaire containing both open-ended and closed-ended questions was used to collect information from the teachers who participated in the study (see appendix A). Questionnaires are a data-gathering instrument used to obtain factual data, opinions and attitudes in a written format (Galfo, 1975). The

questionnaire is self-administered by the respondent (Fraenkel and Wallen, 1993).

Design and development of the questionnaire

According to Gay (1981) the questionnaire should be as attractive and brief, and as easy to respond to, as possible. Below are some advice on designing a questionnaire that the researcher considered in this research.

Table 7: The advice on designing a questionnaire

DOS	REASON
Had to be attractive (Fraenkel and Wallen, 1993).	The appearance of the instrument was important to the overall success of the study (Fraenkel and Wallen, 1993).
Included unstructured questions which the responder had to complete, giving them freedom of response.	This permits greater depth of response and may permit insight into the reasons for responses.
Tried to keep the questions short (Fraenkel and Wallen, 1993).	To encourage respondents to respond by avoiding spending too much time reading (Fraenkel and Wallen, 1993).
Had to be as easy to answer as possible (Fraenkel and Wallen, 1993).	-the question asked exactly the way it is written -the question should mean the same thing to everyone -the question should be one that respondents will be willing to answer.
Questions had to be worded properly and clearly written (Fraenkel and Wallen, 1993)	Poorly worded questions can not yield desired results .
Used common language	To enable teachers to understand the questions.
Used follow-up questions (yes or no, explain).	They can make it easier for respondents to answer a given question and improves the quality of data received (Fraenkel and Wallen, 1993)
Did not present the questions on a single line, but rather used a table format (Fraenkel and Wallen, 1993).	To avoid respondents spending a lot of time reading questions which could discourage them from continuing (Fraenkel and Wallen, 1993)
Don'ts	Reason
The use of sloppy and lengthy questions (Fraenkel and Wallen, 1993).	Questionnaires requiring lengthy responses to each question turn people off which is not the way to get respondents answer the questions.
Avoided leading questions.	Leading questions gives the respondent the answer.
Avoided touchy questions to which the respondent might not reply honestly.	Touchy questions intimidate people who will give an answer to please the researcher.

The researcher used the advice on designing a questionnaire to design a questionnaire below. There was a rationale for asking each question in order to answer the research questions. Table 9 lists the questions asked and provides the rationale for each question.

Table 8: Questionnaire and rationale

QUESTION	QUESTION	REASON FOR ASKING
Question 1 Please fill in the details concerning the purpose of the web page.	Is the introduction of the web page complete and understandable?	The introduction to the package is important for the teachers to know what the package is all about. It also tells them who the package is designed for and what kind of contents are included. Therefore, the purpose of this question is to find out if from the introduction, teachers can understand the aim of the package.
	What is the purpose of the web page?	The purpose of the package if stated clearly will make teachers focus and have a good picture about the content of the package.
	Is the purpose clearly stated?	The purpose that is clearly stated will immediately help teachers know what they are supposed to be doing with the package.
	Does the homepage contain a well-labelled table of content?	Labelling of the contents is important to show what is contained in the package and if clicked will take the users to the stated information. Without this, teachers would not know what they are clicking on and what kind of information is contained on the link.
Question 2 Evaluate the web page for instructional use according to the criteria described below. 5=excellent 4=good 3=average 2=fair 1=poor	The title of the web page is appropriate for teaching human population dynamics.	To find out if the title is appropriate to the purpose of the package and its teaching approach. If this is not the case, the title can mislead the teachers.
	The topics of the web page are well covered and offer a wealth of information related to the human population dynamics.	In order to teach effectively, the topics of the package needs to be well covered so that it does not leave out some relevant aspects of the topic. Further, the information included should relate to the topic that is being taught otherwise it will mislead the learners.
	The web page contains original information which can be retrieved effectively.	It is important that the information is not borrowed from another textbook which teachers can easily use if they wanted to, but rather information needed to be up-to-date and relevant. It also needed to be based on an innovation approach which is learner-centred that would help teachers teach effectively.
	The content of the linked web pages is worthwhile and appropriate to the topic.	To find out if the linked pages on the web contained information that was relevant to the teaching approach and information in the package.
	The subject matter and content are appropriate and relevant to the teachers.	To find out if the topics being covered in the package are relevant to the teachers teaching biology at secondary level and appropriate for the topic. This is necessary if the package has to help teachers to teach the topic. It is also important in teaching STS that the subject matter is relevant. Teachers can use the STS topics to catch the attention of the learners.
	The web page contains accurate and reliable information.	To find out if the information contained in the package is based on facts. If it is not, most teachers may not use the package because the topics are different from the syllabus.
	The definitions of terms are provided when necessary.	Elaboration of terms help understand the content.

	The lessons are well prepared and structured (ie. time allocation, material needed, objectives, grade level to teach)	To find out if the lessons are structured in terms of time allocation, materials needed, concepts been taught under a certain lesson etc to help teachers in planning and timing their lessons.
	The activities (lessons) of the web page are interactive to the users.	To find out if the activities included in the package will enable teachers to actively participate in the learning process. This is important because one of the purposes of the package is to make it learner-centred as opposed to teacher-centred approach to teaching.
	The learners are encouraged to transfer the knowledge from the web site into their school and society activities.	To find out if teachers believe that the learners will be able to use the knowledge gained from these lessons and apply them into their everyday lives. One of the reason for the development of this package is to make learning relevant to the lives of the learners and applicable.
	The instructions given in the web page are clear and easy to follow.	To find out if the teachers could follow the instructions given and can easily understand what is being said. This is crucial for the understanding of this teaching approach and not to mislead them.
Question 3 How easy is it to find your way around the site and follow the activities? Please indicate the accessibility of the computer package by answering Yes and No and explaining your answer.	Can you move around the web page easily?	To find out if teachers are able to move around and follow the teaching approach. If information is not well linked, then certain information will not be available.
	Are there sufficient shortcuts or links available?	In order for the teachers to move around the package, shortcuts are important to use rather than clicking the back or forward button all the time.
	Are the links visually obvious?	It is important that the links are easily seen by the naked eye instead of the users having to search for them. Secondly, these links have to be a hot spot which is underlined so that when the user clicks on it, the intended information will be displayed.
	Are the links consistent throughout the web page?	Consistency in the links is also very important so that the users do not get confused. The use of different style of links can create many interpretations by the users as to whether the information is the same or different, whether it is supposed to be a link or not etc.
	Are the links clearly and accurately described?	Written text on the links or use of clip arts that describe the information to be retrieved is very important. The description of the links should be able to tell the user what kind of information can be retrieved from that link.
	Are the links active internally and externally?	Links which are not working are very annoying and irritating which is supposed to be avoided at all cost if the users are to view the package.
	Do the links take the user directly to the information?	Information that is not linked to the right pages can be annoying and irritating as well as confusing to the users of the package. The links should be able to directly take the users to the information.
	Is the web page organised well to facilitate the location of information?	The ideas is to find out if the links are designed at the same place and well organised such that it is easy to retrieve the information.

Question 4 Give your comments below about the structure of the web page.	Do the graphics and pictures serve any function to the web page?	To find out if the graphics and pictures used in the package relate to the content.
	Is the writing eligible and well laid out in attractive fonts and sizes?	To find out if the font is legible.
	Is the information well organised?	Readability is improved when information is well organised.
Question 5	Is the documentation and instruction of this web-based computer package on human population dynamics adequate?	Documentation: to find out if the STS and population dynamics content is adequately covered.
	A) if so, explain why?	Instructions: inadequate instructions can confuse the users who may not understand the package.
	B) if no, why?	A and B were used as probes for teachers to give an explanation on their answer.
Question 6	Are the tips for lessons (1 and 2) provided appropriate for teaching of this topic?	To find out if the tips for teachers given in the package are helpful to teach this topic.
	A) It is appropriate, because...	
	B) It is not appropriate, because...	A and B were probes for teachers to give a detailed explanation to the question.
Question 7	Do you find the www sites and other articles on AIDS helpful resources for the topic?	To find out if the external web sites included are helpful to teach this topic.
	A) yes	
	b) no	A and B had spaces left for elaboration
Question 8	Is this web-based computer package suitable for matric teachers?	To find out if the package is suitable for matriculation teachers teaching biology and geography.
	A) If yes, explain how	
	b) If no, explain	A and B were included to obtain further data on the suitability of the package from teachers.
Question 9	How helpful do you find this web-based computer package in promoting understanding of human population dynamics concepts? Please explain.	To find out if the package will help teachers to teach human population dynamics.
Question 10	Do you have any suggestions on how to improve the web-based computer package?	To collect ideas on how to improve the package so that it is more useful as a resource for teachers.

Pilot:

According to Gay (1981), a pilot study is sort of a rehearsal where a study is conducted and the results are analyzed. The purpose of a pilot study, even at small-scale pilot study, is to help refine procedures such as effectiveness of the questionnaire and in trying out analysis techniques. However, the larger the scope of the pilot study, the more like the real study it is, the more likely it is that potential problems such as uncontrolled variables and insufficient data processing routines will be identified.

In order to check and ensure rigour in this research, the questionnaire was piloted by two teachers who were not included in the main study. These teachers checked if the wording of the questions were clear, understandable and whether the instructions for answering the questions were also clear. The results

obtained from this pilot study was used to inform changes in language and the layout of the questions. This review of the questionnaire was important to check that the wording of the questions are clear and brief. Questions also needed to be carefully worded so that respondents can easily understand what is being asked (Fraenkel and Wallen, 1993). Therefore, an example of a good questionnaire would be that which Davidson described as; *“clear, unambiguous and uniformly workable. Its design must minimize potential errors from respondents.... and coders* (Davidson cited by Cohen and Manion, 1994: 93).

However, the pilot of a questionnaire to these two teachers may not have been enough because the results obtained after administering the questionnaire was poor. For instance, the questionnaire contained some questions that could not yield a lot of information. According to Gay (1981) the questions that calls for a simply “yes or no” response are problematic because they do not yield much data. Such questions were not identified in the questionnaire during the pilot study. In addition, the pilot study did not reveal poorly worded questions, questions that were not understood and instructions that were not clear to the respondent. The idea of having these two teachers was for them to identify major problems with the questionnaire (Gay, 1981) which was clearly explained to them before-hand.

The design of the questionnaire was modified as a result of this pilot study. The modified questionnaire appears in appendix A.

Administering:.

The questionnaire was administered to the teachers while they were using the package. This gave them an opportunity to write down responses whilst going through the package. However, the time (1 hour) that was allocated to them was not enough to adequately go through the package and give useful feedback. As a result, incomplete information, and inadequate explanations were often given. The researcher was present to give assistance that was needed such as clarifying and correcting any queries from the respondents. Three teachers who could not complete the questionnaire in time were given an opportunity to complete it at home.

From the questionnaire, teachers’ views were sought about the coverage and content of the package, the instructions, the navigation/links, the presentation, the suitability of the package for matriculation teachers, its helpfulness in promoting the understanding of the concept of human population dynamics and suggestions on how to improve the package. Their responses to questions provided information on the teachers’ opinions about the package.

It was important to have teachers interact with the prototype screens as early as possible, to compare their reactions and comments on the design of the package, the design strategy, the navigation system, the user interface design, the degree of interactivity, ease of use etc with what was expected from the

stated objectives of the package. This is very important because what may have seemed to be clear and easy for the researcher in the design phase may not work at all with the intended users (teachers). According to Thornton and Philips (1997) the features that were included during the design phase may cause problems and difficulties to the users such as disrupt their attention, misinterpret the information, destruct etc in the teaching process.

4.5.1.1 Advantages of questionnaires

One of the advantages of questionnaires is that they can be mailed or given personally to respondents at the same time (Fraenkel and Wallen, 1993). The researcher was able to distribute the questionnaires personally to all teachers before they viewed the package. This resulted in a high response rate from teachers.

According to Cohen and Manion, (1994), open-ended questionnaires are advantageous in that they allow respondents to be self-expressive through the use of their own words. It is further claimed that questionnaires yield meaningful information because the actual feelings of respondents emerge, making it possible to validate their quantitative responses and gain some insight into their reasoning (Hockey, 1995). This was not the case in this study because respondents did not have enough time to properly go through the package resulting in short and inadequate responses.

4.5.1.2 Disadvantages of questionnaires

However, questionnaires have disadvantages such as unclear or seemingly ambiguous questions which cannot be clarified (Fraenkel and Wallen, 1993) if the researcher is not available. Even though the researcher was available, it was evident from the responses obtained that teachers did not understand well some of the questions.

Questionnaires also have low percentages of return and incomplete responses caused by lack of comprehension and interest in answering the questionnaire. These problems were minimized because the questionnaires were personally distributed and collected from the respondents. The researcher was also available while the respondents were reviewing the programme, which offered an opportunity to clarify some queries and correct any problems encountered. As earlier pointed out, there was little time for teachers to view the package causing some teachers not to ask for clarification where they had difficulties in understanding some questions.

After some modifications based on the initial stage, the next step involved the researcher talking through the package with an instructional designer and an STS lecturer, both teacher educators, in order to obtain

their views on how to further improve the package.

4.5.2 Expert review/verbal walkthrough

Schumacher and MacMillan (1993) state that the use of experts to make judgements about the worth of an educational programme is a time-honored and widely used method of evaluation. This expertise-based evaluation is widely used in qualitative research because expert review can not only identify problems, but they can also offer advice on how to resolve them (Thornton and Philips, 1997). The method involves two aspects which Schumacher and Macmillan (1993) calls connoisseurship and criticism.

- Connoisseurship is the process of appreciating (in the sense of becoming aware of) the qualities of an educational program and their meaning. In order to perform this, the connoisseur must have expert knowledge of the program being evaluated as well as of other relevant programs. The expert has a special appreciation of the program because of his/her intensive study of related work. As a result he/she will be aware of more nuances of an educational program than will a novice educator or lay person.
- Educational criticism is the process of describing and evaluating that which has been appreciated.

Schumacher and McMillan (1993) claim that the validity of educational connoisseurship and criticism depends heavily on the expertise of the evaluator. It is important that an evaluator is sensitive to both the strengths and weaknesses of the program being evaluated. The evaluator also needs to be knowledgeable about other programs, past and present in the same field of study. This is because expertise is one of the most important qualifications of an educational critic. However, Schumacher and MacMillan note that the validity of the findings from educational connoisseurship and criticism is entirely dependent on the expertise of the researcher-critic.

Two experts were consulted to provide comments and feedback on the package by verbalizing their thoughts and reacting to each screen as they worked through them. Their comments were recorded for analysis using a tape recorder. The STS lecturer reviewed the following issues:

- *the STS approach*: to find out if the researcher in the design is using an STS approach (i.e. starting lessons with an issue or problem, involving the collection of information about the issue or problem, evaluating and analysing the issue or problem, making decisions and taking action) and
- *the content*: Whether in using the topic on human population dynamics, the researcher has selected the appropriate materials within this topic (i.e. is the content accurate and does it meet the requirements of the syllabus on this topic?).

The instructional designer looked at the following:

- the screen and user friendliness of the package

- the instructional strategies used in the package
- general effectiveness of the package.

The critiques and appreciations obtained from expert review are summarized in Chapter five (table 16). The table also indicates some of the modifications that were made to the package.

4.6 USES OF DATA OBTAINED

Based upon the preliminary results obtained from the teachers when the package was first administered and used, the package was modified accordingly. Then it was viewed by the two experts and the results were used to refine and expand the package further. The purpose of using these research techniques was to determine the extent to which the package was achieving its intended objectives, and finding ways to further improve it.

4.7 DATA ANALYSIS

Qualitative and quantitative data was obtained from the two instruments, so open coding was used to analyze it. According to Macmillian and Schumacher (1993) coding is the process of dividing data into parts by a classification system. The purpose of dividing data into categories was for the researcher to rearrange or reorganize the data in order to work with it. During the coding process, all responses were put in common and meaningful themes that emerged, using the accepted procedures described by Cohen and Manion (1994) and Strauss and Corbin (1990). The researcher used the strategy of starting with predetermined categories, for example “coverage of the package in terms of content and instructions of the package”, “suitability of the package for matriculation teachers” and “usefulness of the package to promote learning of human population dynamics” as well as adding new categories that emerged as the data were analyzed. The final categories were not predetermined, but were obtained out of the data.

The next chapter involves a discussion of the results obtained from the questionnaire and expert review.

CHAPTER FIVE

RESULTS AND DISCUSSION

The results of this study have important implications for improving the package before teachers can use it in their classrooms. All quotes are given verbatim and the following trends emerged from the data obtained from questionnaires and expert review.

QUESTION: What is the purpose of the web page, is it complete, understandable and clearly stated?

Teachers were asked to fill in details on a number of items concerning the purpose of the package. Teachers' responses to a number of items revealed that they were not sure for whom the package was designed. Although some teachers realized that the package was intended as a resource for lesson preparation by teachers, it seemed that a number of teachers believed that the package was for use in the classroom as will be seen in the discussion below.

Table 9: Teachers responses according to the purpose of the package

Responses	Frequency (n=9)
to teach STS	1
to use computers to teach STS	1
to teach population dynamics through real-life	1
to give instructions and information	2
to introduction the whole package contained	1
No response	3

Two out of nine teachers indicated that the purpose of the package was to teach STS and to use computers to teach STS. These teachers may have meant that the purpose of the package could be to teach STS or for use in teaching because the responses given were not detailed enough to make conclusions. One teacher recognised that the intention of the package was to teach population dynamics using a computer package which uses real-life issues. However, the other three teachers said the purpose of the package was to give information and instructions as well as to introduce the package. This was contrary to the intended purpose showing that the explanation given on the purpose of the package was not clear. Nevertheless, six teachers when asked if the purpose of the package was clear, they all agreed that it was.

The purpose of the package was explained as shown in the abstract from the package below. This was before any modification was done from the responses obtained from the teachers and expert reviewers.

This site is designed for teachers teaching grade twelve in any school which has computers. The computer package uses a Science-Technology-Society approach to teaching human population dynamics. The theoretical framework behind the development of the package is Situated Cognition which emphasises use of real life examples to teach concepts. This makes learning interesting, and also relevant concepts.

In addition, there have been changes in teaching pedagogy from teacher-centred to learner-centred. This approach supports such a move as learning involves active participation of learners.

The STS lecturer also queried the explanation on the purpose of the package. Reading the text on the purpose of the package, she wondered whether the package was intended to help teachers with their lesson preparation or for class work. However, she thought it was worthwhile to have a school with computers because she can then perhaps use the programme like graphing. But she asked for some clarifications;

“ So I think the question for me is (pause) do you want the teachers to take this programme and actually use aspects of it with the school kids? ”.

This misunderstanding was as a result of the emphasis that the researcher had put across to the teachers that they should go through all the activities so that they could be able to know how to teach the content. But it was strongly cautioned that it should be made clear whether the teachers should use these exercises and then do them with their learners or make hard copies and do other activities with their learners. Reading carefully through the information, the expert reviewer agreed that maybe it is important that teachers should go through the activities so that they can understand the STS approach and how one can use the package in a classroom situation using computers. Therefore, it was well understood that if teachers understand the STS approach through this computer programme, then they will get an idea of how to use it in the classroom. This does not necessary mean that teachers have to use the programme in the classroom.

However, both lecturers who did the expert review acknowledged that the information given up front for the teachers was important because it gave the purpose of the package.

“I really like that bit of information that you have got here, it is telling the teacher the purpose of the package”.

The results from the teachers who used the package and from the expert reviewers revealed that the purpose of the package was obviously not clear and this had to be changed. The response from one lecturer justified this.

“But you are claiming that the package should be used to help teach population dynamics and I don’t think that was the purpose at all. So that needs to be corrected”.

Re-reading the statement on the purpose of the package, the instructional designer suggested that the statement should be changed to indicate that teachers will use the package to develop and understand skills on how they could use the STS approach to meet some of the demands of *Curriculum 2005*.

Part of the purpose included the outcomes of the package which one of the lecturers appreciated. *“It is a very good idea to have up front, what the outcomes of the package are...”*

**Question: How easy is it to find your way around the site and follow the activities?
(Navigation/links)**

According to Herrington and Oliver (1997: 134) *“navigation is provided in instructional materials to enable the user to move around and investigate the resource”*. This is important so that users can locate and access information, move between related information, establish their positions within the information and be able to return to known screens.

Teachers were asked to indicate how easy it was for them to find their way around the site and follow the activities. All the eight teachers found it easy to view different screens of the package and to do the activities. The eight teachers said they could move around the package easily.

Table 10: Navigation

Question	Response
Can you move around the web page easily?	7 = Yes
Are there sufficient shortcuts or links available?	7 = yes
Are the links visually obvious?	6 = yes 1 = no
Are the links consistent throughout the web page?	7 = yes
Do the links take you directly to the information?	7= yes

Most of the teachers responded that the instructions were clear and some of the answers given included:

“Yes, there are key guides that makes it easy to access”

and,

“Yes, didn’t experience any difficulties.”

This was possible, because there were sufficient shortcuts or links on each screen and the instructions given on the computer could direct them. These links were visually obvious as they were highlighted in bold colours. For instance, one teacher said:

“The links were highlighted in bold colours and on every page there is a link to take you either back or forward.”

Below is an abstract from the package showing one example of navigation system and instruction that was given at the end of the screen before any modifications were made.

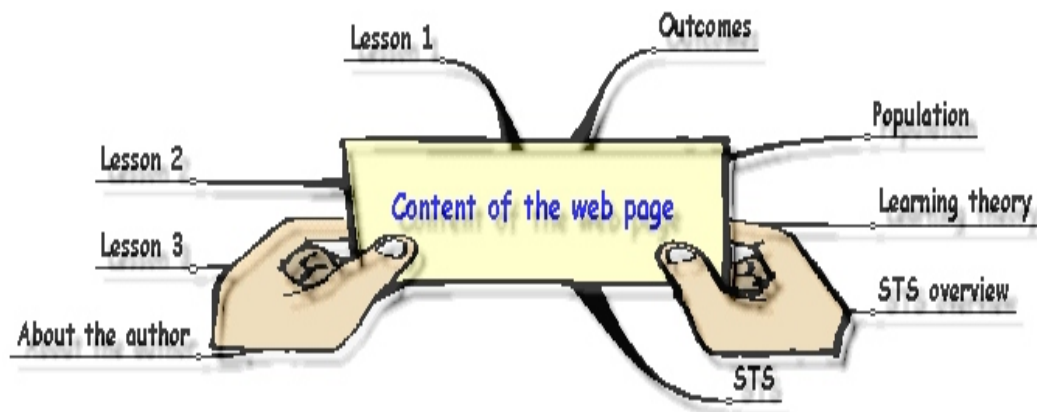


Please proceed to the learning theory by clicking the button below "Learning theory"

Homepage	Learning theory
--------------------------	---------------------------------

However, one of the expert reviewer wondered if the mindmap on the content of the package could not be used to orient the teachers in the programme. In order for teachers not to get lost in the programme, this expert reviewer suggested it could be better to use the mindmap and maybe number the contents so that teachers could follow a particular sequence.

“ I believe that if you want this mindmap to orient them to where they are in the programme so that they don't get lost, you can go back each time to this mindmap”.



One expert reviewer suggested that a mind map like the one below should be used to orient the teachers around the package. The users would always be told on each screen to go back to the home page and make a selection of the next screen to visit from this mind map.

Secondly, it was suggested that the instructions should be changed at the end of each screen. This was important because teachers can be given instructions on how to do it and the map would be one way of helping them to keep track of what they are doing. Without these instructions, teachers could get lost in the package. For instance, on the outcomes, this particular expert reviewer suggested that;

“ ...I’d suggest that at the bottom of this page..... lets look at the learning theory next, to access it or to find information on learning theory go back to the concept map or the overview of the programme, either by clicking on the back button... or by clicking on home page”.

Therefore, it was suggested that at the bottom of each page there should only be buttons to take teachers to the home page (content map) and a back button to take them to the previous page.

“ I think it would be easier for you to just have a home page, your content mindmap, a button which says back or previous page and lesson 1..... they generally know where it is they’re going”.

This expert reviewer preferred to access lesson one and other information from the map because she believed that the map was going to get the teachers to check where they have been in the package.

Thirdly, it was suggested that an explanation should be given to explain why teachers should go to the next screen, ie the relevancy.

“Go straight to the learning theory, but you don’t give the teachers any explanation why this is relevant, why do they need to know about learning theory.... ”

Therefore, it was suggested that some introductory statement should be included such as:

“educational researchers have found that (pause) when teachers use methods in their classroom which are based on learning theories (pause) based on the research, has shown to be effective (pause) it actually improves learning in the classroom. One learning theory that has been used in this package is called situated cognition”.

It is after this statement that teachers would be told to click and find out more about what situated cognition is or any other topic and why it is important.

On the other hand, a number of appreciations were expressed on the directions given to teachers at the end of some screens such as:

“ At the bottom of STS, I think that it’s very good that you’ve said you can proceed to lesson 1....?”

Question: Give your comments below about the structure of the web page (Structure of the lessons).

Teachers and the expert reviewers gave similar responses on the structure of the lessons. Below is a table showing the responses from teachers.

Table 11: Responses on the structure of the lessons

Question	Response
The lessons are well prepared and structured (i.e time allocation, material needed, objectives, grade level to teach).	Excellent = 3
	Good = 2
	Average = 1
	Fair/poor = 0
	No response

Table 12 indicates that six teachers out of nine thought that the structure of the lessons contained in the package was well or averagely structured. The other three teachers did not respond to this question.

There was appreciation for the design of lessons by the two expert reviewers in terms of the way each lesson was structured, that is the time limit, materials needed for that particular lesson etc.

“ I am glad to see that you recommended a time limit for the lesson”.

Going through the structure of the lesson, the STS expert reviewer said,

“ It covers one parameter under this topic population decrease (skimming through the text on the topic, she reads on) the movement of population through mortality, okay, topic, mortality and decrease (stops to read and explains what she understands on the topic) so the general topic is population mortality and decrease..... grade twelve.....one and a half hours..... that is nice (pause again) subject, alright that is good looking, concept..... mortality in a population..... facts..... mortalityokay so we’ve got all the facts”.

However, it was noted that there is no school in South Africa where one can find a lesson being conducted for about 1hour 30minutes. As a result of this, it was impossible to call it a lesson but rather a section of work. In order to cover the whole time limit required to complete a lesson, it was decided that each lesson have three half an hour sections or have a double period and a single period.

It was also acknowledged that it was useful to have something on facts, which in the package was not adequately explained.

“ ...I think it’s quite a useful idea to have a thing here on facts, but you don’t indicate, are these the facts that will be taught to the kids?Are these the only facts that are going to be taught in this lesson?Are these the facts that teachers are going to know in order to teach the lesson?This , it’s got to be made clear what the purpose is in this, and who the facts are for and whether these are the only facts or whether these are the two important things that students have got to know at the end of the lesson..... so that also needs to be made clear”.

Below is an example of a lesson structure that was used to indicate the time limit, grade, topic, materials needed etc of each lesson.

Grade
Grade 12
Total duration
1 hour 30 minutes
Subject
Biology/Geography
Concept
Population dynamics (mortality in a population)
Facts
• Mortality indicates the number of deaths that occur in a population. It is the rate at which deaths occur and it can be shown as a percentage or as a definite number. Mortality causes a decrease in population growth. • The population size can be reduced by disease e.g. AIDS and HIV. Micro-organisms causing these diseases spread, usually by contact, more rapidly in a dense population. The disease can be a major epidemic decreasing the size of the population considerably.
Outcomes of the lesson
At the end of this lesson, learners should be able to; -understand the concept of population decrease -be aware of how AIDS/HIV can in some cases reduce the population numbers

There was also the issue of separating the tasks for the teachers and that of the learners. One expert reviewer said:

“ Now you ’ve got to be careful (explaining) because now you ’re in the middle of the lesson and suddenly you ’ve got some information for the teachers. Any information for the teachers, you must keep it outside the lesson ”.

Therefore, this expert reviewer suggested not to have lessons and lesson plans, but rather to just let the teachers move through the activities in the package. They also wondered if the researcher wouldn't have a certain box, every time in the lesson that something is being said to the teachers, it is put in that colour box. In addition, it should be made very clear up front to the teachers that although the lessons are for the learners, there is need while they are learning as teachers to explain certain things to them and it will always be done in that particular box.

With the lesson development, the expert reviewer supported the idea of having some discussions so that the teacher can see what learners already know (prior knowledge) before they came into the classroom. However, it was argued that the activity should be well structured so that teachers can easily understand what they are expected to do. It was revealed that most of the questions were not clear and had to be re-worded. For instance, on the discussion of AIDS/HIV statistics, it was thought that questions should be separated between the sensitive one and the non-sensitive.

“ you need to say some of these questions are very sensitive and we ’ve put them under the heading “questions for reflection only”. So these are the ones that you ’re not going to ask children to talk about. You ’re going to give them to think about on their own..... just needs a clearer explanation ”.

In addition, caution was given that care must be taken when working with real figures because some figures used in the activities were just examples.

The inclusion of a graph to illustrate the effect of AIDS/HIV on a population (i.e an increase or decrease in a population caused by this disease), was also well accepted.

“ I must tell you, this is attractive, I like the look of your screen ”.

It was also felt that it was a good idea to have the graph next to the table containing the figures which had to be plotted.

“ Okay, I really like the idea of having this table right next to the graph so you can continually compare the figures on the table against the graph ”.

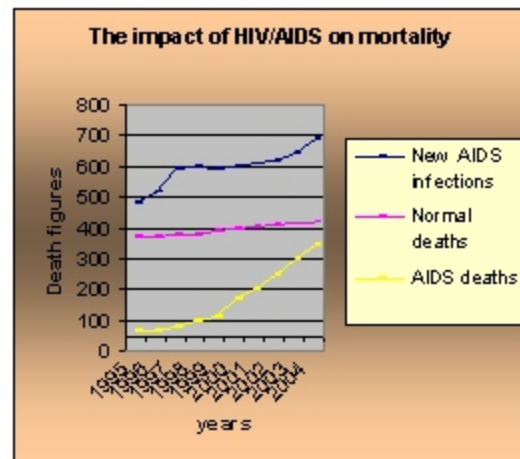
However, there were criticisms pointed out with the background of the graph, the colouring and the numbering of AIDS/HIV figures.

“One problem however, is this background. You ’ve got this dark area in the middle exactly where your writing is (pause) so you can not read that axis (explaining in detail) again your figures which you need in order to answer the question..... it is difficult to read those figures. Can you change the background colour of the legend..... can't be yellow because one of your lines is yellow, so you can't see it ”.

It was revealed that the numbering and labelling of the axis containing the figures for the disease did not indicate the figures in thousands, but rather it read hundreds which was not the case. This caused a fear that the thousand was going to get lost over the table and in the graph.

Below is an example of how the table and the graph were displayed and designed.

Year	New AIDS	Normal	AIDS
	infections	deaths	deaths
1995	480	370	65
1996	520	375	70
1997	590	380	80
1998	600	380	100
1999	595	390	110
2000	600	400	170
2001	610	405	200
2002	620	410	250
2003	650	415	300
2004	690	420	350



QUESTION: Is the documentation and instruction of this web-based computer package on human population dynamics adequate?

1. Coverage and content of the package

Table 12: Teachers' responses on the coverage of the package

Question	Response	Frequency
The topics of the web page are well covered and offer a wealth of information related to human population dynamics.	Excellent	4
	Good	3
Is the documentation and instruction of this web-based computer package on human population dynamics adequate?	Covers concepts taught from the school textbooks.	3
	Covers all the steps required to teach the STS approach.	2
	Does not cover the whole content on human population dynamics.	1
	It contains general coverage.	1

Seven teachers felt that the coverage of the package was adequate and that the topics contained in the package are well covered, offering information related to human population dynamics..

*“For Grade 12, I’d say yes, the information is enough for them to grasp the content.”
(Teacher G)”.*

However, one teacher felt that the package did not adequately cover the content of “human population dynamics” required by the matriculation syllabus. She pointed out that the package:

“leaves out some aspects of the syllabus. If used some educators may stick to it and leave out some important aspects of the topic.”

This indicates that a note must be added to say that this package cannot cover the whole topic of human population dynamics therefore, the teachers will need to use other resources to teach aspects not covered here.

Two teachers clearly used their textbooks as a guide to what content should be covered in human population dynamics. One teacher commented on the package as follows:

“it links the issue to the textbooks provided, so it is not outside the context,” (Teacher B)”.

This teacher was satisfied that the package incorporated the concepts found in the matriculation textbooks. This supports the research findings by Naidoo *et al.*, (1990) that the teaching of human population dynamics is generally textbook-centred. It also supports the claims made by Hockey (1995) that teachers rely on textbooks as the only source of information and that this contributes to the inability of teachers to engage in innovative teaching methods as well as to adopt meaningful approaches in their teaching.

A further two teachers felt that the package covered all the steps required to teach human population dynamics using the STS approach. For example one teacher said:

“Yes, it explains all the steps required in STS, teachers role, materials, learners’ roles, method of assessment”.

2. Instructions

The responses from both the questionnaire and expert review clearly showed that most of the instructions were not clear enough for the teachers to understand what was being required of them. Teachers were asked if the instructions given in the package were clear and easy to follow.

Table 13: Responses on the instructions of the package

Question	Response
The instructions given in the web page are clear and easy to follow.	Excellent = 4
	Good = 2

	Fair/poor = 0
	No response = 3

Even though six teachers who responded to this question said the instructions of the package were excellent and good, one teacher suggested that the instructions of the package be improved and the reason given was:

“The learners instructions..... make sure that they are clear and you have actually applied them before using them”.

A major problem that arose from the instructions is that the intention or the purpose of the package was not clear to the teachers. This caused confusion amongst teachers and the expert reviewer as to who the package was intended for, the learners or the teachers?

“ And one says why do we have to go through the activities that have been developed for learners.....you see those activities are been developed for learners and not for teachers”.

This expert reviewer explained that the language used in the package is often switched from whether the programme is for the teachers or whether it is for the learners.

The aim of the package was to introduce the teachers to an STS approach to teaching human population dynamics, which included various activities that learners would under-take, and the assessment of each lesson. However, the teachers needed to go through all these activities in order to teach the concept of human population dynamics using ideas from the package. The idea was if teachers understood the STS approach through this computer programme, then they would get the idea behind it on how to use it in their classrooms. It did not necessarily mean that teachers had to use the programme in the classrooms. In order to avoid this confusion, it was suggested by one expert reviewer that the wording of the information be changed to:

“ although the learners are going to be very actively involved in this lesson, the teacher has a vital important role to play, in fact, they have a number of different things they’ve got to do....”

The instructional designer also made some criticisms that there were not enough instructions for teachers on how to go about viewing the package from one screen to another. This needed to be modified to include some explanations For instance, after viewing the learning theory, teachers were told to go to the screen on population content. But no explanation was given to justify the importance of doing that. Therefore, one lecturer said:

“ please say, before one teaches this section of work, it is important that teachers understand the biology content. To review the knowledge that a teacher needs in order to teach this section, turn to the concept map and click on population”.

and,

“define and explain the concept population,now you’re telling the teacher they have to define and explain population, and where must they do that?In their heads?..... On paper?..... You’ve given an instruction and you haven’t given them enough information on what to do”

and,

“but now teachers are going to be confused, what is lesson1?..... What is going on here?so you need to say something like, here is a sample lesson or we would recommend that you use three lessons to teach this, have a look at the three recommended lessons. Somehow you’ve got to tell them what is going on”.

One expert reviewer also indicated that there were a lot of assumptions made which needed to be explained clearly so that teachers could understand what was being asked of them.

“ you’re making a lot of assumptions that the teachers knows what you are talking about. For instance, “ you’re now talking about population dynamics lesson, and I am completely lost (pause) you haven’t said that in fact in this package you’ve two lessons dealing with population dynamics or you’re not telling the teachers what is going on and I think it’s because it is so clear in your mind that you can’t think that the people can get lost.....”.

In order to avoid these assumptions it was suggested that some explanations should be given to help teachers interpret the instructions.

QUESTION: Is this web-based computer package suitable for matric teachers?

Teachers were asked if the computer package is suitable for matric teachers. The purpose of this question was to find out if the package is suitable for teachers to use in teaching biology or geography. A number of responses were obtained as shown in the table below.

Table 14: Responses on the suitability of the package for the teachers.

Question	Response	
Is this web-based computer package suitable for matric teachers?	Yes	▶ For teachers to use in their lesson. preparations and use in classrooms. ▶ To enforce skills. ▶ To expose learners to science and technology.
	No	▶ Teachers are not computer literate to use computers. ▶ Computers limit teacher involvement.

One of the eight teachers thought the package was suitable for matriculation teachers because it could be used to prepare lessons and use in class. The response given was:

“The package was suitable for lesson preparation and use in class”.

Whilst the other one who said the package was suitable for teachers said:

“Using computers in teaching is becoming a common and interesting practice which enforces the skill in both teachers and students. The topic will be used for such a purpose also”.

The third teacher thought the package could expose learners to science and technology.

“It is easy to understand and follow. It is a good way to expose learners to both science and technology at the same time”.

However, some reservations were expressed that the users of the package may not be computer literate. Concerns were raised about computer literacy and its effect on the use of the package:

“Would be easy if they are computer literate,”

Yes, but I doubt if most of the teachers are computer literate enough to make their learners learn easily.”

According to Ward and Newlands (1998) greater use of computers will presumably improve people's computer literacy. One teacher observed that:

“It will limit teachers involvement and also hand-outs will be issued in minimum numbers.”

This response may indicate the fear that teachers would be less involved in the teaching and thus would have less control in this learner-centred approach. This supports Naidoo *et al* (1990) research findings that showed that South African schools tend to follow a teacher-centred approach. It is also interesting that this teacher has misinterpreted the purpose of the package. This also reveals a problem in the design where the researcher was finding it difficult about who the package was designed for. The package is intended for the teacher and not for the learners.

QUESTION: How helpful do you find this web-based computer package in promoting understanding of human population dynamics concepts?

Teachers were asked to explain if they found the package helpful in promoting understanding of human population dynamics concepts. Two teachers said that the package would be helpful for the learners and also assist the teacher in dealing with certain topics taught under human population dynamics concept. Some teachers felt that the package was:

“Very informative, encourages learners to participate and regard issues as part of their own.”

In particular one teacher observed that the:

“Package included information from what learners are familiar with, linking learning with real life.”

According to Ausubel cited by Sanders (1988), meaningful learning occurs when the material to be learned is potentially meaningful to the learner. Pope and Gilbert cited by Sanders (1988) agree that meaningful learning will only occur if the content to be learned is regarded by the learners as having personal relevance. These responses indicate that the content used relevant issues that learners can relate to and that the activities are learner-centred.

QUESTION: Do you have any suggestions on how to improve the web-based computer package?

Teachers were asked to give suggestions on how to improve the web-based computer package. Even though most teachers did not give any suggestions on how the package could be improved, one teacher strongly suggested that the instructions be made clear. It was also evident from the responses that teachers would like the package to include all the topics covered under human population dynamics. However, this is not the intention of this package and it will be made clear to the teachers when the package is modified. Two other teachers said the package was well designed and only needed a few changes.

OTHER TRENDS THAT EMERGED FROM THE RESPONSES

Terminology/language

The responses from expert review showed that some terms used in the package would not be familiar to teachers and therefore, needed to be explained.

“...the computer uses a Science-Technology-Society approach (reading and then pauses for a moment), ah, the main words in that explanation that I don't think I will understand.....they won't understand what situated cognition is..... which needs to be spoken, they won't know what theoretical framework is. So you need to use language that teachers are going to understand, because most teachers are not going to be at that level”.

Therefore, it was strongly advised to use everyday language which teachers could understand.

“ I can tell you, that is not teacher level language”.

Layout of text

The most important advice in instructional design is not to display the information like a textbook, full of written text. But rather the information should be easy to read and attractively displayed. This aspect came up in the package, where for instance, the STS expert reviewer said;

"I find it boring on a computer programme to have continuous text..... so to me it would be nicer again to have a sort of mindmap. Get away from the textbook language, give it in simplest terms, its got to be catching".

As a result, the STS expert reviewer advised that repetition of text should be avoided and the researcher should try to have as few words as possible on the screen which focusses on the key words. She felt a computer programme should excite a person and make them want to read facts and move on. Otherwise the users might as well be reading a textbook rather than use the programme.

In order to display information in an attractive and a simpler form, a number of suggestions were given, *"...do this as a bullet list.... carefully list the aims"*.

and,

" I would like to suggest that if you've got several different points that you're trying to make, instead of continuous text on a paragraph (pause) that you consider using bullet list to make these points, (explaining further) because a bullet list is a way of helping the teacher understand the structure and if there is a lot of information, it's going to be much easier for me to grasp".

It was argued by one expert reviewer that the importance of such layout of information is to allow the users to pick up the points just by looking at it and be able to visualize the whole thing quickly.

There were also some appreciations expressed on the display of information in boxes. Looking at the information given on the introduction of the section, one expert reviewer said;

"....I like that you've got this important (pause) and then a box outlined in blue because it makes it easy to see...".

and,

" I must tell you, I love these blue boxes, and they look very attractive and I think it is quite important to show the teacher what it is you're looking at".

The STS expert review also thought some of the layout of the lesson was nicely designed.

(Reading from the text: *" The movement of population through mortality and emigration causes a decline in the population). Now I look at that and then immediately it attracts my attention because you've got a heading..... and I really like the font you've use. Then you've got a short bit of text (pointing to the text on the screen) so it is not boring for me to read. That is only four lines and it has been put in a brown block. That is an interesting block and particularly the method uses a lovely graphic with AIDS on it"*.

However, one of the expert reviewer strongly advised that there should be consistency in the display and colour codes in presenting information. For example,

“I think you need to be consistency in your colour coding throughout the package”.

Secondly, the sequence of the content of different screens had to be re-arranged in order to render better understanding when teachers are using the package. For instance, it was advised that the STS approach to teaching should be brought earlier than the population content because the essence of the package was to teach teachers how they could use this approach which lends itself so well to *Curriculum 2005*.

“ trying to teach teachers about STS, and to me the first thing that you need to do is you need to introduce them to the STS approach.....section on content needs to come later.....first explain to them and linking it to Curriculum 2005 because you’re telling the teachers, one of your outcomes is to link it to Curriculum 2005.....”.

Font/size

It was generally felt that the font size used in the programme was nice and readable to the users.

“ I like the print that you’re using there, very nice and a mindmap there”.

Colour

A number of comments from the instructional designer indicated some appreciation of good designs that were used. Nevertheless, it was pointed out that some designs needed improvements, for instance, looking at the heading of the package, one reviewer said;

“I like your rainbow colour heading (looking carefully at the words) but I need to say that I find the light orange, the yellow and the light green impossible to read”.

and focussing on the type of content display of the package, she said;

“I really like the idea of having a concept map to show them contents of the package”.

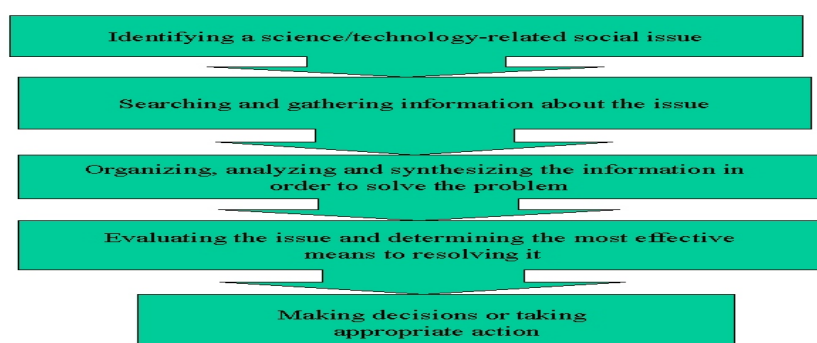


Welcome to an exciting STS teaching approach
to Human Population Dynamics
for
Grade 12 biology/geography teachers

Use of graphics

There were some reservations expressed on the use of graphics for a variety of reasons. For example it was felt that some graphics stretched, becoming impossible to read the words.

“I must tell you that a lot of these graphics that you’ve put in are very difficult to read the-text..... it’s really lost the words”



Most of these graphics mentioned were only impossible to read when inserted in the computer package using Dream weaver software. However, the criticism was taken into consideration because teachers may not read the text.

Other graphics were thought to have been used inappropriately as they were not corresponding to the content of a specific screen.

“Although you’ve got a beautiful graphic there saying AIDS, and then it comes to the heading topic, population mortality and decrease, it doesn’t tell me anything about AIDS, I can’t see the link”.

The STS expert reviewer also expressed these reservations.

“I mean I don’t know if AIDS is appropriate here (points to picture).

Presentation

Even though the package included newspaper articles that were well labelled with dates indicated, one teacher said,

“It would be more interesting if you could also include articles from newspapers and pictures as part of lessons. Provide the newspapers name and date.”

Perhaps the newspaper articles were not well presented, or the teacher simply skimmed through the package and did not read carefully enough. The presentation of these newspaper articles were reviewed when making some modifications to the package.

Teaching approach

Even though the teaching approach linked so well with the *Curriculum 2005*, it was revealed that there was need to explain the approach very well. In order to do so, one of the expert reviewers argued that caution had to be taken to avoid teaching in a traditional method which the package was trying to avoid.

“ And what I don’t think you should be doing now is telling them how to teach, and in particular what you should not be doing is telling them to teach in a traditional textbook way which this is trying them to do, although you may not be aware of it”.

The STS expert reviewer made several comments about the teaching approach used in the package, whether it was an STS approach or not. She also looked at the content of the lessons.

Lesson 1

The STS expert reviewer agreed that lesson one was using the STS approach because it starts with an issue which is relevant, it is using a local and national issue. In the STS approach, emphasis is on social problems, issues or events which are used as the starting point of learning (Hart cited by Hurd, 1989). Carefully reading through the lesson, the STS reviewer says the lesson focus on HIV/AIDS as a local issue by asking the learners questions about people they know and in particular, members of their family who have died of HIV in reflection questions. She explains that for instance, questions for discussion, you ask how many people have AIDS, dealing with figures they know. The STS approach uses activities which deal with problems affecting the learners’ lives and society (Fensham, 1994) which in this lesson is HIV/AIDS. An example of the lesson structure is shown below.

QUESTIONS FOR REFLECTION

Do you know of anybody who have died of AIDS in the past year?

Have any members of your immediate and extended family died of AIDS/HIV in the past year?

Do you know any of your friend's family who have died of AIDS/HIV in the past year?

QUESTIONS FOR DISCUSSION

These questions are probably insensitive and now they should be open for whole class discussion. In our example, we have the following figures, lets' use these numbers and make the number we are trying to calculate x. In maths you have learnt how to solve for the unknown and this is what we are going to do here. Lets find x by doing the sum as in maths.

How many people do you know? e.g. 30 people

How many do you know of who have died of AIDS/HIV? e.g. 3 people

What is the percentage of the total number of people you know who have died of AIDS/HIV? $\frac{3}{30}$ of 100 = 10%

- ▶ If there are 60 people in your local community (in the area you live), how many do you think are likely to die of AIDS/HIV? To guide you, remember 3 people out of 30 people that you know have died of the disease, therefore, how many have died out of the total of 60 that are in your community?

$$\begin{aligned}
 &3 - 30 \\
 &x - 60 \\
 &x = 3 \cdot 60 / 30
 \end{aligned}$$

Let's imagine for our example that South Africa had a population of 33 million and see how we can use our figures to calculate how many people are likely to die of AIDS in South Africa. Use your figures here.

$$\begin{aligned}
 &3 - 30 \\
 &x - 33 \\
 &\text{million} \\
 &x = 3 \cdot 33 \\
 &\text{million} / 30
 \end{aligned}$$

In terms of activities used in this lesson, it was pointed out by the STS expert reviewer that this lesson uses a graph with AIDS statistics in South Africa which is a real issue. The STS approach deals with issues or problems which involves various activities such as analysing, investigation, discussing and debating where learners try to understand the science behind the issue or problem and find possible solutions to solve it (Ramsey, 1993, and Casey and Tucker, 1994). In interpreting the graphs, the learners would be interpreting and analysing the information about the national issue which is current and relevant to South Africa. However, the learners would not be able to undertake the second step in this STS approach of going out in the field to collect information because they would be using the computers. But in order to investigate the problem of AIDS, learners are provided with predictions rates from 2005 - 2010 which gives them an opportunity to investigate the problem further. In the STS approach, the final step is for learners to propose ways to solve the problem based on the evidence rather than emotions (Ramsey, 1993) which was not included in this lesson.

Lesson 2

The STS approach requires a variety of teaching methods (Solomon and Akenhead (1994) were one of one could be simulation. The STS expert reviewer pointed out that activity one in lesson two was using a simulation activity which is often used in an STS approach. The activity also deals with a real and global problem of food and starvation which is necessary and a starting point in the STS approach. Learners are also given the opportunity to analyse the problem by identifying the stakeholders involved.

Lesson 3

It was pointed out by the STS expert reviewer that lesson three is also using an appropriate STS activity where learners try to investigate how HIV/AIDS has reduced the population size using articles on South Africa. They further collect more information on the issue from the Internet. Current newspaper articles dealing with some of the latest information on AIDS gets learners to analyse and find possible solutions

to the problem.

These results have implications for further research if the designers of instructional materials have to achieve their objectives and effective teaching as well as learning.

Table 15: Feedback obtained from expert review and modification made thereafter

Second review of the package: Review of the package by an STS and instructional designer.		
Screen	Feedback	Modification of the package
Home page (front page)	▶ Used nice rainbow colour heading, but the light orange, yellow and green are impossible to read. ▶ Gave up-front important information on the purpose of the package, but made claims that the package should be used to help teach population. ▶ Did not explain the terminology “situated cognition” and theoretical framework. ▶ Use bullet list for aims. ▶ Used a good way to highlight information “blue box” with a title “important”. But re-word the statements. ▶ Used a good idea of a concept map to show the contents of the package. ▶ It is important to acknowledge all the other people who had the interest in designing the package.	▶ Changed the colour combination and font style. ▶ The purpose of the package was re-worded. ▶ Used language that teachers were going to understand. ▶ Used bullet list for aims and explanations of the terminology “situated cognition” and theoretical framework. ▶ Acknowledged all the participants to the design of the package (supervisors).
Outcomes	▶ It is a very good idea to have up-front what the outcomes of the package are. ▶ Explain the word context for teachers to understand. ▶ Aren’t other things that the package would teach? ▶ Make the mind map on home page to direct the users on this particular sequence. Tell the users at the bottom of each page to click on either a back button or on a hot spot “home page” to take them back to the map. Give more instructions to avoid getting them lost in the package.	▶ Included other outcomes of the package and explained some terminologies into simpler language. ▶ Directed users to go back to home page on each page in order to select the next page.

Human population content	▶ Give an introductory statement. ▶ Be consistent in the layout and colour coding of instructions. ▶ Be clear in your instructions to the teachers. ▶ Don't make assumptions that teachers know what is being said. ▶ Even though the idea of a diagram showing the concepts being covered and highlighted, outline clearly which concepts are being taught to help teachers interpret it. ▶ Bring this section on human population dynamics after that of STS. ▶ Link the STS section to <i>Curriculum 2005</i>, you seem to have ignored and missed that. ▶ Give enough information for instructions, such as what to do, how to do it and where to do it. ▶ Don't tell teachers how to teach, especially teaching in a traditional textbook way. ▶ Don't jump to conclusion that teachers would be interested in the vision and purpose. ▶ Use everyday language and try to justify. ▶ Explain what an issue is. ▶ Consider using bullet list to make points of continuous running text or paragraph. This is important because bullet list is a way of helping teachers understand the structure and makes it easier to grasp information. ▶ Most of the graphics used are difficult to read the text. ▶ Start with a problem rather than an issue because people will very easily be able to find a problem in their area. They are going to struggle to find an issue. ▶ Change some terminologies, like determine to propose, suggest or discuss different ways of resolving it and then make decisions about the issue. ▶ State clearly that even though learners are going to be very actively involved in the lessons, the teacher has a vital important role to play. ▶ Give clear directions at the end of the page.	▶ Outlined that before one teaches this section of work, it is important that teachers understand the biology content. ▶ Gave instructions to teachers that they would go through sections listed below. ▶ Clearly stated that the package was dealing with three lessons dealing with human population dynamics. ▶ Explained that the package is still under development and only those concepts highlighted in red have been covered. ▶ Gave suggestions why educators think that this approach is better. ▶ Included a diagram showing different things teachers had to do.
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Learning theory	▶ Give the reason why teachers should know about the learning theory. ▶ Give them direction where to go next.	▶ Included an introductory statement “educational researchers have found that when teachers use methods in their classroom which are based on learning theory, based on the research, has shown to be effective. It improves learning in the classroom”. One learning theory that has been used in this package is called situated cognition. ▶ Directed teachers: to find out more about what situated cognition is and why it is important, click on it.
STS content	▶ Give clear directions at the end of the page. Can’t say proceed to lesson 1 as teachers are going to get confused. ▶ Change buttons at the bottom of the page. It would be easier to just have a home page or content mind map r a button which says back or previous page and lesson 1. Tell them where they are.	▶ Changed to say that there were sample lessons that were recommended for teachers to use which teachers had to look at. ▶ Made teachers access lesson 1 from the mind map on the home page.
Lessons	▶ Re-word your sentences. ▶ Give clear directions. ▶ Link the graphics (AIDS) to the content of population decrease i.e mortality. ▶ Used very attractive blue boxes to tell teachers about the time, materials and concepts being taught. ▶ You will never find a lesson in South Africa that is 1hr 30m long.	