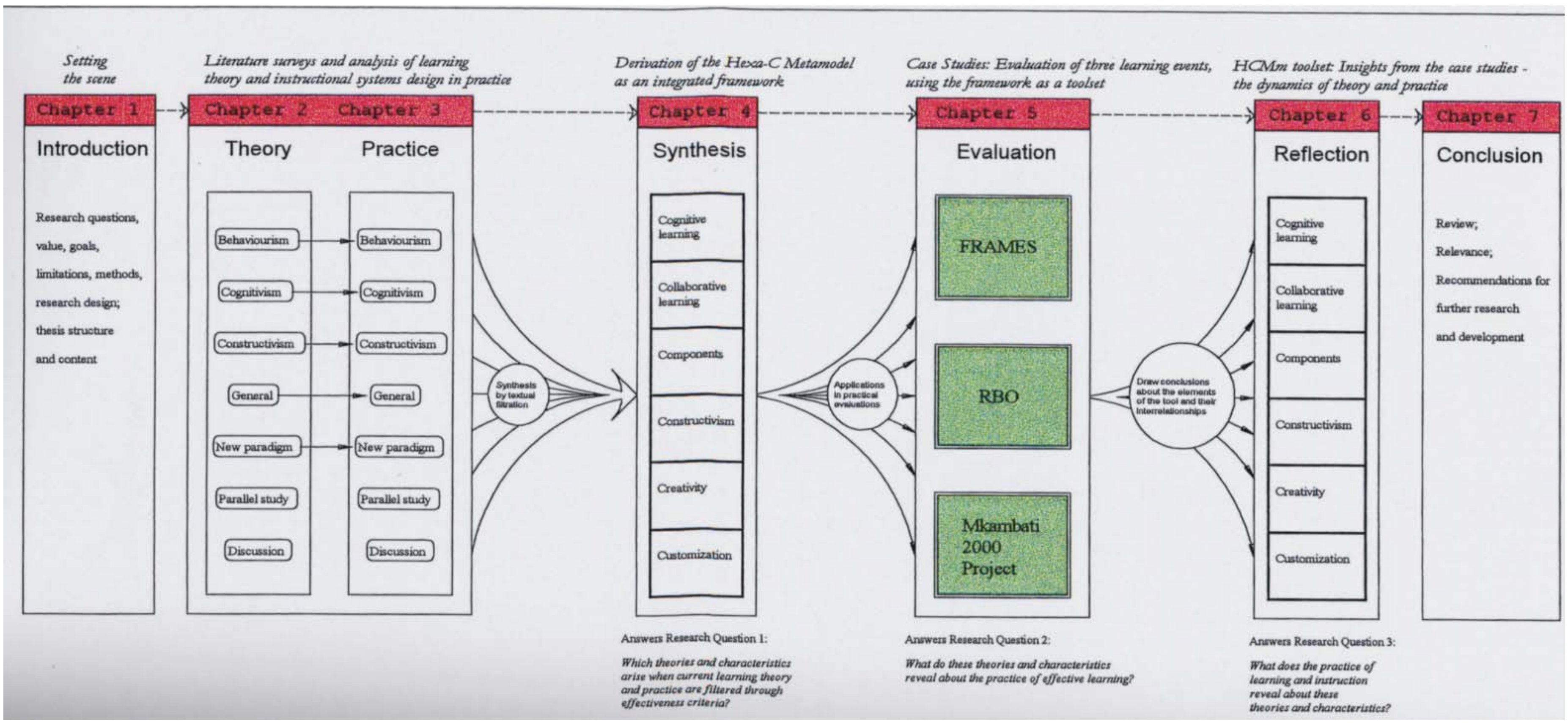
# Structure of the thesis



# Chapter Five

# *Evaluation*

## What the HCMm toolset reveals about three learning events – case studies

## 5.1 Introduction

The framework developed in Chapter Four, namely the Hexa-C Metamodel (HCMm), is applied in three case studies as a set of tools to **evaluate three different learning and instructional events** from the perspective of learning theory / instructional practice. Investigations are conducted to determine how the instructional design of each fulfils its requirements and solves the problem it sets out to address. Studies are undertaken of:

1. FRAMES, a computer-based interactive practice environment,
2. RBO, a web-based course, and
3. The Mkambati 2000 Project, a field trip/project in the subject of Ecotourism.

The inquiry undertaken in this chapter answers the second research question in Chapter One:

> *What do these theories and characteristics (i.e. the theories and characteristics of the HCMm) reveal about the design and practice of effective learning?*

The chapter has three major sections - Sections 5A, 5B, and 5C, for the three case studies respectively. The studies demonstrate the versatility of the HCMm, in that while Section 5B examines an entire course, the other two address specific aspects of courses, as indicated in Table 5.1.

### 5.1.1 The three learning events

The learning events investigated were chosen due to the researcher's close involvement with, and hands-on participation in, each one. Within the three sections, 5A, 5B, and 5C, certain aspects are repeated, so that each case study is complete in itself.

Table 5.1 summarizes the purpose and main features of the learning events, prior to the detailed evaluation and discussion of each study.

**Table 5.1 Introduction to the three case studies**

| **Aspect** | **Case study** | | |
|---|---|---|---|
| | **1. FRAMES (Chapter 5A)** | **2. RBO (Chapter 5B)** | **3. Ecotourism fieldwork and project (Chapter 5A)** |
| **Academic domain** | Mathematical concepts in an undergraduate course, part of a BSc degree in theoretical computer science | RBO, a postgraduate course in Internet-based learning, part of a masters degree in computer-assisted education | Postgraduate course in Ecotourism, taken as part of various honours and masters-level degrees |
| **Learning event analysed in the study** | FRAMES, an interactive practice environment, used as a supplementary learning aid | The entire web-based RBO course | The practical fieldwork and project-based part of the Ecotourism course |
| **Real-world problem addressed by the learning event, i.e. the general purpose** | To provide support for isolated distance-learners, tackling hands-on practice of mathematical skills | To train educators in:<br>- Presenting courses on the Internet, and<br>- Using the Internet to manage resource-based learning and distance-education | To supplement theory and case studies presented in a class situation with practical hands-on field work |
| **Aim of the instructional design, i.e. the particular strategy of the designer** | To produce a 'virtual tabletop' providing the objects normally lying on students' desks when they do exercises, and to offer an 'androgogic activity box' of options to practice | To place the educator-cum-learners in position of Internet-based learners, giving them first-hand experience of the receiving end of an Internet course, and doing so in a web-based 'classroom' | To tackle a real-life problem *in situ* and to present solutions collaboratively |
| **Use of computers** | Computer-based interactive practice environment | Internet and Web-based course | Computers used as tools. |
| **Date evaluated** | 1997, 1998 | 2000 | 2000 |
| **Relationship of researcher to the event, prior to and during the investigation** | Lecturer of the course and designer of the FRAMES computer-based environment | Learner-observer, a student throughout the duration of the 2000 RBO course | Participant-observer, present throughout the Mkambati field trip |

### 5.1.2 Research methods for evaluating the learning events

Basic systematic instruction is traditionally investigated empirically. However, reductive, experimental, quantitative research methods are not the most appropriate for evaluating problem-based learning and team-learning. Moreover, constructivist learning does not lend itself to research-based empiricism (Section 3.8; Willis, 1998). This research design is therefore non-experimental.

For the evaluations in this chapter, **qualitative ethnographic research methods** were used within an overall approach of action research (as described in Chapter One, Sections 1.4.1, 1.4.2 and 1.6.4), combined with limited quantitative data. Ethnographic research entails **investigation in natural settings, in-depth understanding of a situation, and personal involvement of the researcher in situations where he/she cannot exercise scientific control**. The **qualitative** evaluation approaches - data collection by questionnaires, observation, and interviews - elicited rich **descriptive information**, which presents holistic and interpretive pictures of the three learning events. Open-ended questions allow learners to substantiate and amplify their responses.

The surveys differed for each case study. The initial 1997 evaluation of FRAMES was a general survey, not specifically from the perspective of learning theory, while the follow-up interviews in 1998 were more focused on this aspect. Though not initially undertaken for the purposes of this thesis, the FRAMES data provides valuable input for the study. The survey of the RBO learners in August 2000 and the Mkambati evaluation in November 2000 were explicitly undertaken as part of this research and were evaluations from the perspective of learning and instructional theory/practice. The RBO questions were incorporated into a joint survey by two researchers, with each researcher extracting her data of interest. The Mkambati questionnaire was based on pertinent questions in the RBO survey, but expanded. Moreover, the RBO and Mkambati questionnaires were both contextualized to the specific learning event. All the questionnaires and the interview structure are available in appendices, but relevant questions are also included in each subsection.

Processing of descriptive, qualitative data involves careful assimilation and analysis of answers, and manual classification of open-ended responses. The process is labour-intensive and time-consuming, but with the small group sizes, was manageable for the researcher:

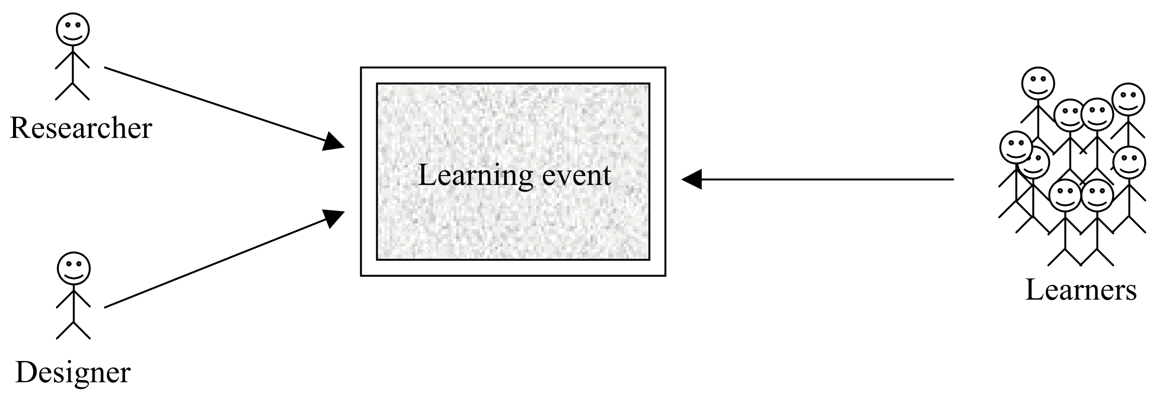
1. Case Study One : a sample of 18
2. Case Study Two: population of 22
3. Case Study Three: population of 12

Inquiry into the events, in turn, generated considerable further information about the evaluation tools, i.e. the elements of the metamodel and ways they can be applied to support effective learning. This is discussed in Chapter Six.

### 5.1.3 Structure and nature of learning event evaluations

Each of the three investigations is structured according to a consistent format, comprising six major sections - evaluating the learning event **according to the six elements that comprise the framework of the Hexa C-Metamodel**, namely: constructivism, cognitive learning theory, component theory, collaborative learning, customization, and creativity. Under each of the six element headers, there are three subsections analyzing the event from the perspectives of the researcher, designer, and learners, respectively, as shown in Figure 5.1.

**Figure 5.1 Evaluation perspectives:**
**How each element is used to investigate each event from three perspectives**




1. First, in the 'Initial discussion' subsection, the *researcher* discusses aspects of the event that comply with characteristics of that element of the metamodel, also investigating each case for features in line with appropriate theories and models introduced in Chapters Two and Three.
2. The second subsection presents the viewpoint of the *designer* of the learning event/resource, acquiring his/her overall impression on whether and how that HCMm element was implemented. These are presented in an informal, conversational style, based on interviews and consultations.
3. The third perspective presents data from the researchers' survey of the *learners*, incorporating appropriate extracts from the questionnaires. (As stated in Section 5.1.2, surveys differed for each case.) An interesting aspect of learners' responses to open-ended questions is that, as well as answering questions directly, many responses reinforce the inter-relatedness of the HCMm elements. For example, an answer to a question about customized learning may refer explicitly to creativity, and answers to questions in several sections related directly to collaborative learning. In such cases, the information is incorporated under the header where it is most appropriate.
4. Each of the six sections concludes with a fourth subsection, which discusses important aspects revealed by that element of the framework - strengths and shortcomings of the learning event, and how it achieved/did not achieve its aims and objectives.

Finally, each of the three evaluations concludes by relating the particular learning event and its wider context to Perkins' (1991a) facets of a learning environment (see Section 3.5.4), and by briefly re-iterating the role of technology in the event.

The credibility and validity of this research is enhanced by the extensive and participatory nature of the investigations. They were not the minor interventions (30 minutes to an hour) which characterize some instructional technology studies (Clark, 1989, cited in Kozma, 2000). Rather, the researcher had ongoing involvements with the learning events, as described in Table 5.1. Furthermore, the research designs (Sections 1.4.2, 1.5.2, 1.7.1, 1.7.3 and 1.7.5; see also 'grounded theory development' - Section 3.8.2), gave the researcher freedom and flexibility to investigate promising and unanticipated avenues within the study, rather than treating them in a *post-hoc* fashion or suggesting a new study.

The rest of this chapter is subdivided into three major sections for the three case studies - each complete in itself - as it sets out the detailed evaluation and discussion of a learning event:

1. Section 5A – FRAMES,
2. Section 5B – RBO, and
3. Section 5C – the Mkambati 2000 Project.

# Section 5A - *Case Study One: FRAMES*

The first case study relates to FRAMES, an interactive practice environment for mathematical concepts in theoretical computer science (De Villiers, 1995; 1998; 2000). FRAMES is investigated using the Hexa-C Metamodel to determine whether and how the instructional design of the learning event achieves its purpose. In the first part of Section 5A, the module and its context are outlined, then the content and *modus operandi* of FRAMES are described.

The next and major part of Section 5A is devoted to discussion, evaluating the practice environment according to the six 'C' elements that comprise the framework of the HCMm. Within each section, FRAMES is examined for its application of the appropriate learning theory or characteristic. As explained in Section 5.1.3, each section is further divided into three perspectives:

(i) Initial discussion by the *researcher*;
(ii) viewpoint of the *designer* of the learning event (who is an *instructor-designer*); and
(iii) *learner-data* - quantitative, but mainly qualitative, obtained from surveys and interviews;

before ending with a *concluding discussion*.

***Note***: The set of second perspectives in this evaluation (information from the designer's viewpoint) contains little information since, as stated, the researcher and instructor-designer are one and the same. There would be little value in repeating information already supplied in the first subsections.

## 5A.1 Introduction to FRAMES

### 5A:1.1 Immediate domain and purpose

FRAMES is a prototype version of an interactive practice environment for a first-level undergraduate BSc module in Theoretical Computer Science (COS101-S) at the University of South Africa. The module covers relevant mathematical concepts from the field of discrete mathematics, whereas other first-level Computer Science modules are oriented toward characteristics of computer systems and fundamental programming concepts. The section involving analysis of infinite relations and their properties has consistently been difficult for the target group. The FRAMES practice environment covers this section of mathematical manipulations on infinite relations, representing approximately 10 - 15% of the module syllabus (De Villiers, 1995). The package is called F R A M E S, because the R, A, and M represent a Relation, an Attribute and a Mode, respectively, the three choices a learner makes when selecting an activity or an aid component from the environment.

FRAMES is not a tutorial; it is a supplementary learning aid, which prompts, supports and makes help accessible as learners tackle problem-solving exercises hands-on. As indicated in Table 5.1, FRAMES has both a general purpose and a specific design aim, namely, to support isolated distance-learners by simulating a 'virtual tabletop' in its design. It is intended to provide the reference objects needed for a meaningful practice session, as well give feedback and guidance.

### 5A.1.2 Greater environment and learners

The greater environment of FRAMES is the University of South Africa (Unisa), one of the ten mega-universities of the world. Unisa is a distance-teaching institution with over 110 000 students. Headquarters are in Pretoria, the capital city of South Africa. It caters largely for mature learners, some of them taking first qualifications and others enrolled for continuing education. Approximately 30% of students are 25 or younger and only 20% study fulltime. Tuition is handled mainly by correspondence; in general, students receive their tutorial matter and submit assignments by mail.

The university is a needs-driven pioneer in the development of instructional multi-media, as printed instruction is increasingly supplemented by educational technology, such as radio, audio-casettes, video, computer-aided instruction (CAI), and more recently, by certain Internet-based facilities. Due to the disadvantaged, technologically-illiterate nature of some of its students, as well as the fact that many live in remote areas, Unisa has not been at the forefront of Internet- and Web-based instruction - but is increasingly migrating in that direction. Students with technological means can obtain information from the website, register and make administrative queries on the Internet, as well as submit assignments on-line. Lecturers can be reached by telephone and e-mail for academic queries.

Approximately 1000 distance learners take COS101 annually, with a high attrition rate reducing enrolment to about 600. As a first-level undergraduate module, it has higher enrolments of young students and fulltime students than the university's general profile, in that 50% of its students are 25 or younger, and 30% study fulltime. They mainly use conventional mail to submit assignments.

### 5A.1.3 Roles: the FRAMES designer, lecturer, and researcher

The researcher, who has a multi-disciplinary background in mathematics, computer science and education, is the current leader of the lecturing team for the module, COS101. She did not write the initial course material, but is the creator of FRAMES - having developed the concept and designed the practice environment, i.e. she is both lecturer and designer (De Villiers, 1995). In this evaluation she has a triple role, also being an action-researcher investigating an artifact of her own design. The product was custom-built and coded in the programming language *TENcore* by staff of the Centre for Software Engineering (CENSE), based in Unisa's Department of Computer Science.

### 5A.1.4 Material and approach of the FRAMES practice environment

Text Box 5A outlines the mathematical content of FRAMES and describes the way in which the computer-based program is used. It also describes how the learner evaluations were conducted.

## Text Box 5A Subject matter and modus operandi of FRAMES and the FRAMES learner-evaluations

***Why the name, FRAMES?***

In CAI terminology a 'frame' refers to a screen presentation. The central acronym, RAM, within FRAMES is significant, because learners using the environment select instructional components by so-called RAM control, selecting (i) a Relation, i.e. a specific mathematical relationship as the scenario for their practice, (ii) an Attribute of that relation, and (iii) a performance Mode.

***The goal of FRAMES***

The goal of FRAMES is to use ID principles to produce a practice-environment, a metaphorical 'andragogic activity box' providing various instructional activities and feedback on learners' efforts. Its human-computer interface is represented by a further metaphor - a 'virtual table-top', providing the objects (diagrams, definitions, worked examples, etc) that would lie on students' desks during typical problem-solving sessions.

FRAMES assumes subject-matter grounding in the simpler discrete relations, as it addresses analysis of the more complex infinite relations. It was designed to offer extensive and intensive practice opportunities in subskills and composite problem-solving skills, to present visual aids, to offer help and feedback, and to increase general domain-familiarity, all within the context of specific examples. It was built (De Villiers 1995, 1996; Kotze & De Villiers 1997), using the authoring language TenCORE 5.0. This highly interactive environment entails innovative instructional strategies, and called for programming techniques new to Unisa. The requirements were imprecise, requiring testing and evaluation. Screen layouts evolved in a form-follows-function manner, rather than adhering to specifications or storyboards. Prototyping was the ideal development route, since it is conducive to modification of the approach and strategies.

***Subject matter***

The content of FRAMES is the domain of infinite relations. Each relation is a set of ordered $(x,y)$ pairs with a specific relationship defined between $x$ and $y$. As an example, consider the relationship where $x$ divides exactly into $y$ - some of the pairs in this relation are (5,15); (4,8); (10,70); ... etc. Understanding the relation is more complex than it would appear from the above simple example, because the relations are expressed as mathematical formulae and furthermore, each relation is defined on a specified domain, such as the set of integers, the set of rational numbers, etc. In an exam or assignment, students are expected to test the given relation to determine whether it satisfies certain properties, e.g. reflexivity, transitivity, and so on. They also tackle composite proofs, which integrate various tests to determine the 'kind' of relation. The FRAMES system was developed to provide support and practice in these skills.

***How to use FRAMES***

As mentioned, learners using FRAMES select activities and aids by R A M control; the choices are executed by clicking on appropriate buttons. Using on-screen control, they make three decisions when choosing a component "to view or to do":

1. **Which Relation to choose**

   Relations are sets of co-ordinate (x,y) pairs, where a specified relationship exists between and the x- and y co-ordinates. The relationship may be defined by a formula or by a textual description. The Relations included in FRAMES are called **P, Q, S, T, V, W,** and **TR,** where, to define some:

   - **P** is the set on Z of all **(x,y)** pairs such that $\mathbf{x \leq y}$
     (where the domain Z is the set of integers { ... ,-2, -1, 0, 1, 2, ... } ).
   - **Q** is the set on Z of all **(x,y)** pairs such that **x - y = 3k**
     i.e. the difference between x and y is a multiple of 3.
   - **S** is the set on P of all **(x,y)** pairs such that **x | y**
     i.e. x is a factor of y, and y is a multiple of x
     (where the domain P is the set of positive integers {1, 2, 3, ... } ).

   On selection of a relation, its definition component appears on-screen as a 'blackboard'.

2. **Which Attribute of that relation to view, apply, or test**

   The 'attributes' of each relations are **Examples** of that relation, a **Graphic** aid, opportunities to test a mathematical **Property** of the relation, and a composite problem relating to the overall **Kind** of relation:

   - **Example** requires the learner to synthesize members of the current relation.
   - The **Graphic** attribute shows a visual representation.
   - **Property** attributes present mathematical tests for the properties of reflexivity, irreflexivity, symmetry, antisymmetry, transitivity, and trichotomy.
   - The special **Kinds of Relations**, namely, equivalence relation, weak-partial-order, weak-total-order, strict-partial-order, and strict-total-order. In order to be one of a particular 'kind', the relation must satisfy a specific set of the properties named above. The facilities available in this category allow learners to view model analyses, or do independent testing themselves to determine whether the appropriate criteria are satisfied.

   Knowledge of the properties of each kind of relation is stored in the FRAMES knowledge base, so that the system can select the relevant set of property tests for the composite 'kind of' analyses, and check a student's selected set in the independent mode (see 3).

3. The choice between Modes **1, 2,** and **3,** for doing property and kind exercises, where Modes relate to the kind of presentation by the system / performance of the learner:

   - **Mode 1** demonstrates a read-only proof, constructed step-by-step.
   - **Mode 2** offers guided practice using fill-in-the-blank structures.
   - **Mode 3** encourages independence, interspersing linking-structure with blank lines on

which learners input a do-it-yourself (DIY) proof.

The three modes cover the same content, but in different ways. Mode 1 sets out a complete worked proof as a model. In Modes 2 and 3 learners use keyboard-input and mouse-clicking to select mathematical characters from a symbol pad. Modes 2 and 3 also incorporate judgement, present feedback, and accept correct alternatives.

***Learner-evaluations***

Pilot-testing and evaluations of FRAMES were conducted in the Unisa context of distance education, with limited direct contact. A general tutorial letter sent to all students registered for the module in 1997 included a call-for-volunteers to try a prototype practice environment, and resulted in eighteen respondents. They lived in widespread regions, and represented an excellent spectrum of the heterogeneous students. The volunteers used FRAMES and completed learner-evaluation questionnaires in their study situations at home, at work, or in Unisa computer laboratories. Three discontinued the module, but of the remaining fifteen, fourteen completed questionnaires. The survey incorporated general aspects (outside the scope of this study), but was also aimed at aimed at evaluating FRAMES from the perspective of learning theory. There were highly structured questions where respondents could choose their rating from the available options, as well as open-ended questions and open-ended elaboration options. Triangulation, the use of data from multiple sources, was applied, in that the researcher held informal telephonic or personal interviews with about half the respondents, and investigated subsequent examination marks as a post-test.

A follow-up study in 1998 entailed in-depth, structured interviews with a few students. A tutorial letter extended a call-for-volunteers in Unisa's immediate locality, the Pretoria region, and resulted in four participants. These personal interviews focused exclusively on assessing the effectiveness of the application of learning and instructional theories.

Combining the volunteers from the 1997 and 1998 evaluations thus resulted in data from 18 learners.

Figure 5A.1 shows an introductory FRAMES screen, which presents the concept of R A M control to a learner, demonstrating the Relation, Attribute and Mode menus. The Relation menu offers a choice of seven relations, describing each by a formula that indicates its mathematical relationship. As the learner clicks on a menu, the selected item turns red. The screen in Figure 5A.1 also shows two pop-up elaborations, explaining, for example, the strategy of the Mode. On the activation of **GO** at bottom right, an operational screen would appear with the learner's selected activity/aid component.

Should a learner opt for the 'Kind of relation' component, he/she will undertake composite analysis, covering all the property tests required for the 'Kind' selected a attribute. Figure 5A.2 portrays the RAM selection - highlighted in red on the right hand control area - of:

i. Relation **P**;
ii. Attribute **Kind** followed by the sub-selection of the **WPO** kind (weak partial order); and

iii. Mode **1** (read-only).

*Figure 5A.1 A FRAMES introductory screen*

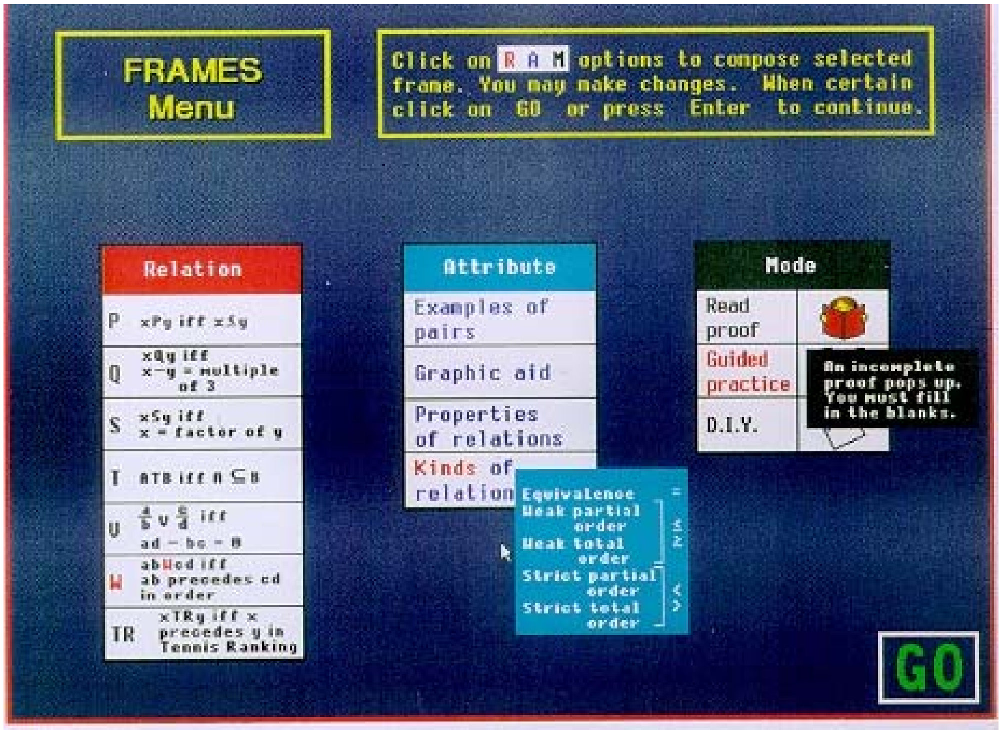
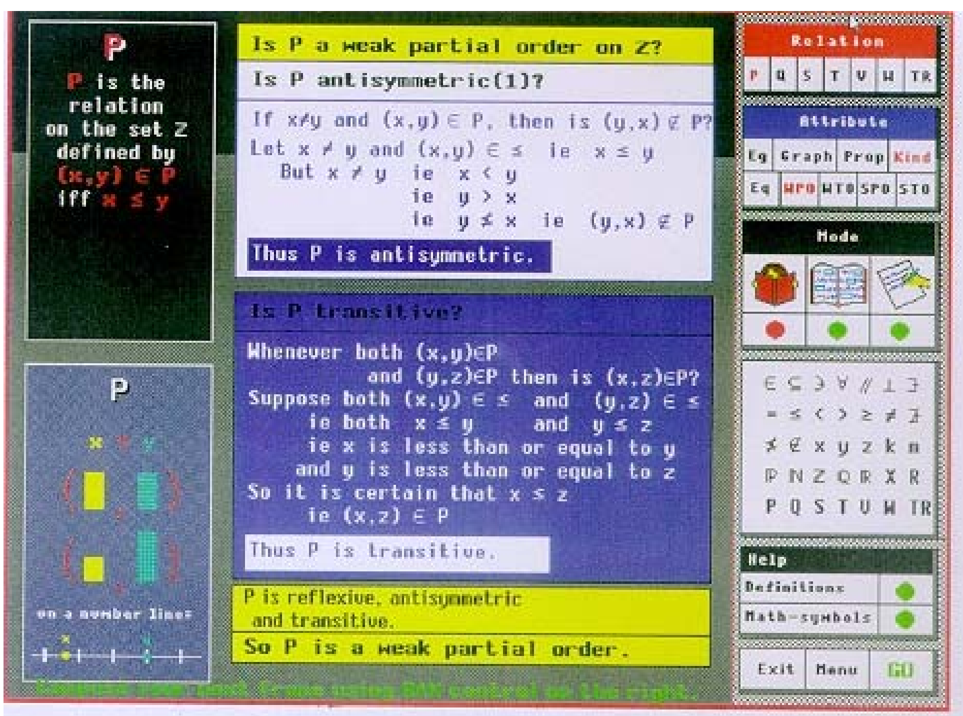



*Figure 5A.2 A composite component for analysis of the 'Kind' of relation*



### 5A.1.5 Research design of the FRAMES case study

As explained in the chapter introduction, Section 5.1, the evaluation has six major sections, devoted respectively to the six elements of the HCMm. Each has four subsections, of which the first three reflect different perspectives, and the fourth concludes the section:

The descriptive data in the first subsection of each, namely, the 'Initial discussion' subsections: 5A.2.1.1, 5A.2.2.1, 5A.2.3.1, 5A.2.4.1, 5A.2.5.1, and 5A.2.6.1, are qualitative discussions written from the perspective of the researcher. The data was generated by *qualitative analytical research*, investigating the case through analysis of an artefact - namely the computer-based FRAMES environment. The case study also falls into the *qualitative ethnographic research* category, since the researcher was personally involved as the designer of FRAMES and had extensive hands-on experience testing the system, as well as observation of and interaction with others who used it.

The set of second subsections, namely the 'Viewpoints of the instructor-designer', entailing 5A.2.1.2, 5A.2.2.2, 5A.2.3.2, 5A.2.4.2, 5A.2.5.2, and 5A.2.6.2, are incorporated to provide information from the perspective of the originator the learning event. As mentioned in the introductory comments of Section 5A, this section holds little information in the FRAMES study, since the researcher and the designer are the same person.

For the third set of subsections, 'Findings from the survey of learners', the methods used were mainly *qualitative, non-experimental empirical techniques*, the primary data collection method being a survey, supplemented by interviews. In the Unisa context of distance-education, learner-accessibility is limited, so a heterogeneous sample of fourteen volunteers (as explained in text box. 5A.1 above) was used for a *questionnaire survey* in 1997, which focussed on learner-evaluation of FRAMES from a general viewpoint, as well as from the perspective of learning theory. Some of the questions were multiple-choice, and responses to these have been statistically analyzed. A subsequent localised *in-depth interview survey* was conducted in 1998 with four other volunteer learners (of whom three were from formerly disadvantaged groups), focusing on the aspects covered by the HCMm. Appendix A1 contains the full questionnaire, and the core structure of the interview is in given in Appendix A2. Questions are also shown in appropriate subsections within the text. Thus FRAMES was pilot-tested and evaluated by a heterogeneous convenience sample of 18 students (De Villiers 1999b, 2000), the sample being a good representation of the COS101 learners of 1997 and 1998. Where responses are tabulated, percentages are not given due to the small sample size.

The *qualitative learner-data* provides insights into the ways that learners use FRAMES. The data was obtained from responses to open-ended questions and elaborations in the 1997 survey and from the 1998 in-depth interviews. In general, twelve of the fourteen who completed the 1997 questionnaire were very positive about FRAMES. Two expressed reservations in addition to praise, one of them an information technology professional. The four students involved in the 1998 interview survey did extensive practice with FRAMES, individually and collaboratively, and praised the learning experience highly. In some cases, learner-responses elicited in a certain category have been integrated into the discussion of another element of the HCMm, where they relate better and add value. As an example, certain information elicited from questions about 'components' is discussed under the header 'cognitive learning'.

Table 5A.1 shows profiles of the learners surveyed.

**Table 5A:1 Profiles of learners surveyed**
(n = 18)

| Characteristic | Subdivision | | | |
|---|---|---|---|---|
| **Gender** | Female 5 | | Male 13 | |
| **Full-time / part-time** | Full-time 9 | | Part-time 9 | |
| **Qualifications** | Previous qualifications 3 | | No qualifications 15 | |
| **Ethnicity** | White 10 | Black 6 | Coloured 1 | Asian 1 |

# 5A.2 Investigating FRAMES - using the Hexa-C Metamodel

FRAMES is investigated with respect to the application of learning and instructional theory, using the elements of the Hexa-C Metamodel as a framework. As stated above, a section is devoted to each of its six elements. The sequence in which the elements are used as headers is not the same in each case study. Rather, in each case, the element whose associated investigation provides the most pertinent background information about that case, is addressed first. This sets the scene for the remainder of the study. Accordingly, component theory is used as the first heading in the FRAMES case study. Three of the elements (namely: component theory, cognitive learning theory, and constructivism) relate more to theoretical aspects and underlying philosophical implications, and are addressed as the first three of the six. The other three elements of the HCMm (customized learning, collaborative learning, and creativity) tend to be more practical characteristics of learning environments and events, and follow afterwards.

## 5A.2.1 Components

This section reports on component-based learning within FRAMES. Most forms of knowledge and skills comprise basic units (components), with which learners interact in different ways. They can:

- read, study and peruse them;
- discover them for themselves; or
- they can apply them, implement them and practice them.

COS101 involves theoretical knowledge of discrete mathematical concepts, and practical skills in applying that theory. This section investigates how FRAMES supports learners in comprehending the components of relations - involving basic theoretical units, problem-solving skills, and complex composite components. FRAMES is also compared to Merrill's Component Display Theory (sections 2.3.3.4 and 3.3.3.1; Merrill, 1983).

### 5A.2.1.1 Initial discussion

FRAMES is evaluated to examine the ways in which it addresses the basic components of its domain. FRAMES has a component-based structure (De Villiers, 1998), and was explicitly designed according to CDT, based on the two dimensions of performance and content (Sections 2.3.3.3 and 3.3.3.1; Merrill, 1983). This section focuses particularly on the correspondence, and Table 5A.2 portrays the occurrence of CDT-type components in FRAMES, with regard to both *performance components* and *academic content components*.

**Table 5A.2 Relationship between FRAMES and CDT**

| | |
|---|---|
| **Performance components** | |
| **CDT performances** | **FRAMES instructional strategies** |
| Remember | Mode 1 Read-only: provides worked proofs as displays |
| Use | Mode 2 Guided practice: fill-in-the-blank frameworks |
| Find | Mode 3 Do it yourself (DIY): mode for independent proofs |
| **Content components** | |
| **Types of CDT content** | **FRAMES content** |
| Facts and concepts | Definition components |
| Procedures | Proof and disproof techniques used in tests for mathematical properties |
| Principles | Rules for testing whether a relation satisfies various properties and for classifying the kind of relation |

To access a component, users select the R of the R A M to call up a relation as the current problem scenario, then the A and M dimensions for attribute (the type of content) and mode (the type of performance) respectively – see Figures 5A.1 and 5A.2 in Section 5A.1.4. There are no fixed combinations of on-screen units. Several components are used simultaneously, so that screens present a windowed appearance, rather than being single-transaction displays. Learners control the selection of components from their *andragogic activity box,* choosing the content, sequence, quantity, the instructional strategy (i.e. mode), and the extent of help they require. Controls are on the right side of the screen; definition of the current relation, visual aids, and supplementary help appear to the left; while content presentation and student interaction occur in a central set of windows.

Whatever the learning style or stage, material would be available to meet the need. For each property, of every relation, in each of the three modes, FRAMES stores both a ready-worked model test for the property - to be used as Mode 1 display components, and partial test-structure components (Modes 2 and 3) to be completed by students as exercises. This forms a rich environment of examples and non-examples. It is unlikely that a single student would tackle every component, but transactions and series of transactions are available, where a transaction comprises a composite RAM selection, for example:

1. Learner-synthesis of ordered pairs that are members of the selected relation;
2. Viewing a graphic aid to form a visual representation of a relation;
3. Viewing or doing exercises, in the form of mathematical proofs, to test whether a relation satisfies a certain property;
4. Doing a series of similar attributes of several relations, i.e. the same property-test on different relations, to consolidate comprehension of that property;
5. Doing several aspects of one relation, i.e. different property-tests on the same relation, to deepen comprehension of that relation;
6. Approaching similar aspects of one relation from multi-perspectives, i.e. the same property of the same relation, in ascending modes. When a practice mode follows directly on a presentation mode, the former remains on-screen and can be used as a model; and
7. Tackling composite integrated analysis of a relation, determining whether it is of a particular kind by testing the relevant set of properties.

In designing according to CDT principles, each proposed component or instructional transaction is positioned by the designer in its appropriate cell on *Merrill's performance-content grid* prior to any implementation (see Figure 3.2 in 3.3.3.1). Viewing the grid identifies gaps in the proposed instruction, helping to ensure adequate coverage and implementation of objectives. Figure 5A.3 categorizes the components of FRAMES on this matrix, indicating excellent coverage of the domain. Certain components (the *read-only* Mode 1, as well as definitions, elaborations, and graphics) are for *perusal*, while others (Modes 2 and 3, as well as example synthesis) elicit *performance* by learners.

**Figure 5A.3 Performance-content matrix for the FRAMES components**

| Level of performance | Fact | Concept | Procedure | Principle |
|---|---|---|---|---|
| Find | | | Property - Mode 3 | Examples synthesis |
| Use | Definition blackboard | Help- maths, graphic aid | Property - Mode 2 | Help - definitions, Example synthesis; Kind of relation |
| Remember | Definition blackboard | Graphic aid | Property - Mode 1 | Kind of relation |

**Type of content**

## 5A.2.1.2 Viewpoint of the instructor-designer

The previous section sets out my personal intentions as instructor-designer of FRAMES, explaining the rationale behind its component-based design. There are two further points:

1. As well as incorporating concise *unitary components* for basic knowledge and skills, i.e. the rudiments of the domain, FRAMES has advanced components that present/test complex skills, and it also offers *composite components* which integrate property test components to determine the kind of relation.
2. The property test components have subcomponents, in that they are subdivided into chunks, resulting in a step-by-step appearance of the proof/disproof.

## 5A.2.1.3 Findings from survey of the learners

The learner-evaluation of FRAMES (De Villiers, 1999b, 2000) focused on its underlying learning theories and characteristics. The findings show how students select instructional transactions in different ways, choosing their own personal set of components, both in terms of content and instructional strategy. They decide on the sequence and quantity of practice, choosing the modes / definitions / elaborations / examples / illustrations / proof-executions appropriate to their individual learning style or stage. Certain *quantitative* questions in the general FRAMES evaluation of 1997 relate to the component-based structure of FRAMES, and responses to these are outlined in Table

5A.1. They investigate students' impressions of using the components and the utility of various kinds of components. Answers to specific survey questions were rated on the five-point scale below, and the average ratings of the 14 participants are shown in Table 5A.3, indicating highly positive impressions. Standard deviation is a measure of dispersion, i.e. it indicates data spread. The low values of standard deviations in Table 5A.3 show closely-clustered ratings.

| 5<br>Strongly agree | 4<br>Agree | 3<br>Maybe | 2<br>Disagree | 1<br>Strongly disagree |
|---|---|---|---|---|

**Table 5A.3**
**Learner-responses to structured questions relating to components**

| | **Statement** | **Average rating** | **Standard deviation** |
|---|---|---|---|
| 1 | The demo screens are easy to use. | 4.28 | 0.61 |
| 2 | The demo screens helped me get started, so I knew what to do when I started the RAM exercises. | 4.07 | 0.73 |
| 3 | When I do RAM exercises, I can easily access the one I want. | 4.43 | 0.65 |
| 5 | The FRAMES system is easy to operate. | 4.07 | 0.62 |
| 6 | The blackboard-style definition of the current relation at top left is helpful. | 4.43 | 0.19 |
| 8 | It is easy to access the HELP information such as definitions and graphic aids. | 4.57 | 0.45 |
| 9 | The definitions of mathematical properties are a useful form of HELP. | 4.64 | 0.50 |
| 10 | The attribute called "EG" (for synthesis of ordered pairs) helps me to understand the relation. | 3.86 | 0.67 |
| 11 | The graphic aids help me get a feel of the relation. | 4.07 | 0.62 |
| 14 | It is easy to understand the meaning of the icons and symbols in the right-hand quick-control column. | 4.07 | 0.62 |
| 15 | I got stuck. | 2.07 | 0.83 |

The high ratings for Questions 3, 6, 8, and 9 show indicate ease of use and the utility of optional support facilities. Ways in which students combined components were described in the *qualitative information* obtained from their elaborations and descriptive comments. Data from open-ended responses in the questionnaire survey and from the in-depth interviews, has been combined. Selected comments follow:

- ***Basic knowledge:***
  *I never needed the book. If you don't know at first what something is, then you click on the screen and it expands. / I liked the elaborations of maths symbols, because I was not familiar with them all.*
  On the other hand, some learners stated that they did not need elaboration options.

- ***Performance components:***
  *I first use mode 1 to understand. / Mode 1 shows you how to do it, then the others prove whether you can. You move on to them because* *the person behind the computer* *has shown you how to do it. / For exams you practice with mode 3. /*
  *I will use those difficult kind-of-relations problems to get confidence before the exam.*

- ***Content components used in different ways:***
  Learners varied the type and quantity of their practice, tackling subskills or composite skills; as many as required. Each learner combined components in their personal style:
  *I liked that you could take one relation and do so many different tests /*
  *I liked the examples where you could substitute to see how it really is* (note; this learner is referring to synthesis of members of the relation) /
  *I choose one relation, starting with its properties then do it all together, analysing the kind /*
  *I first did one test, e.g. reflexivity, on all the relations till I saw the pattern.*

## 5A.2.1.4 Concluding discussion

The FRAMES components effectively supported learners as they reviewed theory and practiced the skills of the domain. They were able to access a range of content components - ranging from revision of definitions, through reading simple worked examples, to composite integrated problems. Furthermore, they could tackle exercises in different ways, choosing a performance component (mode) appropriate to their learning needs or stage of study. The variety of ways in which different learners combine components was intriguing, and shows clearly how component-based support integrates with customised learning - an aspect which is addressed further in 5A.2.5.

There were no negative comments on these features. Two of the 1997 learners initially perceived the full screens as 'a bit cramped', but soon found the interface easy to operate and use, and benefited from all the information simultaneously available. It must be remembered that these were first-level students, some having their first exposure to computer systems. Another requested that the graphics components be permanently on screen, due to their value. However, they are scaffolding components - students should ultimately be able to solve problems without them, so they are deliberately an optional component.

## 5A.2.2 Cognitive learning theory

Cognitive learning relates to the promotion of true comprehension, rather than rote learning and conditioned responses. An evaluation of cognitive learning should examine the capability of an instructional intervention or learning event to integrate new knowledge with old; to foster the development of mental schemata; to encourage higher-order thinking skills; and to support learners in self-planning and monitoring (section 2.3.2.1). This section overviews FRAMES in relation to the explicit and implicit incorporation of cognitive learning practices, and also checks FRAMES for use of West *et al*'s cognitive strategies (see 3.3.2.3:2). The aspect of self-regulation, which also relates to customization of learning, is not addressed here, but deferred to Section 5A.2.5.

### 5A.2.2.1 Initial discussion

It is a requirement of this study that the learning and instructional theories investigated should belong to the cognitive family. Cognitive learning is a key element of the Hexa-C Metamodel, most of the other elements being related to it (De Villiers, 1998).

***Integration of new with prior knowledge and formation of schemata***

Comprehension of new material occurs in a context of guidance, knowledge structures, and support. For example, Mode 2 provides a content-free problem-solving structure, elaborated in 5A.2.2.3 which visually prompts learners to interrelate theory to the current problem. Also, relationships such as 'if ... then ... ' structures help learners construct internal schemata.

***Metacognitive strategies*** (see 3.3.4.1)

FRAMES includes exercises that promote concept development as learners tackle example-synthesis - a process which lends itself to abstraction and generalization. The mapping techniques explicitly and implicitly incorporated in FRAMES develop general intellectual skills.

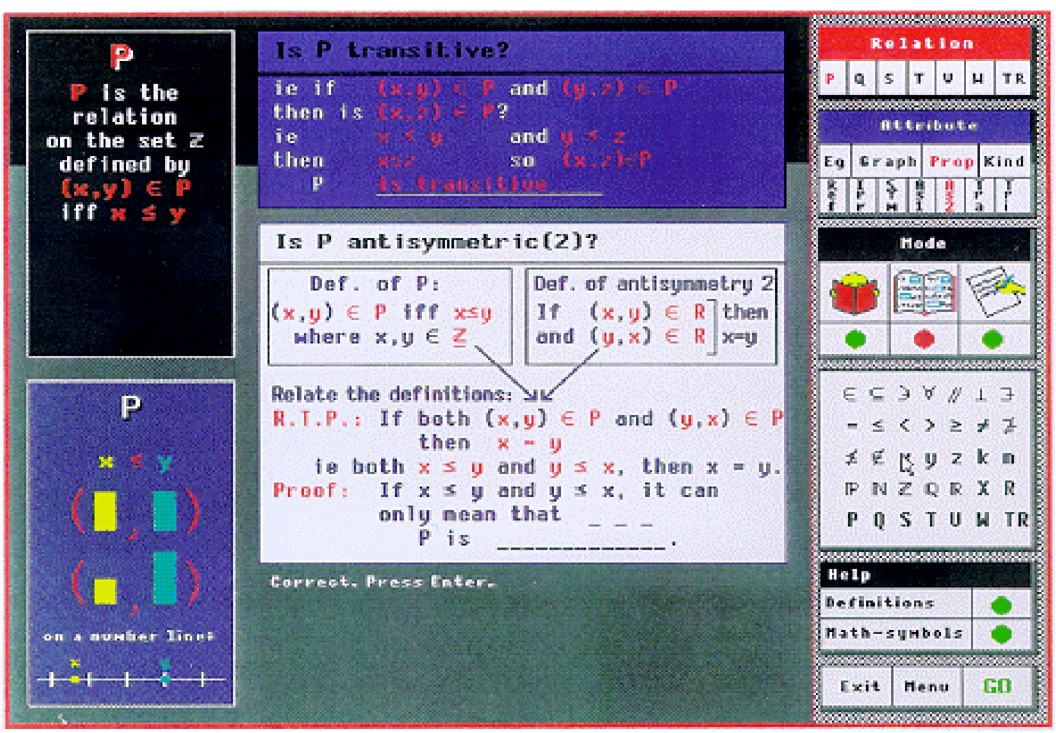
***Use of West's cognitive strategies*** (see 3.3.2.3:2)

1. Chunking - there is rational ordering of chunks. In general there is no underlying sequence of components, because learners choose their own. But within the exercise components used for practice of problem-solving procedures, a template presents the stages in sequence. This mitigates against confusion and cognitive disparity.
2. Concept-mapping - principles are related to specific examples.
3. Rehearsal and multiple presentation - material can be approached and reviewed in various ways - graphically or textually. Within the textual forms, it can be used in three different modes.
4. Graphic imagery - visual representations illustrate the concepts and aid perception.
5. Mnemonics - are incorporated to aid recall and simplify use.

The multiple modes of presentation are clearly indicated in Figure 5A.4, where the learner chose relation **P**, namely $\leq$ (less than or equal to), 'written' on the 'blackboard' at top left, and also selected the **Graphic** component to aid visual perception – see bottom left. The first central proof component is a completed **transitivity property** test in **Mode 3** (DIY) where only a skeleton structure is provided: ' if … then …' and the learner must supply further content. White font represents the fixed structure, and red the learner's contribution, which is entered and judged in chunks. Further colour coding is used for different properties, for example, transitivity tests have a blue background and antisymmetry white.

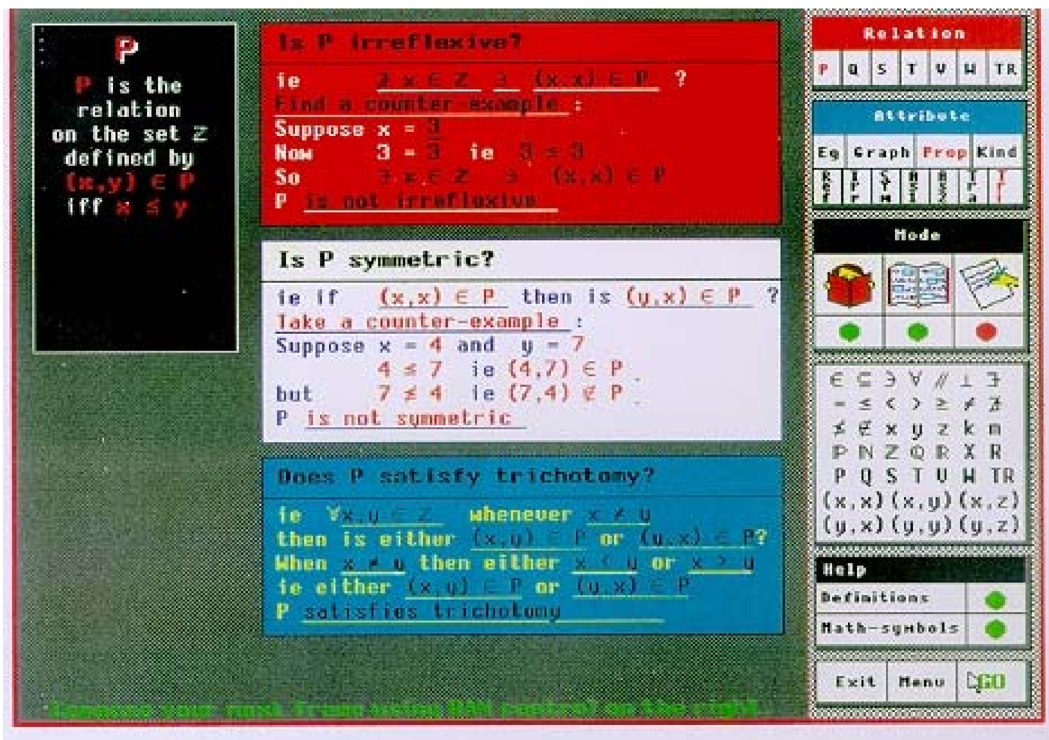
The next central component illustrates the support structures of **Mode 2** (guided practice), presented in an **antisymmetry** test. Arrows link definitions to the proof, visually prompting learners to relate theory to the problem. Mode 2 offers more structure and support than Mode 3. Once again, learner's input appears in red. This proof is incomplete; the feedback underneath is in response to the step most recently entered. The control area on the right offers all the functionality of the main menu, but in reduced form. Note the symbol pad of mathematical characters.

**Figure 5A.4 A FRAMES operational screen**



When a learner elects to do a property test/s ( see **Prop** highlighted in red in the Attribute menu), a lower-level line menu ( see the vertical text for abbreviated properties) appears directly beneath the line of top-level attributes. The screen in Figure 5A.5 shows how the learner did three property tests on the relation, **P,** all in **Mode 3**. The red highlighting on the vertical '**Tri**' within the lower-level line menu, represents the current selection of 'trichotomy' in the third central component in the figure. In comparing Figure 5A.5 with Figure 5A.4, it is noted that the learner has chosen to decrease the level of support and is working without the optional visual aid (**Graph**). As previously explained, a step-scroll mechanism builds up the central display area as the student selects instructional transactions, and moves components off when the screen is full.

**Figure 5A.5 A FRAMES operational screen**




## 5A.2.2.2 Viewpoint of the instructor-designer

There is no need to add to the discussion above, but I would like to stress the value of explicitly including cognitive features in learning materials over and above the actual subject matter, in order to help learners actively manage their study experiences.

### 5A.2.2.3 Findings from survey of the learners

Certain questions in the general evaluation of 1997 relate to aspects such as chunking, guided practice and support for self-monitoring. Results are given in Table 5A.4, followed by qualitative data obtained from the substantiation of open-ended questions.

**Table 5A.4**
**Learner-responses to structured questions relating to cognitive learning**

| | Statement | Average rating | Standard deviation |
|---|---|---|---|
| 7 | The step-by-step build-up of answers really helps. | 4.71 | 0.21 |
| 26 | It was useful having the structure of the proof set out in Mode 2 and Mode 3. | 4.14 | 0.73 |
| 28 | After using the pre-set structures in FRAMES, I will know how to approach written examples in the exams. | 3.57 | 0.94 |
| 31 | I would use FRAMES in different ways at different stages in my studies. | 3.86 | 0.86 |

The pre-set structures in Mode 2 guide learners along the ideal solution path, as they test whether the current relation satisfies mathematical properties. The structure does not permit a different sequence within mathematical proofs, although there are correct variations. The responses to Questions 26 and 28 and the open-ended responses below show the value of this guidance, although two learners would have liked to do it in an alternative sequence.

Qualitative data was obtained by integrating responses to the open-ended questions in the 1997 questionnaire survey and information from the 1998 in-depth interviews. The responses indicate that FRAMES facilitates cognition. Selected comments follow:

- ***Integration of new with prior knowledge:***
  *I really appreciated the way definitions were built into the proofs. / I first used it to learn definitions, then practiced relationships. / I learned how to define properties, then I could start proofs.*
- ***Self-regulation, metacognition, learners planning and monitoring their learning***
  *You could plan. I like to choose the order. / It taught me to think analytically. / To solve a problem it makes you think of all the things related to it.*
- ***Schemata (representations to show relationships); guidance; and heuristics (rules) to help learners construct internal conceptual schemata:***
  *The guidance in mode 2 explains it all. / It taught me to combine concepts. / It helped me to understand the relationship between a relation and its properties.*
- ***Chunking - rational ordering, step-by-step, avoiding cognitive overload:***
  The response to question 7 was very positive. Furthermore:
  *When you see only one part at a time, you realize what is most important. / Now I know how to start.*

- ***Rehearsal and multiple presentation - approaching and reviewing material from different perspectives:***
  *For a specific relation, I would first do mode 1 then mode 2 then mode 3. / The visual representation gave me ideas to get to a practical answer.*
  (More analysis of modes in 5A.2.5 on Customization)

- ***Cognitive strategies; problem solving techniques***:
  *You keep a proof on the screen to use as a model. Then you do a different one using the pattern. / Teaches you to think analytically and holistically. / You think in the right way, then get it right when you go back to paper. / I like to read mode 1 step-by-step, guessing what comes next.*
  (Note: the approach above uses a component in a way not envisaged by the designer, i.e. incorporated subversion - see 2.4.5.3:1.)

- ***Use of certain behaviourist elements (but with a cognitive goal):***
  *The repeated entering of the definitions helps with the learning of them and using them in proofs / The structure forces me to answer exactly to one solution pattern.*

- ***Aspects that could hinder learning:***
  - Questionable colours:
    *... might be a problem to some one who is colour blind, especially where FRAMES gives the right answer* (after an incorrect student-answer) *in red characters on a grey background.*
    But another said: *I like the colours very much.*
  - Time-consuming techniques:
    Most learners did not describe problems clicking in math characters from the symbol pad, but two complained: *There should be keyboard shortcuts. / Finding the characters, using both keyboard and mouse restricted my learning. I was too busy finding characters to understand the theory.*
  - More elaborations required:
    *There should also be a definition table for some of the new maths symbols.*

### 5A.2.2.4 Concluding discussion

The guidance and support enabled learners to grasp this complex section of work. They were able to reinforce their prior theoretical learning and integrate it with the new problem scenarios. By combining use of the three modes, learners personalised the problem-solving strategies and gained a holistic view - a mental model - of each relation. They learned to integrate all the aspects that must be considered in solving problems. The support-as-needed facility worked well. For learners with little confidence, worked examples (Mode 1) and elaborations were available, whereas advanced learners could focus on using the environment for rapid practice of difficult work, with minimal on-screen objects.

However, the examination of FRAMES showed some minor cognitive shortcomings.

- Learners requested additional elaboration of mathematical symbols.
- FRAMES enforces regular keying in of definitions in Mode 2. This is to prevent students tackling a problem without first considering the theoretical definition of the current relation and the requirements of the current property. It is a form of cognitive conditioning to ensure correct

solution paths. However, the process can be tedious, and there should be an option for automated entry of the definitions once the learner is ready. Should such a facility be abused by learners to avoid entering definitions at all, that would be part of the self-monitoring and own-responsibility associated with adult learning.

- There is a trade-off between time-consuming programming techniques and the added value. For example, entering math characters is complex. Doing a proof entails typing in normal words via the keyboard and clicking in special characters from the symbol pad. A frustrated student suggested keyboard shortcuts, but these would cause cognitive load in remembering / looking up the function keys, and would likely be less efficient than mouse-clicking. This student was a professional programmer, accustomed to sophisticated business systems, whereas FRAMES, is an academic aid for a small target group. The same student added: 'Otherwise, well done. As a programmer, I can see the work that went into this'. The same trade-off between programming effort and added value is encountered in the frameworks for Mode 2 proof structures, which use one method only, despite the correct variants.
- To save screen space, abbreviations are used, e.g. 'ref' for the 'reflexivity property'. Two students found these difficult the first time. There should be explanations in supporting documentation or on an introductory screen

## 5A.2.3 Constructivism

Some of the key features to be considered in an evaluation of constructivism in a learning event (section 2.4.2.1) are: active participation of learners, knowledge construction, authentic contexts, the approach to errors and assessment, and multiple perspectives on the topic. Further aspects of constructivist learning are acknowledgement of real-world complexity and the use of collaborative learning. True constructivism and personal knowledge construction cannot be implemented in a closed, procedural domain such as the mathematical realm of FRAMES, where there is only one correct solution to each problem. However, there is a place for the application of selected constructivist elements. The following subsections set out an investigation of these aspects in FRAMES from the viewpoints of the researcher, designer and learners respectively.

### 5A.2.3.1 Initial discussion

Learners using FRAMES are helped and guided as they construct their own comprehension of the domain, and internalise the decision-making processes (De Villiers, 1998). Ways in which constructivist aspects are featured/not featured in FRAMES are listed in a table structure:

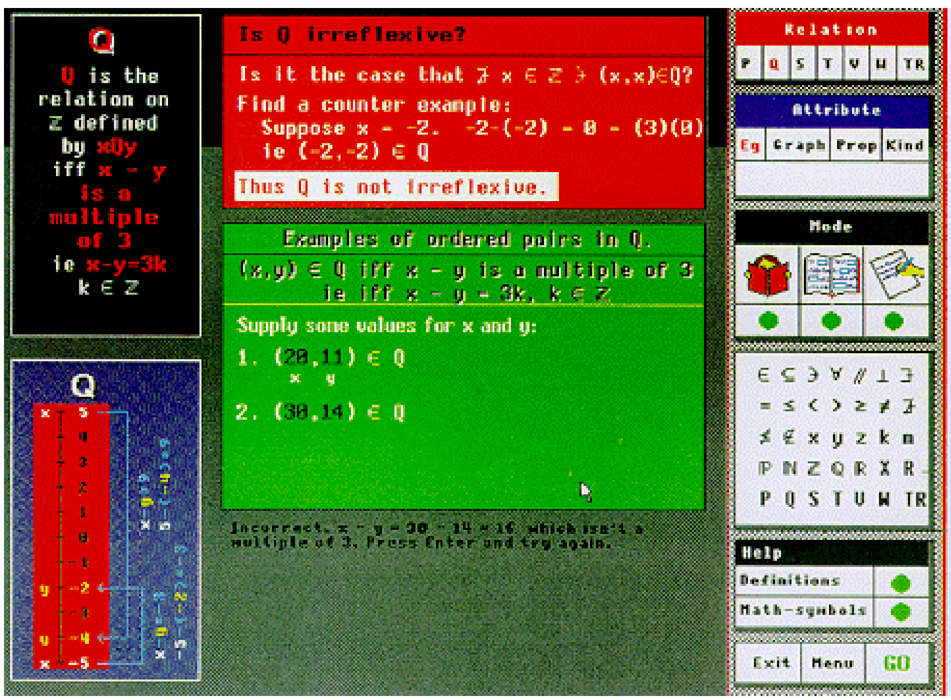
**Table 5A.5 Constructivist aspects of FRAMES**

| Aspect of constructivism | Featured in FRAMES by | Results / comments |
|---|---|---|
| ***High participation by learners in an interactive system*** | User-control allows students to take the initiative - planning and controlling their practice experience in terms of content, sequence, quantity and instructional style. | The system responds to every action, including feedback geared to the nature of their errors when they are solving problems in Mode 2 or Mode 3. |
| ***Anchored instruction*** | Abstraction is related to reality by providing the full definition of the current relation and optional graphic aids. | Learners begin to get a 'gut-feel' of each relation and start to recognise common patterns and variations. |
| ***Real-world relationships*** | Accurate perception of a problem domain and its examples achieved by the visual aids, but particularly by the opportunity for learners to synthesize their own examples of the current relation. | The system uses its knowledge of the underlying mathematical relationships to test learners' input and provide feedback as to whether they are examples or non-examples. |
| ***Contextualized process development*** | Mode 1 entails step-wise demonstration of mathematical processes.<br>Mode 2 presents a generic problem-solving format where students provide the missing information by keyboard and mouse input. It supplements the proof structure by explicit visual linking of the definition of the current mathematical relation to the definition of the property for which they are testing. Pull-down elaboration and definitions are available during proofs when required. | Learners are exposed to problem-solving techniques within the contexts of specific examples.<br><br>A drawback is that FRAMES presents one fixed sequence only (a best-practice sequence), and not the alternatives. It does, however, accept synonymous responses within that sequence. |
| ***Transfer of skills*** | The relations in FRAMES expose learners to variety, and the consolidated practice aids retention of principles. | Transfer of skills is facilitated by practice within the environment. A learner who grasps the principles can do different examples in assignments or exams. |
| ***Multiple presentation of information*** | The three instructional modes, read-only, guided practice, and DIY, offer varying perspectives on the process. Graphics supplement textual presentations. | FRAMES supports different learning styles and stages of study. |
| ***Approach to errors*** | Errors are not handled in a constructivist manner, but are identified by judging mechanisms. FRAMES can diagnose some of the common errors and highlight the cause, thereby supporting students in correcting them. | True constructivism tolerates errors and capitalizes on strategic exploration of errors |
| ***Integrated testing -*** | There is no formal testing or scoring. Completing a task successfully is the integrated 'test'. | Learners do not feel threatened, nor is unwarranted optimism raised. |

Synthesis by learners of their own examples of the current relation is a valuable form of constructing knowledge. Learners key in examples/non-examples and these are assessed by FRAMES' knowledge of the inherent inter-relationships. Figure 5A.6 shows an attempt to generate ordered pairs that are members of Q, the relation where the difference between the x- and y co-ordinates is a multiple of three. The first pair (20,11) gives a difference of 20 - 11 = 9, which is a multiple of three, and therefore satisfies the relation. The second pair (30,14) is a non-example, as explained by the diagnostic feedback in the small black font beneath.

The top central component is a Mode 1 'read-only' proof. The visual aid at bottom concretizes an abstract relationship; it uses colour coding to relate text to corresponding points on the number line. *Note*: Fonts that are small in the figures are legible when portrayed in full-screen size.

**Figure 5A.6 Operational screen showing example synthesis**




## 5A.2.3.2 Viewpoint of the instructor-designer

FRAMES is a learning aid for doing proofs in a computational mathematical discipline. Implementation of constructivist learning in such a domain allows for personal knowledge construction, but not for personal interpretation. Problems do not have open-ended solutions - there may be minor variations on the correct solution path, but there is only one possible solution when testing whether or not a given property holds for a specified relation. Constructivist design, in cases where the fundamental skills of procedural subjects must be taught, offers little scope for open-ended learning or conventional constructivist learning environments, but instead can be applied to offer contextualized support and multiple means of presentation.

### 5A.2.3.3 Findings from survey of the learners

A few of the questions in the general FRAMES evaluation of 1997 relate to constructivist aspects within FRAMES. The responses to these questions are shown in Table 5A.6, and subsequent discussion, but even more valuable information comes from the qualitative open-ended questions and from the interview respondents.

**Table 5A.6**
**Learner-responses to structured questions relating to constructivism**

| | Statement | Average rating | Standard deviation |
|---|---|---|---|
| 29 | It is a waste of time doing interactive practice when I can read worked examples in the tutorial material. | 1.29 | 0.47 |
| 30 | FRAMES helped me with the more complex proofs in the section of COS101-S on relations. | 4.21 | 0.58 |
| 32 | I know that FRAMES is intended to be a non-threatening practice environment, nevertheless I would like a scoring facility. | 3.21 | 1.42 |
| 33 | I should like practice environments for other sections of my studies. | 4.71 | 0.61 |

The statements in Table 5A.3 measure the extent to which the unfamiliar problem-solving approach in FRAMES supports learning more than conventional text book worked examples and paper-based practice. Responses to 29 and 33 are strongly in favour of interactive practice environments. The standard deviations are low, indicating close clustering of the ratings.

Qualitative information is obtained from substantiations, descriptive, open-ended responses, as well as from comments in the interviews. The learner-evaluations of FRAMES (De Villiers, 1999b, 2000) confirms a constructivist approach, anchored in examples:

- ***Active participation - learners planning and controlling their own learning and practice experience:***
  *When you listen to a taught lesson or watch a video, you remember the beginning and the end, but when you are involved in doing it, you can't forget. / Best part was that I could interact. / I try things out.*
- ***Anchored instruction and contextualized process development:***
  *It's brilliant to see the patterns in mode 2. / After doing proofs I know what the theory means when I open the book again.*
  (This learner was using examples to progress inductively to the underlying theory.)

- ***Visualization and graphic aids as multiple perspectives*:**
  *Another way to get it into my head. / Diagrams make the concept clearer. / They showed the relationship between the numbers / Written definitions can be so cumbersome. / These aids make it simpler for me.*

- ***Real-world relationships - by synthesis of examples and non-examples*:**
  *They give me ideas, so I can work out what the right answer will be. / It helps me see which pairs really belong in the relation. / If you key in wrong pairs, computer says it does not ft and you must think why.*

- ***Transfer - applying the strategies to more complex problems:***
  *When I do different problems, I know how to apply it.*

- ***Integrated testing, i.e. no formal testing or scoring:***
  The standard deviation (1.42) in the responses to question 32 indicate varying attitudes, a stance confirmed by learners' comments:
  *It never made me feel stupid / Distance-learning is scary enough - please don't threaten us with a score.*

  But another said: *I would like a mark, not every time, but when I feel ready,*

  An achievement-oriented individual wanted: *tangible demonstration of prowess*.

## 5A.2.3.4 Concluding discussion

Considering the closed nature of its mathematical domain, FRAMES succeeded in implementing several constructivist features. How best how can constructivism be implemented in a closed procedural domain? By active participation, self-generation of examples, multiple means of presentation, and supported discovery-learning. As a learner said: 'When you are involved in doing it, you can't forget'. Also by highlighting the underlying real-world relationships - by transforming an abstract formula into a concrete reality, so that learners personally construct the relationship between the elements of the co-ordinate pairs and perceive its implications. When learners comprehend a relation in this way, they often instinctively know which mathematical properties it will satisfy, and when doing proofs/disproofs, will know in advance what the answer should be

Inductive learning - progressing from practicing examples to conceptual understanding of theory - worked well, and learners attained a conceptual understanding of the underlying principles.

## 5A.2.4 Collaborative learning

An examination of the collaboration dimension of a learning event must distinguish between collaborative and co-operative learning (Section 2.5.1). True collaborative learning involves teamwork with capitalizes on each member's abilities, sharing authority and responsibility as they work on a shared project. Co-operative work is less flexible and involves joint work by small groups to accomplish a specific goal or develop a specified product. Since FRAMES was designed as a stand-alone CAI system for isolated distance-learners, its evaluation was not intended to investigate collaboration or co-operation. No questions in the 1997 survey were focussed on these aspects, but information from the 1998 interview survey reveals that three of the four interviewees worked *co-operatively* with fellow-students. The next subsections set out the findings and review FRAMES against key elements of co-operative learning (Section 2.5.1.2; Johnson & Johnson, 1991).

### 5A.2.4.1 Initial discussion

The FRAMES environment is not a virtual classroom, an online course, nor an environment for team-based projects. It makes no explicit provision for open-ended computer-supported collaborative learning or learner-learner communication. It was designed as support for isolated distance-learners, yet students who live in the same locality spontaneously enjoyed joint use (De Villiers, 1999b, 2000), an example of incorporated subversion (see 2.4.5.3:1).

In small-group co-operative learning, students interact to accomplish a specific goal - such as a closed problem with a single solution. FRAMES has been effectively used by pairs of students at a computer, finding joint problem solving satisfactory and stimulating. This type of learning is often used a means of achieving mastery in foundational knowledge (Section 2.5.1.1; Panitz, 1996), but in the case of FRAMES, also enriched the learning of more complex, integrated skills. Listed in Table 5A.7 are some of the features that show sound co-operative use in FRAMES.

**Table 5A.7 Co-operative learning in FRAMES**

| Key elements | Featured in FRAMES by |
|---|---|
| ***Shared goals*** | Activities selected by learner-consensus (no activity involved product generation); |
| ***Positive interdependence*** | Students gained confidence and made progress as a result of joint decision-making and peer-teaching. |
| ***Individual accountability*** | Only self-accountability - FRAMES is a personal learning aid. |
| ***Social negotiation*** | FRAMES is characterized by choices - selecting which activity to do / deciding on what text/characters to enter in problem-solving. Learners negotiated regarding their input. |
| ***Sharing and support*** *(promotive interaction)* | Breaking down the isolationist characteristics of distance-learning. The learners who used FRAMES effectively developed positive attitudes and were enthusiastic about sharing their new discovery. |

#### 5A.2.4.2 Viewpoint of the instructor-designer

Since FRAMES was envisioned as a supplementary aid for isolated distance-learners, it was a pleasant surprise when students spontaneously mentioned how they had benefited from using it co-operatively. The learners who used FRAMES in this unanticipated way seemed even more excited and enthusiastic about the learning experience.

#### 5A.2.4.3 Findings from survey of the learners

No survey questions were formulated regarding co-operative learning, since joint use had not been envisaged. However, information elicited from telephone conversations indicated that several of the participants in the 1997 survey were working jointly. Furthermore, three of the four in the 1998 interview survey (De Villiers, 1999b, 2000), revealed that they liked to work two-at-a-computer, finding that co-operative problem-solving led to enrichment and better performance. There is therefore qualitative information, but no quantitative data:

- ***Discussion and negotiation*:**
  *We have different ideas and they collide, then we go together to the computer and it explains. /*
  *It really helps to work together /*
  *I don't have to wait until I can contact a lecturer. We discuss it together and work it out.*

- ***Interdependence and improved performance:***
  *At the beginning he understood more and he helped me. But now I can do it better!*

- ***Sharing and support:***
  *It helped me - now I want to show my friend on the computer.*

#### 5A.2.4.4 Concluding discussion

FRAMES achieved a purpose beyond its explicit goals. As a computer system, its interface was intended for single users, not joint usage. The kind of co-operation that occurred goes beyond anthropometric issues, moving into the territory of simple human needs and social requirements. Learners experienced satisfaction and boosted confidence by sharing their learning experiences - in fact, one student brought his learning-partner along to the interview. Moreover, two brains were better than one for difficult activities. Designers should take cognizance of the fact that, for many learners, collaboration and communication are inherent aspects of learning.

### 5A.2.5 Customization and learner-centricity

Evaluating customization of learning and learner-centricity (Section 2.5.2) in a learning event involves determining the extent to which individual learners' interests and requirements are met. Learner-centredness views learners holistically, considering both their cognitive and affective interpretations, and changing the instructor's role more to that of a facilitator. Reigeluth (1997) highlights customization as the most important feature distinguishing instruction and learning in the Information Age. This section investigates the implementation of cognitive customization in FRAMES, whereby learners themselves contribute to customizing an event to their needs.

#### 5A.2.5.1 Initial discussion

FRAMES is not an artificial intelligence system that offers intelligent student modelling, but it is an environment characterized by adaptability, individualization and high interactivity. It supports individual learners in customizing the system to provide the material they personally require. They control their own progress though the FRAMES components, selecting their learning activities - both in terms of content and type of performance - and can also decide whether or not to use the support options - definitions, elaborations, and graphic representations. To distance-learners, unaccustomed to individual attention, the environment offers personalized support (De Villiers, 1998). Table 5A.8 sets out some of the explicit ways that learners are supported personally by FRAMES:

**Table 5A.8 Customized learning in FRAMES**

| Aspect of customized learning | Feature in FRAMES | Implications / comments |
|---|---|---|
| ***Response-judging and feedback when solving problems in Modes 2 and 3, and in example synthesis*** | Response-judging is a major processing event in FRAMES, as learners' input is assessed.<br><br>Feedback is designed to identify likely errors. | Provision is made for two attempts at each answer-entry point. For correct answers, alternatives and spelling variations are acceptable.<br><br>Several versions are on hand at each answer-entry point. |
| ***Explanations and help*** . | Elaborations of mathematical symbols are available when required.<br>Optional help facilities are accessible as on-line pop-up definitions and rules. | This quick-and-easy extra support is useful in early learning stages, or for learners who lack confidence. |
| ***Flexible approach; Learner-control in choice of content, mode, and quantity*** | FRAMES has a rich environment of varied components, so that individual learners can spend the amount of time they choose and do the quantity of work they wish - picking-and-choosing components in any sequence.<br><br>Some activities entail perusal; others elicit performance. | True learner-centricity is implemented by the absence of :<br>(i) pre-set paths through practice material, and<br>(ii) fixed screen combinations. |
| ***Instructor in role of*** | The environment was designed for | Learners use it for independent practice |

| | | |
|---|---|---|
| *facilitator* | isolated distance-learners. | of skills. |

### 5A.2.5.2 Viewpoint of the instructor-designer

It was interesting to find out how students used FRAMES to suit their own learning needs and style. Their responses in the sections on components and cognitive learning, as well as those in 5A.2.5.3 in this section, indicate a wide variety of usage patterns.

### 5A.2.5.3 Findings from survey of the learners

Some of the structured questions in the general FRAMES evaluation of 1997 relate to ways in which learners control their learning and how FRAMES is customized to their needs. Table 5A.9 shows the responses.

**Table 5A.9**
**Learner-responses to structured questions relating to customized learning**

| | Statement | Average rating | Standard deviation |
|---|---|---|---|
| 16 | I appreciate the learner-control that lets me do what I want, as much as I want and in the way of my choice. | 4.36 | 0.84 |
| 17 | The feedback was useful. | 3.5 | 1.02 |
| 18 | I learned to use FRAMES quickly. | 4.5 | 0.52 |
| 24 | I prefer doing exercises on paper. | 2.86 | 1.35 |
| 25 | I find it difficult to use the RAM access method. | 1.64 | 0.91 |
| 31 | I would use FRAMES in different ways at different stages in my studies. | 3.95 | 0.86 |

The responses to Question 17, relating to feedback, are less positive and more varied than others (standard deviation = 1.02). Although diagnostic feedback is attempted, it falls short of being intelligent feedback, since the software program compares learner-answers to certain stored versions, comprising correct responses as well as common errors. If the learner's answer does not fit one of these patterns, there is no diagnostic feedback. Responses were varied with respect to Question 24 on preferred methods of working. FRAMES made it possible to do mathematical exercises via a keyboard-mouse combination, but it is somewhat cumbersome, an aspect already discussed in 5A.2.2 on cognitive learning. The responses to the other questions show that FRAMES is easy to operate, and that the freedom offered by learner-control has high utility.

In qualitative open-ended responses and in answering interview questions (De Villiers, 1999b, 2000), students describe how they controlled the environment and customized it individually:

- ***User-control for efficient learning, as students select components appropriate to their learning style and stage of study*:**
  *I could choose what to do, as well as the order! /*
  *I'm very systematic, so I did them all. I tried out everything, even different answers, to see if they were also right. / Much better than video - a video can't answer you back like FRAMES does.*

- ***Response-judging and feedback to learners' steps in problem-solving processes*:**
  *When I get an answer from the computer, I remember it / When it corrects you, then it proves where you are wrong and says "No guys, this is the way you do it."*

  The response-judging mechanism is designed to diagnose common errors (as in the case above), but cannot diagnose all possible errors. Four learners stated that they would like to know exactly what was wrong with every answer, and where they started to go wrong:
  *You are not sure which part is wrong and will most likely go wrong the second time.*

  The patterns against which learner's efforts are matched have an in-built sequence for each step. Some, but not all, alternatives are recognised. Students' views on this differed:
  *You could improve the syntax checking, so that where order is not important, it does not mark it wrong. / Although I might have a different approach, it is good that it forces me to answer with the best approach. / It's a bit harsh to have to write the answer in a rigid format, but OK - I suppose it's good to learn the best way.*

  FRAMES has no editing facilities. To correct a step, it must be completely re-entered:
  *It was good for me to re-do the whole thing for consolidation. /*
  *It was irritating having to do the whole part again.*

- ***Multiple presentation of information*:**
  As shown in Table 5A.5, each of the three modes was chosen by four students as the one from which they learned most. Some appreciated a certain mode at a particular stage of study. FRAMES thus supports different learning styles, and also the differing needs of the same learner at different times,
  e.g. *I use Mode 1 as a model for doing assignments and Mode 3 for practicing before the exam.*

**Table 5A.10**
**Use of the three modes**

| Statement | Mode 1 No of students | Mode 2 No of students | Mode 3 No of students |
|---|---|---|---|
| 20 Mode I enjoy the most | 6 | 7 | 1 |
| 21 Mode that helps me learn the most | 4 | 4 | 4 |
| 23 Mode I like least | 2 | | 9 |

### 5A.2.5.4 Concluding discussion

Learners appreciated the way FRAMES met their individual needs. From the pre-set content, they could choose activities customized to their learning style and requirements, and they could use the environment in different ways at different stages of study. The utility of each of the three modes was confirmed by the fact that each was, for an equal number of students, the one from which they learned most - in spite of the fact that nine did not actually like Mode 3. They found a variety of ways of combining exercises and modes that resulted in individualization, leading to consolidation of theory and skill acquisition.

Normally, in a closed, structured domain, there would be little emphasis on a learning experience meeting learners' specific interests, since there are no open-ended topics to explore. However, FRAMES did meet some learners' customized interests. As a CAI environment, it matched the interests of Computer Science students. One young, enthusiastic learner remarked, 'I am studying to be a computer programmer and hope one day I could write a program as fantastic as this'.

The system's responses to students and their ability to control the activities they chose, made it seem so 'human' that some of them personified FRAMES with comments like 'it answers you' and 'it says'. The quantitative and the qualitative data indicate certain inadequacies in the response-judging, feedback and re-entry of steps, yet in general learners were very satisfied with the personal tutoring, such as the student who stated that ' ... it proves where you are wrong and says "No guys, this is the way you do it" '.

FRAMES is learner-centered in supporting cognitive processing (see this section and 5A.2.2 on cognitive learning) and in meeting affective needs (see 5A.2.6). There is a strong inter-relationship of customization with creativity and motivation in learning, the aspects overviewed in the upcoming Section 5A.2.6 .

## 5A.2.6 Creativity

An evaluation of creativity and motivation (2.5.3.1 and 3.5.3) should look for innovative and novel features, while ascertaining that such features do not impact on functionality. Aspects to be considered are:

- The extent to which instruction motivates and engages learners;
- flexibility in instructional strategies;
- how information is presented; and
- the kinds of activities.

A further matter to investigate is recognition of the complexity of the cognitive-affective connection, and what features are incorporated to promote sound values, positive attitudes, and hard work.

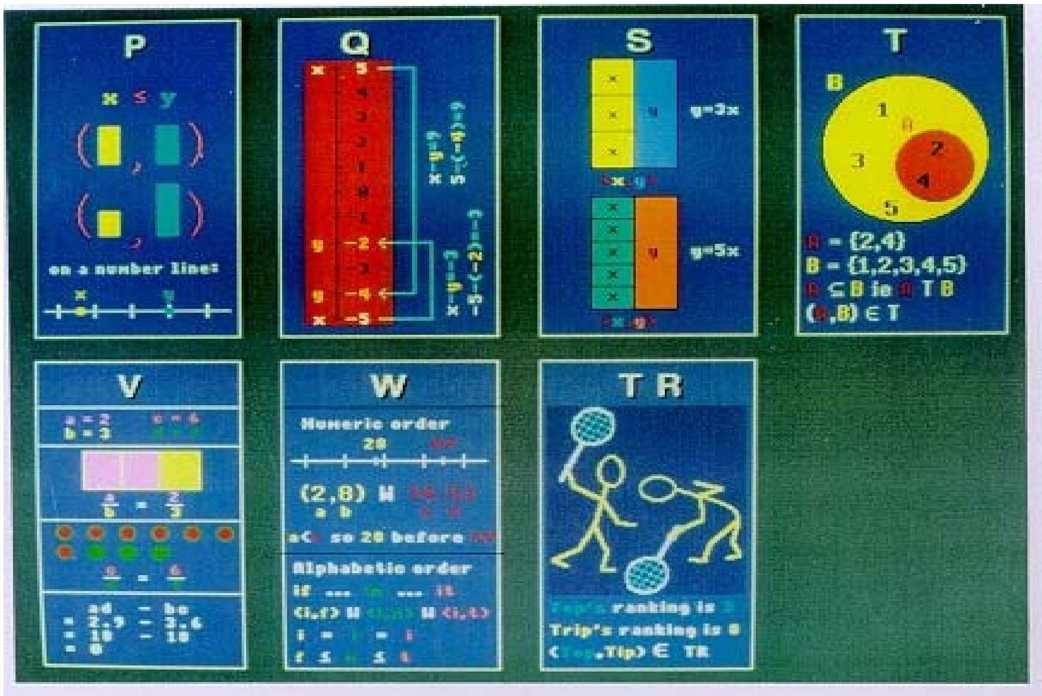
These aspects are incorporated in the evaluation described in this section, as well as a brief inquiry into the application of Keller's (1987) ARCS model in FRAMES.

### 5A.2.6.1 Initial discussion

FRAMES is a novel and highly interactive environment. It entailed innovative instructional strategies and complex computer-programming techniques (De Villiers, 1998), developed through experimentation and prototyping. The design requirements were imprecise, requiring trial and testing. Screen layouts evolved in a form-follows-function manner, rather than adhering to specifications or storyboards. Figures 5A.2 and 5A.4 show the consistent screen layout for functional areas such as control buttons (right) and the definition *blackboard* and graphic aid (left). As learners select instructional transactions, they generate screen displays comprising their own personal set of components. The selected exercises appear in the center, as has been illustrated in the preceding figures, and the step-scrolling mechanism moves them off-screen when the area below fills up with subsequent components. Mathematical symbols are clicked in from the symbol pad in the right hand functional area. All these features are novelties, differing considerably from previous CAI systems developed at Unisa.

Each relation is illustrated by an optional colour-coded graphic aid. Visualization facilitates perception, application, and retention, and enlivens up the screen. The metaphors were carefully designed to represent the mathematical and real-world relationships. Figure 5A.7 is not a FRAMES screen display; it was compiled by combining all the graphic aids for the purpose of demonstration.

## Figure 5A.7 The graphic aid components




FRAMES engrosses learners and induces anticipation. Learners gain satisfaction by organizing their learning experiences, and gain self-confidence as their performances improve. There are no bells-and-whistles, such as themes or rewards. Some learners were so engrossed that they experienced *flow* (see 2.5.3.1; Czsikszentmihalyi, 1990) and *lost track of time* (Wager, 1998), occurrences that are described by learners in 5A.2.6.3.

### 5A.2.6.2 Viewpoint of the instructor-designer

The *virtual table top* is an original approach, in which the screen layout and user interface provide the facilities and objects that typically lie on students' tables as reference materials when they do exercises. For example, definitions would be available on a real table (probably in an open textbook), worked examples are frequently used as models, and diagrams are used to aid comprehension.

The wide variety of built-in options for doing exercises - simple or composite, a well as the opportunity to synthesize ordered pairs and test whether they belong to the relation, all done with varied levels of support, make FRAMES an *androgogic activity box* of options. Screenshots in the preceding figures indicate how learners can simultaneously view graphs, definitions, and other worked examples, while they tackle their current activity.

### 5A.2.6.3 Findings from survey of the learners

Questions in the general FRAMES evaluation of 1997 were not directly focussed on creativity. A few are indirectly relevant and are shown in Table 5A.11. Two relate to the 'demo', - the demonstration component, a simple exercise that students use to learn the system.

**Table 5A.11**
**Learner-responses to structured questions relating to creativity**

| | Statement | Average rating | Standard deviation |
|---|---|---|---|
| 1 | The demo screens are easy to use. | 4.28 | 0.61 |
| 2 | The demo screens helped me get started, so I knew what to do when I started the RAM exercises. | 4.07 | 0.73 |
| 33 | I should like similar practice environments for other sections of my studies. | 4.71 | 0.61 |

The most useful piece of information in the table is the highly positive response to Question 33 - the highest average rating in the whole survey - indicating students' desire for more software like FRAMES. More informative comments came from the qualitative data in response to open-ended questions and the interviews (De Villiers, 1999b, 2000):

- ***Matching learners' specific interests***
  Computer Science students really appreciated CAI:
  *When I work on computer I never think about time. / The computer draws me - it's a better way. / I never knew you could do educational things on the computer - it's amazing!*

- ***Motivational strategies, Keller's (1987) ARCS model involving**:*
  - **Gaining and holding attention:**
    *Entertaining - could do it all day! / Absolutely brilliant / It was easy. I never got cross with it. / The nicest way I've ever learned. / Loved it. / I could not get off the computer. /* and best of all: *Excellent – I even forgot I was learning;*
  - **Demonstrating relevance:**
    *Shows all the important things, so you don't waste time / Good for Unisa students, because it tells you immediately, you don't wait for the next day to phone a lecturer*
  - **Instilling confidence:**
    *Now I know why to do things that way. / I can go it alone / I'm positively clear about things I used to think were difficult;*
  - **Providing learner-satisfaction:**
    Learners tackled varied activities with a positive attitude:
    *Typing examples was the best way to see if you understand. / If you get it wrong you must think why.*

- ***Intrinsic motivation generated by high interactivity:***
  *After a session I feel I must sit down and master the next section. /*
  *I want to work more. / I could not get off the computer.*

- ***Some aspects were irritating:***
  The interface and introductory screens irritated some learners: *Tedious and un-user friendly. /*
  *After the first time I would like to bypass the intro screens.*

- ***Novel and innovative ways of practicing:***
  *Personal interaction / Chance for experimentation / Guidance /*
  *I had seen the concepts in the book, but when I saw them being used, then I understood. / Synthesizing examples was a chance to see if you really understand - if you key in wrong pairs, computer says it does not fit and you must think why .*

- ***The virtual table top:***
  *Everything was there, I never needed the book. /*
  *You must read the book first, then you can put it away, because you have all you need. /*
  *FRAMES gives the main concepts concisely /*
  *Having all the info on the screen is a big plus.*

### 5A.2.6.4 Concluding discussion

Some were surprised to enjoy academic work! The comments show that they not only benefited, but also had a good time with their *activity box*: 'I was learning and I was practicing and I was enjoying myself!'. They had not encountered anything similar, and were intrinsically motivated and engaged.

With regard to the instructional strategies and activities, FRAMES is more about learning than about instruction. The primary learning strategies are active participation, and wide variation in activities - opportunities to 'try things out'. Certain students were so engrossed that they found it hard to stop! The way the information is presented makes it simple to use. Two described feeling daunted by the extent of the prototype environment, then being surprised how easily they grasped the system.

Shortcomings were identified relating to the interface and introductory screens, aspects that are not cumbersome to change, and that should be rectified.

Finally, there is the issue of the cognitive-affective connection, and incorporation of features to promote sound values, positive attitudes, and hard work. FRAMES' primary strategy here is high interactivity and experimentation. Learners enjoyed using FRAMES - the affective element was as strong as the cognitive. High motivation induced a desire to work more than they had intended, and resulted in effective learning.

# 5A.3 General

This section proposes how the five facets of a learning environment are made up in FRAMES and also briefly mentions the use of computer technology in FRAMES.

## 5A.3.1 Facets of the FRAMES learning environment

Table 5.A.7 shows the Perkins' (1991a; Section 3.5.4) five facets of learning environments, and the ways they are implemented in FRAMES and its wider learning domain.

**Table 5A.12 Facets comprising the FRAMES practice environment** (Perkins, 1992)

| **Facets that comprise a learning environment** | **Corresponding implementation in FRAMES** |
|---|---|
| Information banks<br>(external to FRAMES) | Textbook<br>Study guide<br>Tutorial letters |
| Symbol pads | Computer (at home, at work, or in Unisa lab)<br>Rough notes |
| Construction kits | FRAMES interactive practice facilities |
| Phenomenaria | Help components, definitions, visual aid and example-synthesis components within the FRAMES environment |
| Task managers | CAI aspects of FRAMES<br>Individual learner<br>Cooperative partner |

## 5A.3.2 Technology in FRAMES

Technology is central in FRAMES, since it is a computer-based interactive practice environment. The environment served as an effective medium of presentation and interaction, with learners' attention focused on the message and not on the medium. Certain minor frustrations were expressed (Section 5A.2.2.4), but in general the medium was transparent, and several comments indicated that learners perceived the virtual presence of a human teacher.

## 5A.4 Conclusion to the FRAMES evaluation

This evaluation of the interactive learning and practice environment, FRAMES by a volunteer sample of Unisa students indicates that the user-controlled, component-based system operates as the designer had envisaged, yet in a richer manner, as some learners found unanticipated applications. The investigation of FRAMES using the Hexa-C Metamodel as an evaluation tool, shows features in line with all six elements of the framework, despite the fact that FRAMES is not the archetypal domain where elements such as constructivism and collaboration would usually be implemented. The investigation also revealed various design shortcomings.

***Integration of elements***

The examination was focussed on the learning event, but also provided information regarding the elements of the tool itself, indicating strong interrelationships between its elements. Appropriate to its role as a supplementary aid for practice of procedural skills, FRAMES is a strongly component-based system. Its activities and instructional transactions induce high interactivity and ongoing cognitive processing. Constructivism is implemented to a considerable degree, despite the closed, well-defined domain, and in fact, the constructivist goal of supporting personal knowledge construction in a mathematical realm contributed to the creativity of the design. Constructivism is also implemented in the spontaneous co-operative use as learners find socially-negotiated understanding. Learners personalize FRAMES in different ways appropriate for their individual needs or stage of study. The cognitive-affective connection highlights the integration of the elements of the metamodel under the umbrella of cognitive learning; this is addressed further in Chapter Six.

***Triangulation***

For interest's sake, the examination marks of the eighteen learners who evaluated FRAMES were investigated. The average mark that the fourteen learners in the 1997 survey obtained for the question on complex relations was 9% higher than the general average. The results of the four 1998 learners who were interviewed on their use of FRAMES were even better - they averaged 31% more than the general average in the relevant section.

***Instructional design of the system***

Section 5A demonstrates that the FRAMES instructional design succeeded in its purpose and aim (see Table 5.1). The simulated table top achieved its objective, as did the concept of pick-and-choose from the andragogic activity box. Comments indicate the presence of phantom - a virtual coach - 'the person behind the computer' who 'has shown you how to do it' (5A.2.1.3) and who suggests 'No guys, this is how to do it!' (5A.2.5.3). An interviewee, referring to its novelty and value, said 'I wish I had something like it for all my modules, because I am a person who learns by examples'.

A problem in COS101 is that students typically tackle a problem concentrating on what is **required** - aiming for premature conclusions, instead of deriving conclusions from the **given information** and then aiming for the goal. One of FRAMES' most valuable contributions is its problem-solving template, which enforces integration of theory, the given scenario, and practice. This guidance was shown to facilitate learning.

***Incorporated subversion***

Most activities had been anticipated by the designer, but others were positive subversion. The qualitative research method uncovered several such occurrences in FRAMES:

- Spontaneous co-operative use;
- Use of the chunking in Mode 1 in a 'guess what comes next' fashion; and
- Using a Mode 1 read-only presentation of a proof in a particular relation as a model for Mode 2 or Mode 3 problem-solving, but using a **different** relation to increase the cognitive gap and hence the challenge. (This strategy had been anticipated but within the context of the **same** relation.)

***Extensions and refinements***

FRAMES is a prototype in terms of its content. All the functionality is there, but some further relations must be added. In the process, some concerns and technical irritations can be rectified, such as the lengthy introductory sequence which always offers the demo option, and the lack of a quick-exit facility. Two minor editorial errors, identified by four students, were corrected immediately. Certain other shortcomings would be difficult to rectify in a cost-effective manner, so those changes may not be implemented, due to the trade-off between programming effort and added value.

***Finally ...***

FRAMES has been shown to be a rich learning environment, supporting the current paradigm shift towards flexible instructional software. Its high levels of interactivity and individualization capitalize on the capabilities of the computer, customizing the environment to the needs of individual learners. Students were engaged by its innovative, cognitive strategies, and appreciated having control of their learning experience, supported by a comprehensive virtual table-top. Interactive practice, (sometimes in pairs), accompanied by instant feedback, enriched studies and led to personal construction of content, followed by retention and transfer. Learners themselves conclude the discussion of this case:

> *As a distance education student, I can't ask questions, but with FRAMES I can;*
> *The part of my studies I enjoyed most;*
> *A useful tool - a good combination;*
> *This is good interactive software.*
> *I could try things out – the things I wonder about . . . and I learned so much.*

# Section 5B - *Case Study Two: RBO880*

The second case study relates to RBO880, an Internet-based course that teaches educators about the use of the Internet in instruction and learning. The Hexa-C Metamodel is applied to evaluate RBO from the perspective of learning theory, and to examine whether and how it achieved its design aims.

In the first part of Section 5B, RBO, its context, content, and learners are described. The next and major part of the section is devoted to discussion, evaluating the course according to the six 'C' elements - learning theories and characteristics - that comprise the framework of the HCMm. Each section is further divided into three perspectives:

(iv) Initial discussion by the *researcher*;
(v) viewpoint of the *designer* of the learning event (who is the course instructor/facilitator);
(vi) *learner-data* - quantitative, but mainly qualitative, obtained from surveys and interviews;

before ending with a *concluding discussion*.

In all aspects of education and training, there is increasing use of electronic learning applications, including the Internet and World Wide Web. As virtual learning environments and web-based instruction increase, online material proliferates - much of it bypassing scrutiny. Internet-based resources should meet the criteria of accuracy, authority, currency and uniqueness (Smith, 1997). It is also necessary to maintain quality in terms of the instructional approach (De Villiers, 1999a). In the vital applications of online instruction and learning, it is essential that the academic content, underlying instructional and learning theories, and the implementation paradigms, all three, be such that instruction is effective and cognitive learning is enhanced.

The structure of Section 5B, which describes an investigation into RBO, is identical to that of Section 5A.

## 5B.1 Introduction to RBO880

### 5B.1.1 Immediate domain and purpose

RBO880, generally called RBO, is a one-semester masters-level module in Computer-Assisted Communication and Management at the University of Pretoria, with the abbreviated course title, Internet-based Learning. It is one of nine modules for the MEd degree in Computer-Integrated Education (CIE) offered by the university's Faculty of Education, but can also be taken as a short course for non-degree purposes by learners with an appropriate background. The whole course is presented online on the Internet, i.e. it is *immersive* with relation to Harmon and Jones' (1999) five levels of web use, as it uses its website to set out course information and communicates via an e-mail forum. RBO can be viewed as an electronic, or web-based, simulation of a physical classroom. Its general aim (Cronje, 2001b) is to develop in its students the theoretical and practical expertise to use computer-mediated communication via the Internet as a tool for presenting, managing and facilitating resource-based learning and distance education. Course topics are *Learning on the Internet* and *Management of network-based teaching - academic and administrative*.

RBO students do practical task-based projects, as well as written analytic and interpretive assignments. The semester work comprises individual tasks, co-operative small-group tasks and a major whole-group collaborative project involving multi-media. There are no tests or conventional examinations; instead, the exam is a major individual project worth 50% of the final mark. Learners post all their products on web pages and also provide links to the collaborative and co-operative projects in which they had a part.

The particular aim of RBO is for the educator-cum-learners who take the course to experience first-hand the situation of Internet-based learners. Not only do they gain the required theoretical knowledge and practical skills, but they do so in a position which gives them empathy with their own learners and enriches them as consultants in computer-integrated education.

The RBO topics and tasks described in this study are those presented during 2000, although mention is made of tasks and events in previous presentations.

### 5B.1.2 Greater environment and learners

The University of Pretoria is a contact-teaching institution in the capital city of South Africa; it has over 27 000 students. The university has taken an active role in telematic teaching and 51 of its academic programmes are currently presented/supplemented online as part of a model of flexible learning, using a mix of media-, web-, contact- and paper-based teaching. RBO is not a directly a part of this telematic teaching initiative, and the MEd (CAE) degree, for which it is a credit, is a contact degree. However, due to RBO's nature as a course in computer-assisted communication and management, it is itself presented online using facilities of the World Wide Web and Internet. The instructor calls it *Teaching 'teaching on the Internet' on the Internet* (Cronjé & Clarke, 1999). There are no meetings or fixed class times. Students tackle the course asynchronously in the place of their own choice, but are expected to adhere to deadlines for task submission. The core information and instructions are provided on the RBO website, but supplemented with regular communication, as students daily access their newsgroup facility to receive messages from the instructor and communicate with fellow-learners. Online chat sessions are also scheduled. Instructor and learners provide their personal e-mail addresses, so that one-to-one messages can be sent when required. Learners not only find information on the WWW, but generate their own web pages as part of individual and collaborative projects.

Class size is approximately ten students annually. In general, the students are mature adult learners, employed full-time, with ages ranging from 30 - 50, doing post graduate studies in education for enrichment and to gain further skills - typical life-long learners. A few are younger students who continue directly to masters-level after completing honours degrees. Most of the RBO class are MEd students, but some are professionals in similar fields doing the course for non-degree purposes as enrichment.

#### *5B.1.3 Roles: the RBO880 developer, instructor/facilitator, and the researcher*

The current lecturer is a professor who has presented RBO since 1995. He developed the current distance-presentation version of the course in 1997 and designed its website, i.e. the roles of instructional designer and educator converged. Furthermore, design was not separated from the implementation of instruction, since the lecturer in his role of instructor-designer could refine the approach iteratively in the light of previous experience, and even implement minor refinements to instruction, schedules and content on an immediate basis, if and when required.

The researcher took RBO for non-degree purposes as an external student in 2000 as a learner in a class, initially, of eleven. She was, therefore a learner-observer-evaluator. In this study, she evaluates the content, tasks, and examination of the 2000 presentation from the perspective of learning and instructional theory, using the elements of the HCMm as a framework. She undertook qualitative analysis by surveying 22 students (13 who completed RBO in 1999 and 9 of the class of 2000), so that the learner-evaluation incorporates a broader base than just the researcher's fellow-learners in 2000.

### 5B.1.4 The approach, classroom, and tasks in RBO's electronic world

Text Box 5B explains the approach of RBO, in particular its metaphorical classroom and the objects in the classroom.

## Text Box 5B The virtual world of an RBO learner

The RBO electronic classroom (Cronjé, 1997; Cronjé and Clarke, 1999) uses the metaphor of a junior school classroom. Branscomb (1996) points out how 'Metaphors serve as a map for sorting out what is similar and what is different when confronting a new problem'. In the web-based classroom, the instructor-designer set out to mimic, in a web-environment, the objects and events of a real, physical classroom. For Jones (1997, cited in Cronjé 2001b), 'the degree to which information technologies can effectively control or aid virtual communities is delimited by the finite capacity of human cognition ... Humans can think about almost anything, but they cannot deal with everything at once'. Because of this, the visual similarity between the digital classroom and its real-world counterpart must be as strong as possible since the physical differences are great. The students do not communicate face-to-face, nor do they meet at all.

The classroom has two components - a website and an electronic mailing list. The website represents the physical aspects of a classroom and the list server allows the interpersonal (speaking) interaction and communication that occurs in a class situation. The classroom and its associated mailing list comprise a 'virtual settlement' (Jones, 1997 cited in Cronjé 2001b).

***The web-based classroom***

The 2000 web-classroom, which resides at the URL <*http://hagar.up.ac.za/rbo/2000/index.htm*>, is shown and discussed in Figure 5B.1 following this text box. It has four sections:

1. At the top of the screen are buttons which link to the virtual documentation of the course - matters such as the required outcomes, tasks, timetable, references, etc. Clicking on these provides details of the associated timetable (see Figure 5B.4), tasks and so on, similar to information on notice boards or in printed material in real classrooms. (Some of these objects are elaborated in the discussion following Figure 5B.1.)

2. The second major object is the poster wall, which links to projects by previous students, as well as links to any 'posters' created by the students as the course progressed.

3. On the right is a blackboard, implemented as a graphics file. As a special challenge, students may access and edit this 'chalkboard', manipulating it and replacing it, amounting to the graffiti on a blackboard in a real classroom. Technologically, this is a reasonably complicated task, but several rise to the occasion.

4. The most important area, from the learners' perspective, is the central region containing their 'desks'. Each student's desk links to the personal website he/she develops in the course of the module. Students replace the initial generic desk image in the classroom website with an abbreviated personalized desk representation. This representation is linked by a URL to the full-scale 'desk' or even a 'study', designed by the learner in their personal website.

The idea is for the learners progressively to 'fill their desk' with objects typically associated with a school desk, namely their:

- Ears (mail to: ... their e-mail address as contact information, in lieu of direct conversation);
- Utility bag (links to utilities such as HTML editors, search engines, clipart libraries);
- Textbooks (links to useful sites);
- Work (relevant work they do/did in their studies/employment);
- Hobbies (personal info and links to sites of special interest);
- Class work (RBO assignments and tasks); and
- Portfolio (a link to their examination project).

***Electronic communication***

The initial electronic presentations lacked real-time interaction; this was introduced in the class of 2000 by holding two synchronous sessions using a 'Chat' facility. General conversation and communication with the instructor is done by means of a dedicated mailing list. The message acts conducted in the classroom are similar to conversations in a face-to-face classroom. The messages sent through this class discussion list (Cronjé and Clarke, 1999) indicate that the most frequent actions of the instructor are to make suggestions, give information, explain how to do something, offer encouragement, and give directives. Learners mainly use the communication forum to provide information, ask questions, present a problem, generally initiate/contribute-to discussion, or to express amusement or a joke. As the course matured, the communication broadened to include discussion and suggestions regarding collaborative tasks, as well as issues of confrontation and conflict.

The classroom is also augmented with 'extra lessons' by means of a link to an HTML tutorial.

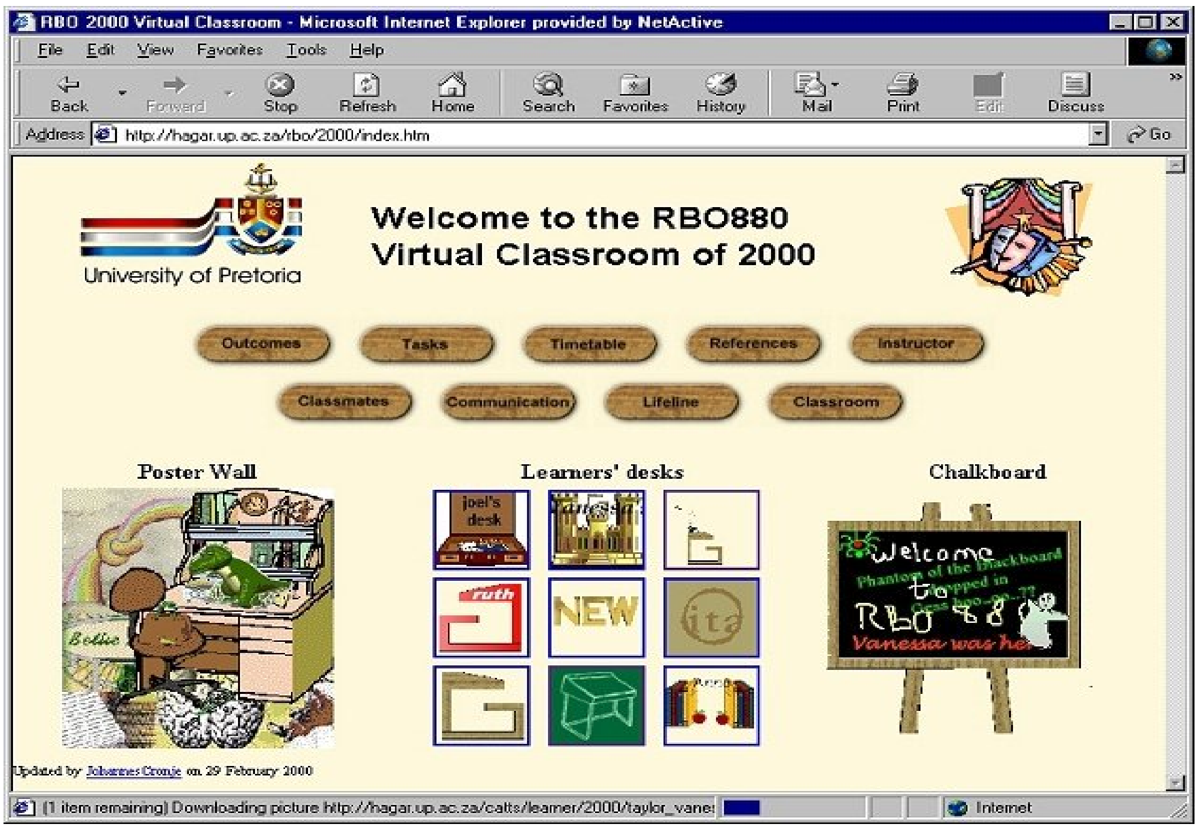
***Class behaviour***

The personalized desks and the inter-learner communication show an interesting blend of students' creativity or lack of it – much the same as one would find in a real classroom. Certain students respond to the metaphor by 'down-aging' and role-play. They take on the roles of learners in a schoolroom, addressing the instructor as 'Sir' or 'Teacher' in their emails to the mailing list. Such learners tell tales on one another, interrupt proceedings with humour, and generally act with a light-hearted air. They exercise typical schoolroom mischief, for example, by using their desk to represent 'bunking class'. When this spontaneous role-play activity occurs, it assists in developing a team spirit.

Other characteristics of a class are conflict, 'bullying', and criticism of fellow-learners. These too, occur from time to time in the RBO communication.

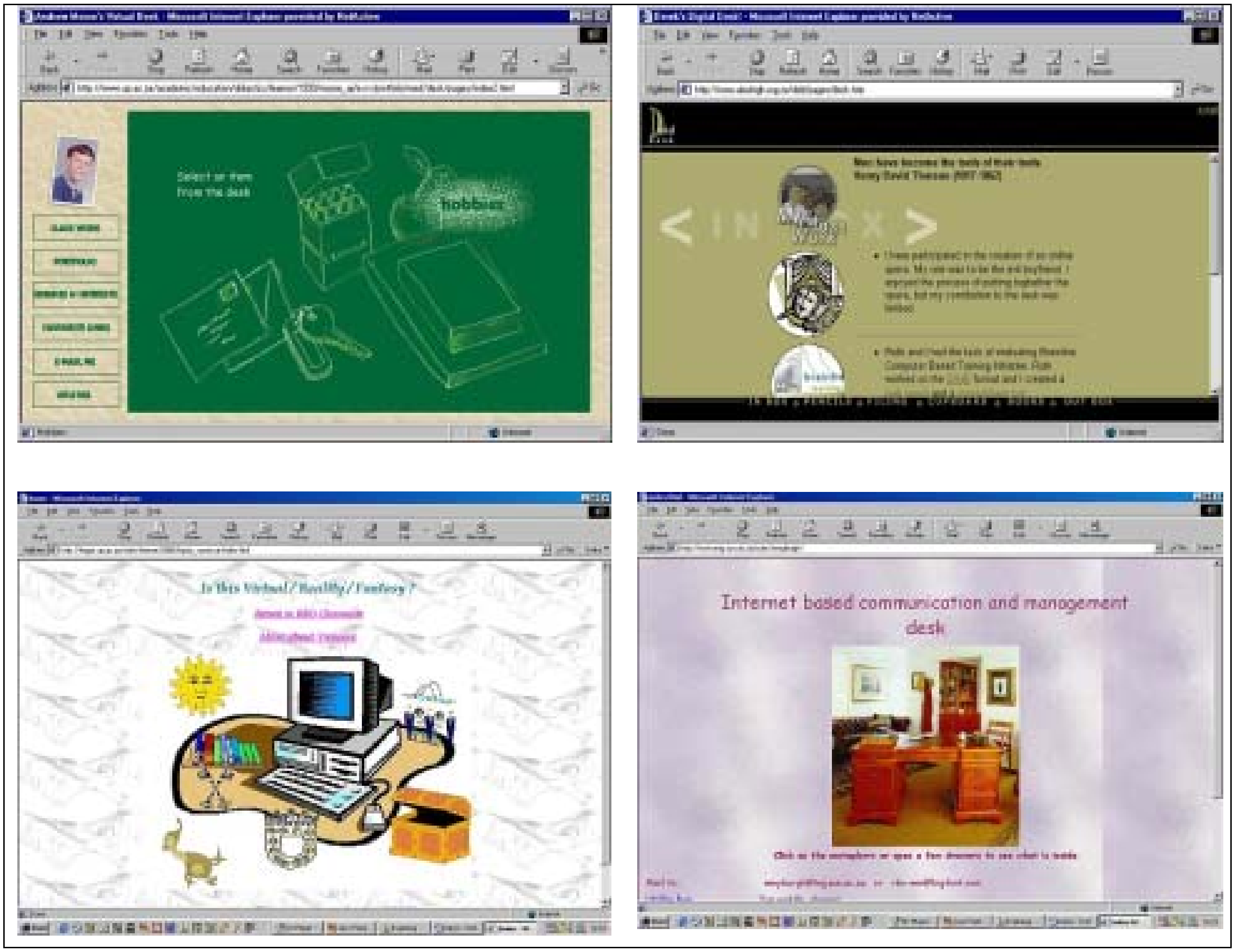
Figure 5B.1 presents the website of the class of 2000, showing the 'classroom' described in the text box. Several attributes of a physical classroom are simulated. The buttons at the top link to objects such the instructor's desk, resource cupboard, tasks and timetable. The instructor's desk branches to his home page containing links to aspects of general interest. The references (comprising resource cupboard and tool box) entail links to subject matter and construction programs such as hypertext mark-up language (HTML) editors, as well as additional reference information, graphics utilities, and website construction tools. Clicking on others accesses academic information, such as the course timetable and tasks, required outcomes, topics to be covered, the grading system, and the practical competencies learners should acquire.

**Figure 5B.1 Website of the RBO electronic classroom**



The objects and material within, and accessible from, the classroom increase as the course proceeds. The learners' mini-desk representations (centre screen in Figure 5B.1) link to each learner's full-scale desk on his/her own home page. Figure 5B.2 shows four different full desks created by learners in 2000.

**Figure 5B.2 Desks of four of the learners of 2000**




Each desk communicates something of its owner - formality/informality, personal characteristics, web-skills, and so on. Clicking on the objects on and around the desks links the viewer to the objects bulleted in Text Box 5B. Each learner has a personal set of such objects.

***Exercise for the reader:***

Try to match each desk in Figure 5B.2 with its linked mini-desk in Figure 5B.1.

The mini-desks are also revealing.  The class of 2000 was fairly conventional, but previous students used humour to convey messages, as shown in the mini-desks in Figure 5B.3, where the former communicates a learner 'bunking class' (i.e. playing truant/ 'hookie').

**Figure 5B.3  Mini-desks of two former learners**


After constructing their desks in the first two weeks, the class of 2000 tackled the collaborative opera, then the two-person team tasks, as shown in the timetable in Figure 5B.4.  Finally, the individual projects, which comprised 50% of the final mark, had to be completed over a six-week period.

**Figure 5B.4  The RBO timetable for 2000**  (RBO880, 2000)

| Phase | Date | Purpose | Activity & Deadline [Time = SA Standard time (GMT + 2)] |
|---|---|---|---|
| Pre Intro | Sat 5 Feb | Familiarisation | Students enrol on listserver; browse in virtual classroom. |
| Intro | Mon 7 Feb | Introduction | Students introduce themselves and get to know one another by their *Whoami* postings.  All students must have done so by **16:00 on Tues 6 Feb 2000.** |
| Desks | Wed 9 Feb - Wed 16 Feb | Getting ready | **Individuals** arrange their desks. |
| Tech | Wed 16 Feb to Fri 3 March | Opera | Students discuss the opera project, identify roles and compose their parts. |
| Explore | Tue 7 Mar to Sun 19 Mar | Distance Learning and the Internet | Students do their Team Tasks. Final product must be posted to the desks on **Sunday 19 March at 16:00.** |
| Proposal | Thu 16 Mar to Thu 23 Mar | Proposals | All students must post their project proposals before **16:00 on Thurs 23.**  Discussion of the proposals will continue up to **Tues 28 March.** |
| Kickoff | Fri 23 Mar | Launch project | Students launch their individual projects.  These will run for six weeks, i.e. till about **Tues 16 May**.  This allows enough time to process data and create the portfolio. |
| Publish | Tues 4 May | Publish results | The report on the individual project is published on the Web in the form of a portfolio.  Deadline **30 May** 16:00 SA standard time. |

### 5B.1.5 Research design of the RBO case study

Within the overall approach of *action research*, as outlined in Chapter One, Sections 1.7.4 and 1.7.5, a combination of qualitative and quantitative research methods is used.

The descriptive data in the six 'Initial discussion' subsections: 5B.2.1.1, 5B.2.2.1, 5B.2.3.1, 5B.2.4.1, 5B.2.5.1, and 5B.2.6.1, is generated by *qualitative analytical research*, investigating the case through an analysis of RBO course artefacts - namely the course website, and listserver. Furthermore, the researcher used a *qualitative ethnographic approach,* obtaining rich observational data by participating in RBO as a learner. Under each element of the HCMm, attention is also paid to aspects of the course that are in line with theories, practices and stances described in Chapters Two and Three.

The information in the six 'Viewpoint of the instructor-designer' subsections: 5B.2.1.2, 5B.2.2.2, 5B.2.3.2, 5B.2.4.2, 5B.2.5.2, and 5B.2.6.2, is obtained by a *qualitative ethnographic method*, interviewing the lecturer for his insight and in-depth understanding of the situation in which he operated.

The primary data collection method for the six 'Findings from survey of learners' subsections: 5B.2.1.3, 5B.2.2.3, 5B.2.3.3, 5B.2.4.3, 5B.2.5.3, and 5B.2.6.3, was a *non-experimental survey* (comprising *questionnaires, ' virtual' observation* and *interviews*). The entire learner populations of 1999 and 2000 - thirteen students in 1999 and nine in 2000, i.e. 22 in total - were used in this evaluation, investigating RBO from the perspective of learning theory. All the questions (except for some Yes/No responses) required qualitative textual answers, i.e. there were no multiple choice questions as in the FRAMES evaluations. The questionnaire, as a whole, is given in Appendix B, but pertinent questions are also inserted in the text. The data in Section 5B is not statistically analyzed, since this would not be the best way to deal with rich descriptive data. Percentages are not determined, because they would not be significant in the case of such a small population. Table 5B.1 shows profiles of the learners surveyed.

**Table 5B:1 Profiles of the learner population surveyed**
(n = 22)

| **Characteristic** | **Subdivision** | | | |
|---|---|---|---|---|
| **Gender** | Female 13 | | Male 9 | |
| **Full-time / part-time** | Full-time 2 | | Part-time 20 | |
| **Prior qualifications** | Honours degrees 16 | | Masters / Doctorates 6 | |
| **Ethnicity** | White 21 | Black 1 | Coloured 0 | Asian 0 |

# 5B.2 Investigating RBO880 using the Hexa-C Metamodel

RBO is investigated with respect to its application of learning and instructional theory, using the Hexa-C Metamodel as a framework and structuring the analysis according its elements. In the analysis that follows, the six Cs of the HCMm are structured into a sequence that addresses, first, the three sections that relate more to the underlying theories and basis of RBO, and then three aspects relating to the more practical characteristics of the learning experience.

## 5B.2.1 Cognitive learning theory

An evaluation of cognitive learning should examine the capability of an instructional intervention or learning experience to integrate new knowledge with old; to develop skills for storage and retrieval of information; to encourage use of higher-order thinking skills; and to support learners in planning, self-monitoring and transfer of learning. It should also look at the types of learning in the domain.

### 5B.2.1.1 Initial discussion

This section examines the application of cognitive learning theory and practice within RBO, also investigating the cognitive-affective relationship (Tennyson & Nielsen, 1998), and the application of enterprise schemas (Gagné & Merrill, 1990).

- ***Objectivist-cognitive aspects: entry-level requirements and intended outcomes***

  *Entry behaviours:* Admission prerequisites are very basic:
  - Possession of an honours or other fourth-level degree,
  - access to the Internet,
  - the ability to upload and download documents to and from the WWW,
  - familiarity with the term *constructivism,* and
  - teaching/learning experience and knowledge of classical writings in education.

  *Pre-specified outcomes (specific and critical outcomes) for each task:*

  The outcomes relate to practical Internet- and web-competencies, as well as a critical-conceptual grasp of the domain.

- ***Integration of new with prior knowledge***

  RBO learners are a heterogeneous group, with a wide range in prior knowledge and skills. Most are educational practitioners; others are recent graduates, familiar with educational structures from the learner's perspective. RBO learners build on their existing educational skills and experiences, and apply new media to the presentation, delivery and/or administration of their known practices. Some approach the course with prior learning in their own domains, but with no prior Internet skills. RBO does not explicitly teach these, although the website has links to external sites with HTML tutorials, web-construction tools, etc. Implications of this are elaborated under the upcoming header on the *cognitive-affective connection*.

- ***Cognitive strategies***

  RBO uses some of West, Farner and Wolff's (1991) cognitive strategies, in particular, advance organisers and metaphors. Advance organisers on the RBO web pages for *Outcomes* and *Tasks* make it clear what is expected. The conventional classroom metaphor and analogy have been described and illustrated in Section 5B.1.4, showing how the 'desks' are positioned in rows in a metaphorical class space, with further graphics of a blackboard and posters on the walls. In line with the analogy of associating each desk with its occupant, learners auto-customize their desks and hyperlink them to their websites, which expand during the course as they update them with the material listed in Text Box 5B.

- ***Skills for encoding, storing, and retrieval of information or skills***

  Once the initial Internet skills are obtained, they are reinforced by practice. In the course of the various tasks, learners repeatedly use web authoring systems, graphics tools, etc. and upload products to their websites. These skills are consolidated and internalised by frequent use.

- ***Types and categories of learning***

  With regard to the learning types in Bloom's taxonomy (section 2.3.2.2; Bloom 1956), RBO incorporates application, analysis, synthesis, and evaluation. The course calls for some of Gagné's categories of learning (section 2.2.3.1; Gagné & Glaser, 1987), namely, discriminatory and problem-solving skills, and metacognitive strategies as learners plan and control their creative processes. Motor skills are required for proficient use of computer keyboard and mouse.

- ***Transfer***

  The Internet expertise acquired in RBO has been applied and adapted in varied domains and contexts by learners in their own tasks as educators. For example, a university computer science lecturer presented a fourth-level Internet-based course in computer operating systems using a detective metaphor. Another former student ran a course in research psychology, in which students created web pages around specific themes. The instructor provides links to these 'spinoffs' from his so-called 'museum' web page.

- ***The cognitive- affective connection***

  Thinking and learning are complex, dynamic, non-linear processes, making learning outcomes hard to predict. The final outcomes of RBO vary greatly from one learner to another (Cronjé

2001a). Tennyson & Nielsen (1998) apply complexity theory to learning theory to determine the influence of non-linear learning on the design of instruction. Some of the factors that create non-linear conditions are time, anxiety, and environmental variables:

- *Time and personal factors*

RBO learners are part time students, balancing careers, studies, and family commitments. Those who are educators/trainers experience periods of peak pressure during which their own studies cannot be a priority.

- *Anxiety and frustration*

This is a major issue for those who are not competent in web design (Cronjé, 2001a). There is a wide skills-gap in entry-level expertise - some are experienced web educators and web designers; others have only the minimum technical prerequisites, and become frustrated and stressed as they self-construct certain facets of knowledge. These affective issues impact on cognitive processes. Complexity theory proposes interaction of content knowledge and cognitive strategies to help with problem solving, decision making and creativity. RBO addresses this by encouraging learners to form collaborative online support systems, to call on RBO's buddy system which uses past learners as a 'lifeline' (see *Lifeline* button in Figure 5B.1), and to explore the hyperlinks to a range of resources. Students who persevere and use these facilities are able to reach appropriate levels in HTML, graphics, and general web-authoring.

- *Attrition*

Some RBO learners find the situation beyond them. They withdraw, either to re-register the following year knowing what is expected, or to find an alternative course for the necessary credit.

- ***Enterprise schemas for multiple objectives***

Enterprise schemas relate to situations where the instructional goal is a combination of several different objectives (sections 2.3.2.3 & 3.3.3.3; Gagné & Merrill, 1990). RBO integrates multiple objectives in its comprehensive activities. For example, the task on *Distance learning and the Internet,* done in co-operative pairs, involved a comprehensive investigation of an existing web-based teaching initiative. The objectives were to:

- Determine criteria for successful web-based teaching, using the literature,
- Ascertain the aims, procedures, etc of the web-initiative under investigation,
- Analyse the initiative in the light of the criteria,
- Write a report in the format of an accredited journal,
- Submit recommendations to the authorities at the given initiative,
- Develop an interactive spreadsheet to measure WBT-readiness of an organization, and to
- Apply the spreadsheet instrument by using it to analyze the given organization.

### 5B.2.1.2 Viewpoint of the instructor-designer

> With regard to the level of prior learning and the extent of the work, I think I may have asked too much, too soon, contributing to the attrition rate. Some of the learners in 2000 were scared off by the extent of the initial collaborative virtual opera.

### 5B.2.1.3 Findings from survey of the learners

Twenty-two students from the classes of 1999 and 2000 participated in an evaluation of their RBO online learning, focussing on its underlying learning theories and characteristics. The questionnaire is in Appendix B, but certain questions relate to core features of cognition, such as the integration of new and prior learning, self-regulation of one's learning experience, and cognitive-affective issues:

| | |
|---|---|
| 7. | Had you used the Internet and WWW in teaching/learning before doing RBO? |
| 8. | With the RBO course behind you, do you classify yourself as a newbie or a webbie? |
| 33.1 | Describe how the knowledge and skills required in RBO related to your own prior learning. |
| 33.2 | Where you lacked prior knowledge, how did you bridge the gap? |
| 33.3 | RBO students largely plan their own study and learning experiences. How does this work for you in terms of scheduling and monitoring your time, other priorities and obligations, self-discipline, etc? |
| 29.4 | Did you at any time experience overload and/or anxiety? Please elaborate. |

Learner-responses to Questions 7 and 8 indicate low initial skills. Tables 5B.2 and 5B.3 indicate that thirteen of the twenty-two had used the WWW previously, but only seven had created web pages. By the end of the course, seventeen were confident of their web-ability; three still saw themselves as 'newbies', and two did not respond.

| **Table 5B.2<br>Internet familiarity prior to RBO** | | | |
|---|---|---|---|
| **Had you previously used the Internet or WWW in teaching or learning?** | **No of learners (n = 22)** | | |
| Yes | 13 | To create web pages | 7 |
| | | For searches only | 6 |
| No | 9 | | |

| **Table 5B.3<br>Internet familiarity after RBO** | |
|---|---|
| **With RBO behind you, how do you classify yourself?** | **No of learners (n = 22)** |
| A webbie (proficient) | 17 |
| Still a newbie (unfamiliar) | 3 |

Responses to Questions 33.1 and 33.2 about the relationship of prior learning to the RBO skills showed that several entered RBO with a theoretical orientation stronger than their practical competencies. There was a range in entry-level expertise. Some had strong technical abilities, and the (virtual) presence of these expert web-designers resulted in a major skills-difference. Students' comments are categorized below.

- ***Integration of prior knowledge and experience*** (Question 33.1)*:*
  *I have a need to discuss and debate /*
  *Conceptual knowledge of the Web / primitive HTML coding /*
  *No Internet skills / no web expertise /*
  *Certain computer and other technical skills, but basically I just kept at it ... /*
  *I grew up with computer technology ../*
  *I'm a computer person, not an educator*
  *Conventional educational expertise - I'm an educator / adult learning /*
  Some had a dual foundation:
  *Combining my learning theory and knowledge of a web-authoring tool was very relevant.*

- ***Bridging the web-skills learning gap*** (Question 33.2):
  *I asked, I experimented a lot. / Used the recommended references for the course / Research /*
  *Studied HTML manuals / Web-searches / Examined the work in previous virtual classrooms /*
  *Copied others' techniques / Desperation, self-discovery / Networking and asking people who knew how /*
  *Perseverance, trial and error on the technical things / Reading, reading, reading ... /*
  *By yelling for help and using RBO's 'lifeline helper' system.*
  (Note: lifeline - a buddy system using past-learners as peer-helpers)

The next aspect of cognition (Question 33.3) relates to progression of the work. Most learners did not have problems with the schedule, although some experienced pressure and found that RBO impacted on other obligations.

- ***Self-regulation of the learning process - planning, scheduling and monitoring***
  *Hectic!!! / The isolated learning in RBO impacted adversely on my self-discipline. /*
  *I can't understand why there are deadlines in a course is not class-based - can't it be self-paced?*

  Self-regulation plays a critical role in collaborative work:
  *The whole group must co-operate, otherwise it delays things /*
  *My preferred style is autonomy and at the end of the day, I am responsible for my successes and failures. When time constraints undermine the process, I accept this ... It is harder to do this in group-work when the importance of the group-goal needs to take precedence. This is sometimes stressful for me, as I have a strong sense of not wanting to let the side down. In some groups this is not a shared view, and can make meeting the group-goals not very evenly spread among members. /*
  *I really appreciated fellow students' tolerance when my illness delayed a group project.*

Question 33.4 addresses the related field of affective aspects; learners' elaborations are consolidated in Table 5B.4.

| **Table 5B.4**<br>**Aspects of overload/anxiety** | **No of students (n = 22)** |
|---|---|
| I experienced overload/anxiety | 8 |
| Pace was too fast / initial skills-gap | 5 |
| Fitting it in with other commitments / Impact on my other studies | 7 |
| Meeting deadlines is stressful | 3 |
| Technical aspects - making it work | 3 |

Collaboration brings an added dimension to affective issues. Some students take their responsibilities to fellow-learners so seriously that they over-commit. Some under-contribute, but with little impact on overall performance, because others bear the brunt. The comments that follow relate specifically to collaborative work:

- ***Affective-cognitive connection within collaborative work***

  *In the very beginning it was overwhelming. The first month was sink or swim - all the initial setting up and then straight into the Opera* (note: the Opera was the whole-group collaborative project). *That was probably why the drop-out rate was high in the first few weeks. Then the pace slackened. Those who dropped out will probably be sorry they did not push through that initial difficult month. /*

  *I was irritated when someone didn't send through what they were supposed to.*

### 5B.2.1.4 Concluding discussion

RBO exacts a high degree of independent work, and is suited to mature self-motivated learners. It incorporates a broad variety of types of learning - conceptual and practical. Once web-skills are in place, learners reinforce them by the continued development and uploading of web-product. The integration of graphics, animation, text and spreadsheets provides broad exposure to web-design, over and above the educational aspects. The evaluative skills used in the investigation of an existing web-learning initiative and in commenting on fellow-learners' project proposals, hone learners' analytical skills.

The learning environment and requirements are cognitively challenging, but are in line with Squires' (1999) notion of cognitive authenticity (see 2.4.5.3:1).

The evaluation does, however, reveal some cognitive shortcomings. Learners' comments show that RBO makes stressful demands on those with an inadequate technical background, as they struggle to bridge the web-skills learning gap. They also work much slower as they develop their web-based products. A possible solution is to enforce technical expertise as a pre-requisite. Learners without appropriate skills could attend one of Pretoria's University's web-authoring certificate courses, where the practical skills can be acquired in a class situation. Although collaboration brought rich expertise to tasks, it hindered progress and some learners found it intrusive.

The attrition rate is high. The 22 survey participants do not represent the initial complete groups of 1999 and 2000 learners. The 13 learner-evaluators from the class of 1999 represent 13 of the original 22 who registered, i.e. the attrition rate was 9 out of 22. Of the 9 learner-evaluators of 2000, two who completed the questionnaire did not finish the course, so the overall attrition rate was 4 out of 11.

## 5B.2.2 Constructivism

Key features to be considered in an evaluation of constructivism in a learning event are active participation and learner-ownership, knowledge construction, real-world contexts, the approach to errors and evaluation of learners, and multiple perspectives on the topic. Further aspects are acknowledgement of real-world complexity and the use of collaborative learning. RBO's open-ended tasks lend themselves to implementation of the constructivist approach. The following subsections investigate these issues and also review the foundations of RBO's grounded design (Hannafin *et al*, 1997), as well as comparing RBO with Hannafin *et al's* (1994) open-ended learning environments.

### 5B.2.2.1 Initial discussion

This section discusses the researcher-learner's impressions of the theory and practice of constructivism within RBO.

- ***Active participation, knowledge construction, and learner-ownership***

  RBO learners actively explore web tools, sites, and facilities, as they build products for their own websites. The end results vary from accomplished professional-type designs to basic text-on-the-web, as learners personalise their desk - using graphics, gimmicks, grandiosity, or just-the-basics. Each mini-desk on the RBO home-page is linked to the learner's full desk and portrays something of the desk's occupant, for example, the feet-on-the-desk and the signpost-to-the-beach, shown in Figure 5A.3. The full desks, in turn, provide links to that learner's information and tasks. To a large degree, RBO learners decide for themselves on the content of their tasks.

  In RBO, domain knowledge is not viewed as a defined set of facts and techniques to be remembered, but as resources to support learners in operating as expert practitioners. This approach necessitates top-down, just-in-time learning, where learners supplement their knowledge and skills, as needed, during the learning-and-construction process. In two of the tasks, RBO supplements personal knowledge construction with socially negotiated learning to provide complementary strengths and support weaker learners.

- ***Instructional goals and learning objectives***

  Figure 5B.5 shows the requirements for two tasks, as given on the RBO web site. First, it lists the outcomes of the whole-group collaborative task, where the students were required to construct a web-based opera. The *modus operandi* is described, but the roles of each learner, how to allocate roles, and the name, content and structure of the opera are not specified. (Note: The group used an analogy, and called their opera, *Phantom of the Internet*. The broad story line and 'songs' were based on themes and tunes from the Lloyd-Webber production, *Phantom of the Opera*).

For the individual task (the examination project) there were two broad options. Within these options, goals were negotiated and projects open-ended - one relating to administration of Internet-based learning, and the other entailing research into facilitating learning on the Internet. The second part of Figure 5B.5 shows the broad specifications for the latter option, indicating the content- and context-independent nature of the exam project.

**Figure 5B.5 Outcomes and requirements of two RBO activities**
(RBO880, 2000)

**Outcomes of the collaborative task**

Upon delivery of this product, you should be able to

- Work together as a team.
- Produce web-pages in a frames environment.
- Obtain and produce suitable graphics and animated objects in gif or jpg format and use them to enhance your web page.
- Edit MIDI files and insert them as background objects in web pages.

Present at least 20 Internet terms with their definitions in a decontextualized format.

**Requirements of the examination project**

Identify a specific context where the Internet could be used to facilitate learning. Design a sustainable project which will ensure that the Internet is used for at least six weeks on a weekly basis. Post your proposal to the listserv for comment from the rest of the group. After incorporating any valid comments/suggestions from the group, run this project and publish a collection of web pages on your results. The publication should be in the form of a portfolio which contains the following sections:

- Rationale for your project
- Literature review
- Description of project and execution
- Findings (data)
- Conclusions and recommendations

- ***Personal learning goals***

Figure 5B.5 shows that RBO content and performance goals are not precisely pre-specified. Requirements are flexible and tasks open-ended, with solutions dependent on the interpretations of the individual or group, resulting in a variety of different objectives.

Learners' personal goals were negotiated, as they posted their exam project proposals on the listserver for discussion. Each chose a subfield of the domain, ideally with personal relevance (so that the product has practical real world value), and used the rich environment of the Internet and WWW to extract, present, and solicit information. The completed artefacts differ radically in purpose, scope, and structure. Examples of projects generated by the class of 2000 are:

- Post graduate didactics of history,
- interactive web-based assessment, and
- industrial skills training on an intranet for semi-literate labourers.

- ***Problem-based / Authentic real-world context***

  Both options for the examination project were real-world problems which learners could relate to their professional situations. The idea was to generate products suitable for use as a learning environment or an administrative toolset in authentic settings of teaching or training. Several students ran their projects on their own learners or invited colleagues to peer-evaluate. The projects were authentic and complex as the learners tackled real-world problems – exploring, correcting, and refining solutions. Note that they were **not simulations of real-world issues, but actual problems** from the work environments or personal contexts of these adult learners.

  Section 3.4.4.2 describes constructivist learning environments (Jonassen, 1999), showing how the problem is the focus of the environment, surrounded by support systems and resources. The **problem drives the learning**, rather than merely serving as an example of concepts and principles. Similarly in RBO, students learn domain content in order to solve the problem, rather then solving problems as application of learning.

- ***Incorporated subversion and exploration of errors***

  Exploration and self-expression are synergistic features well suited to an environment designed for incorporated subversion (Squires, 1999 - see 2.4.5.3). The RBO task that required learners to design their own desk was subverted positively, as students took the basic structures provided and transformed them, configuring them to express individuality. Some of them subverted the graphic to such an extent that there was no resemblance whatever to a desk, as demonstrated in Figure 5B.2. In generating web-artefacts, learners extended and refined their products, and self-corrected errors.

- ***Evaluation of learners and integrated assessment***

  Learners are graded - in line with university policy. The instructor applies multimodality in assessment, evaluating a portfolio of products, as well as participation in online communication, resulting in a form of integrated assessment. Learners submit self-assessment estimations; and although there is no formal peer-evaluation, they can express opinions about the extent and worth of others' contributions. Assessment is not criterion-referenced.

- ***Grounded design in RBO***

  For a learning system to be based on a grounded design (Hannafin et al, 1997; Sections 3.1 & 3.4.3.3), five foundations must be aligned to maximize coincidence and shared functions. The RBO environment is examined with respect to these five:

*1. Psychological foundation*

RBO situates cognition in the development of visible, yet virtual, products related to real objects and events. Individual and shared cognition are focussed on the dual aims of

(i) assimilating, creating, and collating material, and

(ii) presenting it in the form of web pages.

Knowledge and skills are applied in ways that add value to real, complex circumstances. All RBO learning is contextualized and elements are not isolated in order to teach them. Knowledge gained is immediately activated in authentic activities, i.e. students learn domain content in order to solve a problem or participate in executing a task.

*2. Andragogical approach*

The andragogical foundations are consistent with the above, since learning and instruction are anchored in realistic, holistic contexts, without simplification or compartmentalization of knowledge and skills. Scaffolding is provided in the form of reading assignments, references to resources, and links to online tools. The instructor provides no coaching, but learning in the 2000 class was facilitated by two 'lifeline helpers', former students who answered queries and guided strugglers and stragglers.

*3. Technological foundation*

Course content and domain heuristics are integrated into the learning tasks and interpreted by learners on a need-to-know basis. Technology is therefore not used as a tutor, but rather offers tools for exploring resources and integrating knowledge in the problem-solving process. This is in line with the constructivist use of technology to promote learning instead of to deliver instruction. The course is not technology-independent, since it relates integrally to learning via technology and is presented on the Internet. But it is independent of any specific web-based platform, training product, software package, or authoring tool/language.

*4. Cultural considerations*

There are various cultural considerations:

- *The organisational culture and systems of the University of Pretoria*
  There are institutional principles and procedures - in particular, the commitment to outcomes-based education (OBE), and a grading structure for the purpose of credits and merit. Hence the entry requirements, specification of intended outcomes, unit standards for each section, time schedules, and mark allocation (50% to pass; 75% for a distinction).
- *The MEd culture for those learners who are part of the MEd (CIE) degree -*
  A culture of mutual support, collaboration, and group projects.
- *Internet culture -*
  A culture of the global community - entailing shared use as hyperlinks permit easy import of material and as underlying code is lifted and modified. Furthermore, it is a culture of saying-it-like-it-is, which can lead to virtual relationships of conflict or even romance.
- *The traditional classroom culture of competition*
  Competitive learners strive to out-perform one another in the products they generate. RBO is transparent in that co-learners' emerging products are exposed on the web for all

to see. An achievement-oriented individual knows exactly what he/she must beat. The transparency includes web-classrooms of previous years, building up a heritage of available ideas and underlying code.

- *Finally, the 2000 presentation had an inherent Eurocentric flavour*
  This was due to Opera project with its Western theatre structures. This could be a disadvantage to learners of African origin, unfamiliar with classical opera.

5. *Pragmatic foundation*
   Hannafin *et al* (1997) suggest pragmatic accommodation and balanced foundations to mitigate against extreme constructivism. RBO remains highly constructivist, but also has objectivist features in the prespecification of its (very general) objectives, unit standards, and outcomes. It is distinguished from many conventional courses in that products developed by learners must have a practical application.

- ***RBO as an open-ended learning environment (OELE)***

OELEs (Hannafin *et al,* 1994) empower individuals to learn, rather than promoting mastery of specific concepts. They support student-centric learning, with parallel application of technology and are associated with constructivism and situated cognition. Three of their critical assumptions (see 3.4.4.3) are reflected in RBO:

1. *The process and the context of learning are closely related.*
   RBO embeds learning in experience and in authentic contexts. The resources it offers form a type of online phenomenarium, in which learners can create virtual products. The rich environment of the Web can provide multiple perspectives and multiple approaches toward solving a problem.
2. *The cultivation of cognitive processes can be more important than actually generating learning products*. The decision-making, interpretation of data, and self-reflection inherent in RBO activities help learners develop higher-order thinking skills and invoke metacognitive skills.
3. Finally, *the qualitatively different learning processes of OELEs require qualitatively different methods*. RBO's examination project incorporates problem-solving, theory-building, and hypothesis generation. Certain resources are provided as support structures, and students are expected to access and use suitable tools. Communication is in distance-learning mode, which is very different from traditional instruction at Pretoria University. RBO thus uses completely different methods and activities in pursuit of its goals.

OELEs are appropriate for less-structured contexts with domain-specific thinking, and are unsuitable for formal, procedural domains, such as mathematics. Many of the broad educational problems encountered by the typical RBO learner are ill-structured, situated in social science domains, and enable the type of learning that occurs in OELEs.

- ***Cognitive puzzlement/conflict in RBO***

Cognitive conflict or puzzlement (Savery & Duffy, 1995; Perkins, 1991b) manifest themselves in RBO, as will become clear from this and the ensuing sections. Despite giving rise to a degree of learner-frustration, they serve as a stimulus for learning.

### 5B.2.2.2 Viewpoint of the instructor-designer

> I wanted learners to experience learning by constructing meaning as they constructed their sites. To do this I had to give deliberately vague instructions.
>
> For learners to be in charge of the process, the instructor has to let go. This is very difficult, because eventually the instructor is still responsible for the success of the course!

### 5B.2.2.3 Findings from survey of the learners

RBO is a highly constructivist course. References to constructivism occur, implicitly and explicitly, throughout most of the 'C' evaluations in this section. However Table 5B.5 shows responses to a series of survey questions, Questions 32.1 through to 32.6, that related specifically to constructivism. The learners rate RBO as a strongly constructivist learning experience.

**Table 5B.5 Constructivist aspects in RBO**

| **32. To what extent did you experience the following aspects of constructivism in RBO800?** | **No of learners (n = 22)** | | | |
|---|---|---|---|---|
| | **Very great extent** | **Great extent** | **Moderately** | **Little** |
| 32.1 Learning situated in the real world | 5 | 12 | 5 | - |
| 32.2 Discovery learning | 9 | 9 | 2 | 2 |
| 32.3 Anchored instruction | 1 | 11 | 4 | 5 |
| 32.4 Integrated testing | 1 | 10 | 6 | 3 |
| 32.5 Active construction of knowledge | 7 | 10 | 3 | 2 |
| 32.6 Transfer of skills | 8 | 8 | 3 | 3 |
| **Total** | **31** | **60** | **23** | **15** |

- ***Situated learning, discovery-learning, active knowledge construction, transfer of skills***

These are particularly evident. For Questions 32.1, 32.2, 32,5 and 32.6, relating to situated learning, discovery-learning, active knowledge construction, and transfer of skills respectively, three quarters of the participants rate them as occurring to a 'very great' / 'great' extent. The researcher observed concrete constructivism, as learners visibly constructed knowledge, developing publicly accessible web pages, and thus presenting their work to their peers.

RBO learners were familiar with constructivist learning from the educator's perspective. Table 5B.6 shows their responses to Question 32.7 regarding being on the receiving end.

| | |
|---|---|
| 32.7 | As an educator yourself, how does it feel to be on the receiving end of constructivism? |

**Table 5B.6 Being on the receiving end of constructivism**

| Impressions | No of learners (n = 22) |
|---|---|
| Enjoyed it immensely | 7 |
| Initial frustration / challenge | 11 |
| No comment | 4 |

These responses indicate that only seven fully enjoyed the experience. Half the learners (eleven) described initial frustration/challenge regarding constructivist learning, but found it a good way to learn if they persevered. The qualitative data following includes highly positive comments as well as indications of a mixed experience:

- ***Real-world context, and personal goal-setting:***

  *A new universe to me - I LOVE the educator-as-learner experience. /*
  *I found that I had new ideas all the time - I enjoyed being challenged. /*
  *I learn a lot because I can choose what I want to do.*
  *I liked the experimentation and lack of boundaries. /*
  *Pressure!! Lots, not as much external, but self-laden /*
  *Discovery learning was fun. / My institution wants to extend and use my exam project. /*
  *Tough, yet liberating as you had a large say in how you designed work.*

- ***Frustration and insecurity***

  *I feel there is still basic knowledge that one needs to master. /*
  *The learning curve is very steep. /*
  *It is rather a nerve wrecking experience ... really tough because of the lack of boundaries. /*
  *A good way of learning, but it is time and energy consuming. /*
  *Frustration, irritation ... / If you persevere, you gain and retain.*

  And some offered suggestions:
  *Why can't it go truly constructivist and give learners their own time schedules to complete projects? /*
  *It's a different medium but has the limitations of conventional learning ... it should be open-ended.*

### 5B.2.2.4 Concluding discussion

The examination of RBO against constructivist features shows a strong match. RBO is highly constructivist, despite being implemented under distance-learning conditions. The seven primary constructivist values (Lebouw, 1993): collaboration, personal autonomy, generativity, reflectivity, active engagement, personal relevance, and pluralism are all supported within RBO. Furthermore the evaluation shows that all the activities are highly contextualized in tasks relevant to the real world.

The initial discussion section highlights the occurrence in RBO of constructivist concepts such as negotiated personal goals, resources available on a need-to-know basis, real-world authenticity, and the emphasis on cognitive processes. The instructor's comments indicate that he deliberately 'lets go', so that students can construct their own meaning as they develop their sites. These factors describe a learning experience that exacts self-responsibility on the part of learners, in an environment without explicit guidance. One would anticipate that the personal responsibility for knowledge and skills-building, the lack of boundaries, and the replacement of fixed scaffolding by demand-scaffolding would cause learner-insecurity, an impression confirmed by findings in the survey. These 'negative' aspects should not be termed shortcomings. Rather they are manifestations of true constructivism.

RBO was shown to conform strongly to constructivism, except for the non-constructivist practices which are part of organizational norms, such as grading students' work and establishing deadlines. Grading of products was done by the instructor, but included a self-assessment component as well as a rating for 'classroom' participation. The request for self-paced schedules is an issue beyond the control of the instructor, but in any case, self-paced schedules would impact negatively on collaborative work, which is a key feature in RBO.

## 5B.2.3 Components

This section examines the occurrence of component-based learning within RBO. The knowledge and skills of each academic domain comprise basic units or components. In RBO these would relate to conceptual knowledge of the WWW and Internet, and particularly to the technical expertise required to implement web-based learning, communication, and management.

### 5B.2.3.1 Initial discussion

RBO includes neither explicit nor implicit component-based instruction, nor any teaching of decontextualized, basic skills, since it operates holistically. No elements are isolated in order to teach them. Nevertheless, it requires learners to be capable of both basic and integrated technical skills. For example, they must be able to manage basic abilities such as using e-mail links, but must also be able to tackle tasks such as generating animated 'gif' files, which is a complex composite skill.

Componential instruction would be inappropriate in RBO's discovery-learning ethos. Nevertheless, although there is no internal instruction of basic components, the web-classroom has links to external web sites that teach HTML, the fundamental web language.

### 5B.2.3.2 Viewpoint of the instructor-designer

> The course has two different types of components. In the first place there are the basic physical aspects such as basic HTML, elementary graphics, retrieving items from the WWW and placing your own content there. Then there are the integrated composite skills. Students need to be comfortable with these basic skills to figure out how to do more complex things.
>
> RBO tested students' abilities in these technical aspects. For example, they were expected to create various graphical elements in the course of their RBO tasks. However, I think one of the main problems with the course is that the technical stuff was left for the students to figure out <u>without</u> components to teach it to them.
>
> As well as the two kinds of technical component skills, there are also basic theoretical components relating to Internet terminology and concepts. Some students' basic conceptual knowledge is too low to allow them to be able to teach effectively using the Web. One student, for instance, a week into the course, asked the question 'What is a URL?'. In order to ensure that students' Internet knowledge is up to standard, they are asked to construct elementary web pages and glossaries of terms. In 2000, these were included in the songs and script of the Opera.

### 5B.2.3.3 Findings from survey of the learners

The survey incorporated no direct questions about components, but in open-ended responses, two learners mentioned the value of the links to the HTML tutorials.

Others discussed their non-use of the linked list of references (literature and web sites):

> *Learning material was available, but packaged differently. Due to lack of a theoretical introductory 'session', I tended not to use the instructor's comprehensive list of references. /*
> *I followed the link and printed it, but never actually accessed the material. /*
> *The instructor provided a list of references, but they seemed remote.*

### 5B.2.3.4 Concluding discussion

There are no explicit knowledge or skills components communicated in RBO. This is a disadvantage for learners without adequate technical skills, and some less-able learners may find the external linked tutorials too abstract. Either, these links should be made more explicit and the tutorial used as a pre-RBO course, or else attendance at a certificate course should be compulsory for learners with a skills gap. HTML courses could be supplemented by optional instruction in graphics skills.

## 5B.2.4 Collaborative learning

This section investigates the worth of both the collaborative and co-operative forms of learning (section 2.5.1) in RBO, determining whether the collaboration helped or hindered ultimate learning, and whether the whole was greater than the sum of the parts. Collaborative learning involves teamwork which capitalizes on each member's abilities, allocating separate roles in a joint project. Co-operative work entails small groups working together towards a stated goal or specific product. Further collaboration examined is the communication via e-mail on *e-Groups* and chat sessions, which replaced normal class contact. The subsections set out these findings and also investigate the two team tasks with respect to Johnson and Johnson's (1991) key elements of co-operation, adding the further dimension of *Communication,* which is a major factor in distance-teamwork.

### 5B.2.4.1 Initial discussion

Collaborative learning in the RBO course of 2000 comprised four aspects:

1. The whole-group task to produce a web-based 'virtual opera';
2. Evaluation of existing educational web initiatives by two-person teams;
3. Ongoing communication via the listserver, which was mainly used for an open e-mail forum; and
4. Membership of a newsgroup.

Each of the four is discussed:

***1. Whole-group collaborative learning***

The timetable and requirements for the whole-group task of creating a web-based 'virtual opera' in Unit 1 of RBO 2000 are given in Figures 5B.4 and 5B.5 in sections 5B.1.4 and 5B.2.2.1 respectively. Aware of the skills gap and varying expertise, the instructor designed a task that placed responsibility on the composite body of learners - to share and complement one another, offering multiple perspectives on the theme and building on each other's contributions. The opera project is examined under the key elements of co-operation (see 2.5.1.2; Johnson & Johnson, 1991), as well as under the separate aspect of general communication.

- *Empowerment of learners*

  The idea was for learners to plan, communicate, delegate, and self-regulate, so as to capitalize on talents for management; research; an intriguing story line, script, and rhymes; use of music files, graphics and animation; and the co-ordination of choreography for the sets and scenes. The instructor specified the dates and duration, but gave no suggestions for the title, theme or task allocation, leaving it to the students to handle planning and construction online via the listserver. Deadlines passed - a few tentative suggestions were made on the e-mail forum, and the theme *Phantom of the Internet* was chosen, but no learner was decisive or assertive enough to take charge. The instructor suggested a session in the 'chat room' and shortly afterwards a learner nominated two of the group - those who had communicated the most and made informed suggestions - for the roles of director and producer. Finally the process was underway!

  The director and producer accepted, and took charge. Other roles were allocated - some defining the story line; some taking parts in the drama (this entailed writing script and 'songs' for that character); and others researching web terminology to integrate into the script. The director delegated, co-ordinated, and selected suitable online music files, while the producer used software and web frames to hyperlink the elements into an operational production. The instructor gave a two-weeks extension, prolonging RBO.

- *Positive interdependence*

  Allocating roles was a good start. The other issue was to manage internal consistency in the opera. As contributions arrived, so the product unfolded. RBO learners had to follow the e-mail and view the dynamic opera site daily so as to make perceptive contributions that fitted what was already in place. They could spot the gaps, inform the forum of their intentions, then submit appropriate graphics, animations, poems, etc. The public e-mail forum revealed the unfolding of the opera, as well as the complexities:
  - Learner A made a suggestion to which both B and C responded, but with differing viewpoints.
  - A male made a suggestion that could be interpreted as denigrating females.
  - Tardy or busy learners delayed responses, and on making them, found that the dialogue (eight-alogue) had moved on and their contribution was useless.
  - Social negotiation led to arguments, temporary offences, apologies or assertiveness, and eventual consensus as conflicting viewpoints were channelled into convergence.
  - A learner became ill, and the producer handled it by defining an independent contribution for her, which could be linked in later.

- *Shared goals, individual accountability, and co-operative evaluation*
  There was group and individual accountability; teamwork and goals of personal excellence. Creating the opera was a joint responsibility, but the students did not all receive the same mark. The instructor knew what each had contributed and graded accordingly, awarding grades comprising both joint and individual marks.

- *General communication*
  Why the delay in start-up? It would probably not have occurred had been a face-to-face meeting up front. Another reason is that the learners did not all know each other - if they had all been MEd students who had met on previous contact modules, the inter-personal dynamics might have strong enough to foster quick decisions. A third factor was the lack of an assertive, even 'pushy' character to force-start the process.

  With regard to the effectiveness and efficiency of doing the job via distance-collaboration, asynchronous computer-mediated communication was not optimal for an eight-person project with such varied contributions. The director and producer occasionally supplemented online communication by telephoning one another, and a local class member joined the producer in physically sorting printed versions of songs and scripts - simultaneously visible - to allocate them rapidly to final positions in the score.

  If there had been a few class contact sessions, the product could have been completed in less than two weeks, instead of more than a month. In keeping with the distance-education nature of the course however, online communication was a requirement so that learners could experience first-hand the problems inherent in such ventures. Two chat sessions were scheduled on *e-Groups* to discuss the opera, but did not operate effectively. Due to technical problems, some learners could not access the *chatroom.* If it this synchronous communication been successful, it might have expedited the process.

Despite delays and frustrations, the ultimate web-based multimedia product was excellent, with a realistic structure. It achieved balance in academic terminology; web-techniques; graphics, animation and audio effects; and has an amusing storyline. *Phantom of the Internet* was a source of pride to its joint-creators, and received acclaim when the instructor demonstrated the RBO2000 website at an educational symposium and a Human-Computer Interface conference. This is line with the 'no significant difference' phenomenon which postulates that medium does not influence learning (Clark, 1994; Kozma, 1994; Russell, 1999).

### *2. Co-operative pairs*

RBO's Unit 2 on *Distance learning and the Internet* involved co-operative pairs researching and reporting on existing web-based teaching initiatives, developing a generic interactive spreadsheet instrument to test for web-readiness, and applying it to that organisation. Of all the RBO2000 activities, this task, with its specified deliverables, was the most tightly defined, although the content was open to personal interpretation. The instructor assigned each pair an organisation to investigate, and strategically determined partners - in some cases allocating a strong student to support a weaker.

Again Johnson and Johnson's (1991) elements of co-operation and the added dimension of communication are used as discussion headers:

- *Empowerment of learners*
  The task required solid investigative research, report-writing in the format of an accredited journal, technical expertise to develop an interactive spreadsheet, and final presentation. The partners subdivided the tasks, capitalizing on strengths.
- *Positive interdependence*
  Some co-operative pairs designated separate sections of the task to each member; others developed joint products, adding sections and editing one another's contributions.
- *Shared goals, individual accountability, and co-operative evaluation*
  The co-operative evaluation system used by the instructor included both joint- and individual accountability. The partners did not necessarily get the same mark. Grades were allocated for perceived learning as well as the value of their contributions. Assessment was done by the instructor, but if they chose, individuals could inform him of their personal roles and responsibilities in the tasks.
- *Communication*
  Work distribution between the two was handled mainly by e-mail, using personal e-mail addresses instead of public communication via *e-Groups*. Likewise, documents that involve joint reasoning were transferred back and forth as attachments to e-mail. With small groups, communication and planning went smoother than in the opera, although there were occasions when learners with heavy schedules kept a partner waiting, and delayed completion.

***3. General e-mail communication***

E-mail on a dynamic mailing list was the forum for interaction. The instructor used it for briefings over and above the information on the website, and learners used it to communicate with instructor and classmates. All mail sent via the group-server is public, but private contact with peers as well as with the instructor could be done using the 'Ears' links from learners' desks.

In the early part of the 2000 course, when students introduced themselves and constructed the opera, there was high activity, which subsequently tailed off drastically. The instructor asked the class to comment on each other's exam-project proposals, but there was very little response. In other years lively, and even contentious, debate ensued throughout the course, as students bonded and confronted. The class of 2000 used their e-mail listserver in the process of generating joint deliverables. It did not serve as a channel for metaphorical class banter. There was very little 'chitchat' or humour, except for contributions from a past student who was one of the lifeline helpers. The nature and duration of the interaction depends on the personalities and group dynamics. When the forum is lively, it holds attention. Even those who do not participate are present - observing invisibly in anticipation. This is where the metaphor of a physical class breaks down. In a face-to-face situation, non-participant onlookers are visible and are perceived to be implicitly involved, whereas Internet onlookers can lurk anonymously.

***4. Newsgroup communication***

Membership of the international IT Forum (Information Technology) newsgroup via *e-Groups* is mandatory for RBO learners. In fact, the first RBO task is to learn how to subscribe to the forum. The Forum publishes an online paper is monthly, followed by open discussion on the stance and proposals of the paper. There is overlap between the Forum and the journals, *Educational Technology* and *Educational Technology: Research and Development.* Perceptions of this discussion list vary. Some learners become active participants - remaining on the Forum post-RBO, while others experience its daily offering of e-mails as intrusive.

## 5B.2.4.2 Viewpoint of the instructor-designer

> In the collaborative opera project, the class was put into one big group to let them feel how difficult it is to kick-start a project without clearly defined roles. I wanted the learners to experience that online learning takes longer and can easily lead to missed deadlines, misunderstandings, and other problems. I gave them the project and waited for them to start working on their Opera. Nothing happened. After a while I realised that I would have to create some urgency. This was done in the form of a session in a chat room. During this chat, students realised the importance of defining roles.
>
> The whole point is that I didn't want them to go through an errorless, fault-free automated process, because then they would not experience the frustration that their learners feel if certain things go wrong. The RBO learners had to feel, 'I went through that - it was awful - I never want my learners to undergo something similar'.
>
> The co-operative tasks were done in teams of two members each. I based the selections of the teams on a number of considerations. Firstly I put the very strongest members together in such a way that their relative strengths would be complementary (i.e. a good graphic designer and someone good at writing). Then I put the very weakest students with some reasonably strong members so that they would not be lost completely. Then I grouped the middle students together. When it came to grading the work I awarded marks to individuals and not to groups, so that weak students would not benefit from the work of their stronger team-mates, nor would stronger students be pulled down by their weaker partners.

### 5B.2.4.3 Findings from survey of the learners

Several of the questions relate to collaborative learning and communication, and their central roles in RBO:

| | |
|---|---|
| 15 | How did you experience interaction with your classmates - e.g., useful /supportive / complex / frustrating, etc? |
| 16 | Were there issues relating to e-mail communications and the chat sessions - other than technology-related - that were problematic, e.g. misunderstanding of meanings or intentions? |
| 18 | Did you use any other means of communication with the facilitator or other learners? |
| 21 | One of the problems in collaborative learning is getting started. What factors influence group members to take initiative? |

The responses to Question 15 on personal interaction are shown in Table 5B.7, classified into three groups and clarified beneath the table by their elaborations. Some responses (not shown) related to the co-operative work with a single partner and those responses were mainly positive.

| **Table 5B.7 How did you find the interaction with classmates? (n = 22)** | |
|---|---|
| Positive experience | 4 |
| Mixed feelings / Useful, but frustrating at times | 12 |
| Negative experience | 6 |

- ***Collaborative interaction***
  There were insightful and thought-provoking comments on whole-group online collaboration:

  *It was frustrating in that we did not all work with the same urgency. /*
  *Working collaboratively without face-to-face contact was a recipe for irresponsibility on my part. /*
  *A simple decision takes days to pan out. ...*

  *The Opera - whole group collaboration: the aspects that could be very time-consuming due to lack of skills not yet acquired were done collaboratively. Many hands and brains made the assignments flow, while learning simply happened.*

  *Second group tasks - pairs: I noticed the clever grouping of the slow and the fast workers, the strong and the weak students. A commendable skill to use when leading a group task. I also appreciated the formative feedback.*

- ***E-mail contact***
  Five of the six who responded negatively in Table 5B.7 were from the class of 1999, where online conflict had occurred:
  *Too much irrelevant online bickering. /*
  *Tedious and sometimes irrelevant. /*
  *All those e-mails every day ... I found them intrusive*

Some learners felt the daily interaction did not come up to expectations:
*I felt frustrated there was so little interaction between students and that they weren't really supportive of each other (except for the Opera). They all stuck to themselves. /*
*I like discussion and debate - it happened to an extent, but the human factor wasn't there. /*
*I prefer instant response.*

Question 16 relates to problems with online communication. Apart from more references to the 1999 online 'flaming' (conflict), comments acknowledge that misconceptions and ambiguities occur online, which would have been speedily resolved in direct contact.

- ***Chat room sessions***
  Several learners were unable to access the chat room, but those who had, made suggestions:
  *It should be regulated, so that everyone gets a turn to speak or respond. /*
  *My initial lack of expertise made my responses slow. When I was misunderstood, the conversation flowed so fast that explaining myself was no longer relevant and I just let it go. I did not find the experience hindering, though. I learnt a lot about communications and online chats. /*
  *It would have been much better if it had been controlled, e.g. a leading question and chances to contribute. /*
  *Timing of the chat ... I could not make one of the sessions for work reasons. Maybe a chat archive would be a good idea, so I could catch up.*
  (Note: there is actually a chat archive facility on the service provider)

  - ***IT Forum news group***
  Students gave their varying impressions of the international IT Forum group communication:
  *It was irritating - all those e-mails. I was glad that once the module was over, I could unsubscribe. /*
  *It cluttered up my computer.*

  Others participated actively and regularly, and stayed on the Forum after completing RBO.
  *Stimulating - I enjoy contributing. /*
  *I savoured the daily debate and anticipated each new paper on ITForum.*

Question 18, the responses to which are given in Table 5B.8, investigates to what extent learners supplemented e-mail by other forms of contact:

**Table 5B.8 Did you use any other means of communication? (n = 22)**

| | |
|---|---|
| **Yes** | 8 |
| **No** | 7 |

Most co-operative learning pairs phoned each other, and those of the 1999 class who lived near each other had met. In 2000 the wily instructor paired students who lived far apart. As stated in 5B.2.4.1, the opera generated direct communication - phone calls between producer and director, and face-to-face between the producer and a local co-learner in the final stages of integrating the material.

The problem addressed by Question 21, namely, getting started, is experienced more in online collaborative learning than in face-to-face teamwork. Minor delays occurred in the small teams, but delay was a major issue in the large-group opera task. Students had different ideas about the factors that influence group members to take initiative. It appears that, all else failing, deadlines and frustration force the issue. In general, many factors contribute:

- ***Confidence, lack of self-confidence, time, work commitments***
  *A person may fear exhibiting one's lack of skill or knowledge ... it is safer to lurk in the background until one has the self-confidence to make a contribution. /*
  *So "nice" ... so scared to be too forward ... someone has to get started and stick your neck out. /*
  *The instructor did some encouragement, coaxing, "When are you going to start?". /*
  *In desperation I offered to be the director. At least we got some direction then and found that the actual task was less daunting than the prospect.*

  - ***Dynamics between isolated distance-learning and collaboration online***

  Both the above situations are non-ideal, yet each can add something to the other to bring about balance. Some general remarks provide different perceptions about the balance:

  *I learnt that even with a listserv and co-operative group projects, web-based courses can be isolating and lonely. / ... not an optimal environment at all. /*
  *I like to get on with a job ASAP in a focused way and interaction interferes with this. /*
  *My partner was under pressure at work and just disappeared into cyberspace, delaying our efforts. If there had been face-to-face contact, it been much harder to do this.*

  *Never having been a full time student, I was accustomed to working on my own with very little interaction, so the aspect of working independently was nothing new.*

  *Feeling free to learn from others definitely made me learn more and enjoy the process. It is exciting to see what is possible and try to improve on that by putting your own stamp of individuality on it. I am better at japaneering than engineering.*
  Note: this comment refers to the opportunity of viewing the code underlying web products and re-using it with modifications and enhancements.

  *I learned lots about the process of creating a climate and a community with which to promote such learning. / I appreciate the immense impact of computers on groupwork!*

### 5B.2.4.4 Concluding discussion

The evaluation shows how teamwork can generate products of a standard and extent way beyond what individual learners could produce. Combining different forms of expertise and complementary abilities is synergistic, contributing to the quality of end-products. Both the opera and the two-person tasks comply with the recognized characteristics of co-operative learning, including interpersonal skills as learners share goals and acknowledge interdependence.

The main contribution of this study is the light it sheds on **online collaboration**. The evaluation, especially the investigation of the collaborative opera experience with its delays and complications, highlights the complexities of online collaboration. First, there was the difficulty of online decision-making and planning. Second, it was cumbersome and inefficient to assemble a multi-media project by virtual collaboration.

Do these complexities represent a shortcoming in RBO? To the contrary they comprise strengths. The instructor permitted the problems to occur - a deliberate tactic to make a point and expose learners to the issues first-hand. The instructor- designer achieved his aim of demonstrating how and where web-collaboration is appropriate - a valuable lesson for learners about to become Internet instructors. A real shortcoming of collaborative work, however, is that a team member/s can delay the project. This problem is exacerbated in virtual collaboration, because the offender can disappear into cyberspace, ignoring online calls.

Working collaboratively was further exposure to the integration of learning theories - this time, the close coupling of collaboration and constructivism. Collaborative discovery-learning assisted personal knowledge construction and interpretation of meaning.

## 5B.2.5 Customization

Customized learning is implemented in many different ways – varying from in-built properties of computer-based learning systems to non-technological attributes of a learning event or experience. Section 5B.2.5 reviews RBO to determine how it customizes learning to the requirements of individual learners. The evaluation also investigates the extent to which RBO is learner-centric, where learner-centricity, according to Jonassen, Campbell and Davidson (1994), emphasizes supporting learners rather than controlling them.

### 5B.2.5.1 Initial discussion

The original perception of customization views it as a technique implemented by the branching options in programmed learning and CAI lessons. Constructivist customization, as practiced in RBO, is related to more to philosophical human factors underlying the learning process, than to hardware or software attributes of instructional technology systems. RBO personalizes the course to each learner by aiming for:

- Self-actualization, meeting the requirements and preferences of individual learners, so as to provide them with a fulfilling and useful learning experience;
- Self-regulation, as learners take active responsibility for the learning process;
- Self-direction as learners decide for themselves what to tackle as an exam project and how to set about it; and
- Augmentation of understanding by *situating it in personal experience*, supported by scaffolding.

Each learner emerges from the learning experience with different knowledge and expertise. The role of the designer is to support and guide those individual processes.

This individuality is also evidenced by the class website, where each ‘desk' conveys something of the owner's personality and customs. Although constructivism de-emphasizes grading and competitiveness, the desks gave full opportunity for achievers, graphic artists, and web 'techies' to display their skills.

### 5B.2.5.2 Viewpoint of the instructor-designer

> I designed the course with as many options as possible. The learners had to design their own desks – both the mini-desk graphic in the classroom and the picture of the desk that formed the index to their own work. The students could select the theme of the opera for themselves. Their major project was also on a theme of their own choice.
>
> In other words, I did not customize the course, but made it customizable. Each learner had to personalise RBO for him/herself, i.e. auto-customization rather system-customization.

### 5B.2.5.3 Findings from survey of the learners

The questionnaire included questions on individual needs and the extent to which learners encountered personalized learning in RBO. Moreover, their perceptions of grading and the worth of RBO as a career benefit were addressed.

| | |
|---|---|
| 35 | What are your personal learning preferences, and in what way did RBO match/mismatch these preferences? |
| 36 | The conventional instruction paradigm includes marks at intervals for students' interim tests / assignments. How do you feel about the lack of this in RBO? |
| 37 | How did you find the course useful in your personal or professional life? |

Most of the responses to Question 35, shown in Table 5B.9, indicate that learners were able to personalize the learning experience to their own particular requirements:

**Table 5B.9 Realization of personal learning preferences in RBO (n = 22)**

| Extent of personalization perceived | No of learners |
|---|---|
| Fully personalized | 10 |
| Personalised to a certain extent | 9 |
| No personalization | 2 |

Elaborations to learners' answers were compiled, and are listed in Table 5B.10 and 5B.11, showing personal learning preferences that were realized in RBO, as well as some aspects that were not matched.

**Table 5B.10 RBO and learning preferences**

| **Learning preferences that were realized** | **Number of students (n = 22)** |
|---|---|
| Constructivist learning / active learning | 4 |
| Experimentation / trial-and-error/ hands-on / experiential learning | 4 |
| Holistic, contextualized learning | 2 |
| Open-ended approach to tasks and projects / we could be creative | 3 |
| Asynchronous nature – work at own time in own place | 5 |
| Independent learning / working in my own way | 4 |
| Contact with fellow students / groupwork | 3 |
| Practical skills | 1 |
| Sense of achievement | 2 |
| **Learning preferences that were not realized** | **Number of students (n = 22)** |
| Clear guidance and instruction | 3 |
| Face-to-face learning / direct contact with fellow-students | 4 |
| Discussion and debate on issues of the domain / Academic stimulation | 2 |

As education students, they know the jargon and unprompted, they used the correct terminology to indicate clear preference for active, contextualized, constructivist-style learning (13 of the 22 - first four rows of Table 5B.10). The lack of boundaries and constraints gave them freedom and convenience to work independently in their own place, time and way (nine learners – fifth and sixth rows of Table 5B.10).

The responses regarding preferences not realized showed that seven learners missed the clear guidance and class-contact of conventional learning. A learner raised the pertinent issue of matching personal skills and learning preferences within RBO. Does the purpose of RBO relate to technical web skills or is it about didactics and learning? The answer is the latter – the prime aim is to promote sound use of the Internet and WWW to support teaching and learning, but certain students may not perceive it that way. Such students customize RBO to display their technical superiority and graphic web design expertise.

Table 5B.11 shows the views that emerged in answering Question 36 on the lack of interim marks (grades) in RBO. In general learners were ambivalent:

| **Table 5B.11 Would learners like marks on an ongoing basis? (n = 22)** | | |
|---|---|---|
| **Yes** | **Immaterial/ not an issue** | **No** |
| 5 | 10 | 3 |

- ***Interim scoring / feedback***

*Don't bring it in / You can do it or you can't, and you know ... /*
*The lack of conventional marking systems is one of its greatest strengths.*

Seven of the ten students who were content not to receive ongoing marks, would have liked more comments or impressions from the instructor:

*Very frustrating not knowing what your work to date is worth. /*
*I did not require marks, but wanted feedback to know whether I was on track or off track.*
*As a person - very approachable. During the course - no: no feedback. I had to wait until the end of the year to receive my mark in the official report from the university. /*
*I understand his position. He prefers to step in only if he has to. This is part of his constructivist outlook that learners must discover it for themselves, which they indeed do /.*

*I wasn't bothered by the lack of a mark, because I wasn't focussed on the outcomes. But I missed caring interaction from the instructor towards learners, if the instructor had made comments such as: "why aren't you participating?", "that was something good that you said", or "you are missing the point". The learners had to fight it out. There was no adult care for learners.*

The previous remark was made in the context of the class of 1999, where there was online conflict and aggression between certain learners, and withdrawal on the part of others. Deliberately, the instructor observed, but did not intervene. Although he may have made the right decision in avoiding contentious issues, it would have encouraged learners had he made regular input on non-controversial matters. In general, they found him very approachable, but the class of 2000, more so.

*A people-oriented person / His enthusiasm is pure joy - he motivates his students / He is prepared to listen to your problems / His understanding attitude when you have problems, definitely motivates one to follow up with trying one's best. / Always keen to hear from you.*

Question 37 asked students to consider the worth of the course in their personal or professional lives. Responses were mainly positive, as shown in Table 5B.12 and the comments following.

| **Table 5B.12 Was RBO useful in your personal or professional life? (n = 22)** | | |
|---|---|---|
| **Yes** | **No response** | **No** |
| 17 | 4 | 1 |

*Very useful and I'm excited - I'm going to set up information portals concerning my different interests. /*
*I'm experimenting with presenting my material on the Web. /*
*I want to give web-based courses* (8 learners). /
*Have made my own website for professional use. /*
*Broadened my perspective on group dynamics / collaboration* (2 learners).

And finally:
*People can learn wherever they want, however they want - information available 24 hours a day. That's progress and civilization!*

### 5B.2.5.4 Concluding discussion

Customization, RBO-style has nothing to do with customized user interfaces or learner-controlled software. Rather, it integrates various tenets of contemporary learning theory by offering constructivist customization in a context of self-regulated cognitive learning.

The instructor's intention was to offer a course that learners could take in an immersed web-based distance environment, choosing context and content to suit their individual needs, supplemented by electronic distance-teamwork to mitigate against isolation. This design aim was largely successful as learners were able to auto-customize the RBO experience to their own circumstances and requirements. A high number (19 of the 22) felt they could personalize the course to their needs.

There may be a shortfall in direct guidance and support. The open-ended responses show that approximately a third of the learners preferred the structures and guidance of conventional learning, while the others appreciated RBO's unconventional presentation.

Another shortcoming, expressed by one learner, and also perceived by some other learners and the instructor (Cronjé, 2001a) is the way some learners customize RBO to demonstrate their technical expertise. This is a further example of incorporated subversion, whereby certain learners appear to use RBO to compete in demonstrating advanced web-design abilities. Some of the less technically-skilled did not appreciate being perceived by fellow-learners as less competent. Although technical skills can simplify a web-educator's task, the purpose of RBO is to present a far broader picture. Technical prowess is not the prime aim in RBO, and that is one of the reasons behind the collaborative work - to capitalize on varied abilities and compensate for inadequacies. Only a certain basic technical standard is actually required of each learner.

## 5B.2.6 Creativity

To evaluate creativity in RBO, this section must investigate certain basic tenets of creativity. The prime issue to examine is the use of original and novel means to engage learners and support their learning. Creativity is closely coupled to affective aspects, such as the motivation of learners. The RBO model is compared to various conditions proposed by Dick (1995) for producing creative instruction, such as learner analysis to match their interests, a supportive environment for the designer of the instruction, participatory design, and use of elements of Keller's (1987) ARCS model. A highly relevant issue is the exploitation of technological and multi-media opportunities. It should also be determined whether creativity in the instruction engenders corresponding creativity in its target group.

### *5B.2.6.1 Initial discussion*

This subsection discusses the researcher's impressions of creativity and motivation within RBO.

- ***Originality and novelty***

RBO's structure, content, and presentation are novel and original. While much web-based training is presented using commercial products that provide web-based instruction and course administration in an integrated package, the RBO instructor took an original approach, custom-building his site and procedures. A way of generating creative approaches is to consider instruction in its totality early in the design process (Reigeluth, 1999). This facilitates an early vision of the ideal product. The RBO instructor's specific goal was to present a web-learning experience based on the artefacts, events, and activities of a real-world classroom, and his efforts were focused throughout in that direction.

Course assignments and the nature of the collaboration change each year, entailing re-design of timetable and tasks, and references. Course structure and outcomes remain the same.

- ***Dick's conditions of creativity***

Dick (1995) suggests means towards producing creative instruction (see 2.5.3.1):

- **Innovation and novelty**
  RBO's novelty is structured around its metaphorical classroom-on-the-web. Metaphors are a an aspect of cognitive learning, but are equally relevant to creativity as they attract and support learners by inducing an appropriate 'familiar' environment. The relaxed and humorous class idiom engenders enthusiasm and creativity within the students in turn, as they enjoy the freedom to communicate something of themselves in the process of designing and building their desk and its links to pages about their hobbies; academic work and publications; and their cumulative RBO portfolio. Colours and animation are the order of the day.

- *Awareness of learners' needs / relevance*
  This has been discussed in the previous section, 5B.2.5 on customized learning, reinforcing the overlaps in relationships between the learning theories of the HCMm framework.

  - *Participatory design - involving learners on the team* (also Willis, 2000; Reigeluth, 1996c)
    Participatory design has been used in RBO. Following positive criticism by a learner of the design of the 1999 classroom-on-the-web, the instructor invited that student to work jointly on a facelift for the classroom of 2000.

  - **A supportive environment for the designer**
    This is addressed by the designer himself in 5B.2.6.2.

  - **Exploitation of technology and multi-media**
    RBO is founded on sound educational use of technology and multi-media; in fact, teaching with technology is the reason for its existence. The collaborative project to design and build a multi-media virtual opera,was creative not only in the audio, visual, and textual aspects, but also in the way it exploited distributed technology to develop administrative and technical teamwork, being managed and hyperlinked by remote control.

- ***Use of strategies from Keller's ARCS model***

Keller's model is primarily geared for enhancement of conventional teaching and learning structures and is not altogether applicable to RBO. The classroom metaphor grabs initial attention, although when frustration-in-isolation occurs, it may not continue to hold attention. Since the exam project is directly focused on learners tackling issues of personal career benefit, RBO meets the criteria of attention and relevance. For those who complete it, it also complies with the S of the model, in that they are well satisfied.

- ***Creativity that engenders creativity***

Finally, there is the matter of creativity that engenders creativity, as mentioned in 2.5.3.1. RBO is highly successful in inducing creativity in the learners. However, it is important that creativity remains supplementary to learning. Gimmicks, animation, special effects - whether used by the educator or the learner - must be used in support of the information communicated and not be the content themselves. In evaluating learners' products, the instructor's prime aim is to assess their grasp of the role of the Internet in managing and communicating instruction, and not to judge a graphic design competition.

### 5B2.6.2 Viewpoint of the instructor-designer

The initial creativity in the course is based on reversing the traditional way of doing things, restructuring the patterns (De Bono, 1970). Whereas in a traditional contact class on the Internet, students would gather in a computer laboratory and surf out to various sites, in this course, students stayed at home and surfed into class.

Other elements of creativity centred around letting the learners do things that they would not have done in a normal classroom such as designing their own desks. The most radical form of creativity included letting them create Internet versions of things that they would find in real life but not usually on the internet – such as the ' Virtual opera'.

The supportive environment was personally encouraging. The students showed it by their enthusiasm, and so did my colleagues, who would peer over my shoulder as I built classrooms. The IT Forum community also visited and commented.

### 5B2.6.3 Findings from survey of the learners

The survey incorporated questions on creativity, innovation, and motivation in RBO:

| | |
|---|---|
| 34.1 | RBO is offered in an innovative, unconventional manner. Describe the innovative aspects you experienced, both in terms of the presentation of the module and in the content of the assignments, and how you feel about the approach. |
| 34.2 | What aspects and styles of this innovative approach did you incorporate in your own RBO project, or plan to use in your subsequent teaching ethos? |
| 22 | Were you at any time so engaged and absorbed by certain activities that you seemed to 'flow' along with it, experiencing satisfaction / glued to the computer? |

Question 34.1 asked students to highlight features of the online course and its classroom that impressed them as innovative and different. The findings are shown in Table 5B.13:

| Table 5B.13 Innovative aspects of RBO | | |
|---|---|---|
| **Aspect** | **No of students (n = 22)** | **Elaborations** |
| Online classroom environment | 5 | - New way to learn / Unconventional concept<br>- Appealing approach, design and presentation / Stimulating and motivating<br>- Genuine learning / Communications forum<br>- Learning could actually occur in a virtual simulated class environment. |
| The tasks and the project | 10 | - Very open-ended, was never limited<br>- Assignments creative and innovative, especially the opera<br>- The virtual opera integrated different ideas and creativity - I learned a lot.<br>- Because responsibility was left up to learners, we would put in more than was expected.<br>- Tasks were interesting, appealing, unique, and exciting.<br>- Freedom to do a relevant project in line with own taste - to do own design, using own choice of software, to put in major effort on product you could use yourself<br>- Opera most original, but as a lover of good music, I was frustrated not to hear the real thing.<br>- Tasks were allocated that seemed to be matched to the students (1999). |
| All work done being made available to all participants | 2 | - Improves and creates knowledge<br>- Enhances learners' self-esteem when others appreciate your efforts<br>- I learned much from the work of the others. |
| Innovative use of technology | 3 | - I discovered the immense impact of computers on groupwork by remote students.<br>- This medium is powerful - it was the first time I had experienced this kind of interaction amongst people in a learning environment.<br>- There are so many possibilities for using the web in teaching others and learning myself. |
| Challenge: new tools | 3 | - The tools had to be mastered at our own pace, with very little help.<br>- My lack of expertise made me slow in the chat room. When I was misunderstood, the conversation moved on so fast that explaining myself was irrelevant and I just let it go. |
| Do not experience the RBO approach as significantly different | 3 | - Some of the other MEd modules combine class sessions with distance-learning, with learners posting products on their own web page, so RBO is not unique.<br>(*Note*: This is because other modules adopted the RBO approach!) |

Table 5B.13 categorizes the responses and incorporates learners' substantiations into the table. Some of the aspects mentioned by students are closely associated with Dick's conditions for creative instruction, mentioned in 5B.2.6.1. The students experienced the classroom metaphor as innovative, motivating, and functional. In particular, they considered the activities (tasks and projects) creative and relevant, and were able to use them to match interests. The course made innovative use of technology and demonstrated the value of Internet technologies in teaching and learning, so that learners students felt encouraged to try them out in their own careers as educators. Their responses to Question 34.2, relating to this aspect, are classified in Table 5B.14 which lists aspects of RBO that they would, in turn, use with their own learners.

**Table 5B.14 Aspects of this approach that I have used / would use in my own teaching**

| Aspect | No of students (n = 22) | Elaboration |
|---|---|---|
| Forum for class communication | 6 | - Listserv<br>- Bulletin board<br>- Electronic groups |
| Gave them open-ended projects. /<br>I want to stimulate my students with innovative ideas for activities. | 3 | - Their initiative surprised me!<br>- Something unusual is a stimulating challenge and I want my students, in turn, to experience that. |
| Constructivism | 3 | |
| Group projects | 3 | - Used what I learned and acted as a facilitator<br>- Would give a challenging assignment to a few people, strategically grouped for efficient work output |
| Learners constructing their own web sites / online portfolios | 2 | - Viewing fellow-students' work |
| All the work done being made available to all participants | 2 | - As above |
| Interactive participation / critical thinking and HOTS | 2 | |
| An Internet tool as additional help to facilitate learning | 1 | - For supplementary help and guidance |
| Classroom metaphor | 1 | |
| Would not use any of those aspects | 1 | - This exercise cured me of RBO. |

- ***Reservations***

One learner stated that he liked the approach, but would like ongoing feedback, and would provide it in any online teaching he himself might do. Another claimed that RBO, the fully online course, was:

> *... by far the loneliest I've experienced - I missed personal contact.*

In contrast to those who appreciated the 'fun' nature of RBO, a certain learner felt that the 'frivolous' nature of the assignments undermined the credibility of the course.

One was consistently critical. During the duration of the course, that student had disturbed equilibrium by using the forum to criticize classmates' contributions. Now, on completing the questionnaire, the student took the opportunity to define the feature that he/she found innovative:

> *I enjoyed the freedom of expression, but clearly the majority of my classmates still needed to be spoon-fed. I was disappointed in their non-performance.*

The primary motivating force varies from learner to learner. When asked in Question 22 about activities that engaged and absorbed them, some described flow (Csikszentmihalyi, 1990) - being 'glued to the computer' and working far longer than intended when generating their own products. The opera project had stimulated most of the class of 2000, who found it fun and challenging to develop their contributions. It had been good to work together, exciting to watch it grow daily, and rewarding when one's own contributions were linked in by the producer. The personal exam project was easier to control with its single, personal involvement, and this had induced high motivation in several. Yet others had really enjoyed following and contributing to the e-mail discussions.

## 5B.2.6.4 Concluding discussion

The findings in this investigation show that the instructor achieved his aim of restructuring learning patterns, so as to generate a highly creative and innovative learning experience. The novel classroom metaphor is effective both in motivating learners and in stimulating cognitive processes, a relationship previously mentioned in Section 5B.2.1 under discussion of the affective-cognitive connection.

The course content relates to educational use of the new technologies, and RBO is an example in this respect. It exploits technological opportunities, conveying its message and receiving learner-input in an original, yet platform-independent manner, since it is not tightly coupled to any hardware or software systems.

In discussing what is unconventional in RBO, some learners again raised the matter of low-level support, and would appreciate more explicit guidance. This shortcoming should be addressed either by explicit teaching within RBO or by raising the entry requirements to ensure higher initial skills. Motivation entails not frustrating learners, and these issues should be resolved.

## 5B.3 General

This section proposes how the five facets of a learning environment are made up in RBO and also briefly discusses its use of technology.

### 5B.3.1 Facets of the RBO learning environment

Table 5B.15 shows Perkins' five facets of a learning environment (Section 3.5.4; Perkins 1991a) and their associated resources/implementations in RBO.

**Table 5B.15 Facets comprising the RBO virtual classroom**
(Perkins, 1991a)

| **Facets that comprise a learning environment** | **Corresponding implementation in RBO** |
|---|---|
| Information banks | RBO web-based 'classroom'<br>Technology manuals<br>Online tutorials and help facilities<br>'Techie' friends |
| Symbol pads | Computers with Internet connections<br>Scanners<br>Rough notes and representations |
| Construction kits | Web-authoring systems: Html, Frontpage, Dreamweaver, Netscape Composer, CorelPhotoshop. PaintShopPro, Arachnophilia, Adobe, Shockwave<br>Other: Spreadsheets, databases. |
| Phenomenaria | Internet and World Wide Web |
| Task managers | RBO online directives (in web-classroom and via e-mail)<br>Instructor/facilitator<br>Individual learner<br>Co-learners |

### 5B.3.2 Technology in RBO

Technology is the core subject matter of RBO, due to its role as a course in Internet-based Learning. Virtually all RBO work was undertaken online, with the computer serving as source, conduit, and tool. Apart from accessing information in the 'web-classroom', students were engaged in using various packages and Internet-tools of their own choice, and about half would have appreciated (optional) opportunities for explicit teaching in using these systems. Internet- and Web- skills were essential, yet were partially assumed. As described in Section 5B.2.1.3 on cognitive learning in RBO (Tables 5B.2 and 5B.4), nine learners were new to the Internet and five experienced a skills gap or found the pace too fast. There were very few complaints (only three) about technological problems. Despite the constructivist frustration experienced, at the end of the course 17 of the 22 respondents classified themselves as 'webbies' (Table 5B.3 in Section 5B.2.1.3) and stated that they found RBO useful in their personal/professional lives (Table 5B.12 in Section 5B.2.5.3). About half plan to use the Web in their careers as educators; intended use is elaborated in Table 5B.14 in Section 5B.2.6.3.

The other major aspect of computer usage relates to online communication, which gave rise to some problems (Sections 5B.2.4.1 and 5B.2.4.3). Nevertheless, despite complaints and frustration regarding decision-making-by-distance and construction of the opera, the ultimate web-based multimedia product was gratifying to those who generated it, and enjoyed by those who viewed it and gave feedback. In both the *Opera* and the co-operative pairs, the resulting work benefited from a blend of knowledge and expertise, and optimised the skills mix of its creators. This is line with the 'no significant difference' phenomenon relating to learning by different media (Clark, 1994; Kozma, 1994; Russell, 1999). Undoubtedly, collaborative learning is more efficient in a contact-environment. However, the Internet, Web, and networks in general have made computer-mediated collaborative work possible. In distance-learning situations where formerly, teamwork would have been impossible**, it is now feasible** due to these supportive technologies.

## 5B.4 Conclusion to the RBO evaluation

This section, Section 5B of Chapter Five describes an evaluation of RBO800, a masters-level module in Internet-based Learning, from the perspective of learning and instructional theory. The investigation was two-pronged - the researcher personally investigated the 2000 presentation of the module (virtual observation) and also conducted a survey of RBO, namely, a learner-evaluation with the classes of 1999 and 2000, using the six elements of Hexa-C Metamodel as a framework.

***How elements of learning- and instructional design theory integrate in RBO***

The investigation based on these six elements showed strong connections between them. RBO is about learning-by-doing as learners take responsibility for their own learning, with little guidance. It evidences strong constructivism - experimentation, challenge, lack of boundaries, discovery-learning, personal interpretation. The constructivism in RBO is a complex variant - it is **constructivist online collaboration** - an integration of three paradigms, each of which is challenging, even daunting, in its own right. Collaboration by distance is inefficient and complex, yet - made possible by the Internet - it is collaboration where formerly collaboration could not have occurred. Capitalizing on technology, on learner's personalities, and using their varied expertise in teams, collaboration is an added dimension to mitigate against isolation in distance learning.

However, RBO need not have been distance-education - it became so by choice. The MEd modules at the University of Pretoria are traditionally offered as contact teaching. But the RBO instructor, setting out to teach about the Internet, decided to do so via the Internet - a creative strategy that would give a concrete experience of web-based learning to intending web-educators. To help the learners feel more like learners than like educators, he presented it in the metaphorical classroom, where each learner could creatively customize, not only their desk, but also the direction, depth and breadth of their exam project. Auto-customization occurs as each individual uses the course to move in relevant directions and assume responsibility for their own learning. The subtle humour in the course is a contemporary approach, whereby amusing approaches are used as communication media. Academic communication, too, need not be sober and sombre.

The purpose of creativity in instruction is to obviate against learner-boredom, and to engage and motivate learners. Motivational and affective issues do more than just motivate learners - affective aspects are also strongly connected to cognitive learning. In RBO the affective structures are achieving the first objective - to engage learners and gain attention. However, the second matter, the affective-cognitive connection may be lacking, as evidenced by requests for more feedback and guidance, and learners' lack of confidence. But RBO falls short on the affective-cognitive connection, causing some to learners to feel overwhelmed and discontinue the course. The shortcoming could be addressed by supplementing RBO directly or indirectly with component-based instruction of basic knowledge and skills.

***The instructional design of RBO***

Table 5.1 sets out the designer's aim for RBO, 'to place educator-cum-learners in the position of Internet-based learners, giving them first-hand experience of being on the receiving end of an Internet course and doing so in a web-based classroom'. This has been effectively achieved by a combination of inter-related learning strategies. FRAMES was shown to successfully support cognitive learning within a paradigm of constructivist collaboration. The creative design of the learning event facilitated auto-customization by individual students.

# Section 5C - *Case Study Three: Mkambati 2000*

The third learning event analysed using the Hexa-C Metamodel is the Mkambati 2000 Project - a fieldwork trip and practical project in Ecotourism. The structure of the study is identical to that of Sections 5A, 5B, and 5C. In the first part of Section 5C, the multi-discipline of Ecotourism is outlined, after which the scope and activities of the project are described, using a text box for the narrative.

The second and major part of the section is devoted to discussion, evaluating the project under the six elements of the HCMm framework. Under each element, the project is examined with respect to the appropriate learning theory or characteristic. As explained in Section 5.1.3, each section is further divided into three perspectives:

(vii) Initial discussion by the *researcher*;

(viii) viewpoint of the *designer* of the learning event (who is also the course lecturer); and

(ix) *learner-data* - quantitative, but mainly qualitative, obtained from surveys and interviews;

before ending with a *concluding discussion*.

## 5C.1 Introduction to Mkambati 2000

### 5C.1.1 Immediate domain and purpose

The University of Pretoria offers a postgraduate course called Ecotourism. It was initially offered in 1996 by the Department of Geography as one of six subjects for a BSc Honours (fourth-level) degree in the broad field of ecotourism. Since 2000 it has been presented by the Department of Tourism Management and aimed at a broader target group. It is a focused course in the principles and practice of the ecotourism discipline, consisting of fourteen weekly two-hour contact sessions. There is no prescribed book, but the learners are given an extensive bibliography including journal articles. They collect information from the library and Internet, and present topics during class session. Classes are informal, with high learner-participation and discussion.

The course has a balance between theory and practice. It incorporates a field trip and a collaborative project, during which learners conduct intensive research and analysis aimed at proposing solutions to a real-world problem. The class of 2000 spent a week at the remote Mkambati Nature Reserve on the so-called Wild Coast of South Africa, investigating future development and drawing up planning guidelines in harmony with the fundamental principles of ecotourism. This practical project is the subject of the third case study.

The reserve has unique natural attractions in pristine condition, but facilities are run-down and the situation is fraught with complications and conflict. Management is in the hands of provincial nature conservation officials, desiring to optimize utilization of their mini-paradise, yet facing:

- Budget constraints;
- Responsibility for the preservation of fauna and flora - including a unique species;
- Game poaching;
- Decay, poor maintenance, and poor access roads, along with complex bureaucratic procedures which make purchase and repair cumbersome;
- Issues of accommodation and hospitality, which they would prefer to privatize, since their training and expertise is primarily in nature conservation;
- Barriers to such privatization, in that private companies require long-term guarantees and reasonable prospects of profitability before making heavy investments; and
- Unrealistic expectations by the local community of benefits from the reserve.

The learners worked in four groups to investigate:

(i) Fauna and flora;

(ii) activities for the ecotourist;

(iii) culture and community; and

(iv) accommodation and facilities.

Basic information regarding the reserve was supplied. Learners were required to supplement this and their class-based learning with independent research and to integrate theory into their investigations.

### 5C.1.2 Operational environment and learners

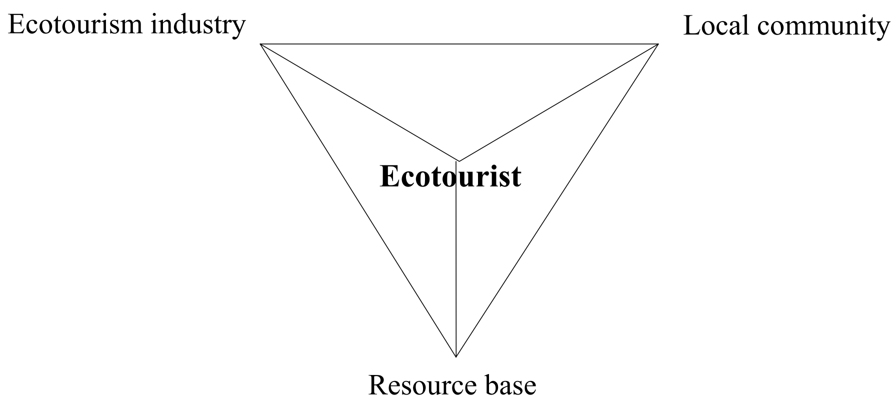
The Ecotourism course is taken by honours- and masters-level students from disciplines such as environmental studies, environmental education, sociology, botany, landscape development, tourism, etc. This multi-disciplinary student base synergistically brings wide expertise to the collaborative environment, impacting positively on the type of task that can be tackled as a practical project. Class size is ten to fifteen students annually, mostly fulltime students with part-time employment. The class of 2000 comprised fourteen learners aged between 22 and 33, of whom twelve went on the field trip. The two who were unable to participate subsequently discontinued the course.

The definition of *ecotourism* used in the course defines it as:

- An enlightening, interactive, participatory travel experience,
- to natural and cultural environments,
- making sustainable use of resources,
- providing economic opportunities for industry and local communities, and
- implementing sound environmental management beneficial to all role players (Hattingh, 1996, cited in Queiros, 2000b).

These elements are represented by the *ecotourism tetrahedron model* (Figure 5C.1), which sets out the fundamentals and their interrelationships. This model serves as the basis of the theoretical and practical components of the course. The *resource base* on which the ecotourism product is based can be natural or cultural, and its sustainable usage is the key to ecotourism. The *local community* should be involved in an integral manner in the venture, and aspects of their culture are, in turn, utilized in the tourist product. The *ecotourist*, at the centre of the model, requires an interactive, enlightening experience with active participation - more so than the traditional tourist. Finally, the *ecotourism industry* plays a coordinating role in determining that the other three fundamentals are in place (Queiros, 2000a).

**Figure 5C.1 The Ecotourism tetrahedron**
(Adapted from Bewsher & Hattingh, 2000, cited in Queiros 2000a)




## 5C.1.3 Roles: the project designer, facilitator, and the researcher

The leader of the course planned and designed the format and requirements of the Mkambati 2000 Fieldwork Project. Thus, once again, the roles of lecturer and instructional designer converged. During the previous fourteen-week class-based period, she had served more as a facilitator than a traditional lecturer. Students presented material, while she planned, co-ordinated and concluded the discussions. During the actual fieldwork and project write-up, she undertook the role of project leader-cum-facilitator, along with a professor who was a co-lecturer in Ecotourism.

The researcher accompanied the class on the fieldwork as an observer-participant. She joined in the activities, and contributed in a practical way by helping with logistics. Subsequently she evaluated the project, surveying the twelve student-participants and interviewing the course leader.

## 5C.1.4 Scope and events of Mkambati 2000

The narrative in Text Box 5C.1 describes the field trip, the dynamics of the problem, and the progress of the project. The text box is followed by a map of the reserve and photographs.

## Text Box 5C The Mkambati 2000 Project

The class of 2000, accompanied by the course leader-facilitator, a co-lecturer, and the researcher, undertook a one-week field trip to the remote Mkambati Nature Reserve to study the situation and suggest ecotourist planning guidelines for future development. The fieldwork was followed by collaborative proposals and documentation.

***The problem and the task***

The region is characterized by pristine coastal and estuarine topography, as well as by grasslands, gorges, and small-scale occurrences of two kinds of forest. Mammals, birds and marine life draw nature-lovers and fishermen. Some of the particular attractions are a unique species of palm tree - the Mkambati palm *Jubaeopsis Caffra*, a fragile breeding community of endemic Cape Vultures *Gyps Coprotheres,* loggerhead turtles, and kingfish. The reserve has unique natural and cultural attractions, but due to poor infrastructure, is not easily accessible. The facilities and infrastructure are limited and run down. Like various other nature reserves, it is embroiled in contentious political and community issues. Its future is under the spotlight due to unresolved tourism policies, differing management proposals, and uncertainty regarding future control over its accommodation and hospitality facilities. Current management both of conservation and tourist matters, i.e. of all aspects of the reserve - ecological, preservation, facilities, and tourism - is in the hands of provincial nature conservation officials, running their secluded paradise on a restricted budget.

The task facing the group of learners was to present proposals for the way forward in line with the fundamental principles of ecotourism, yet practically addressing the multi-facetted problems surrounding the reserve, under the topics of:

1. Fauna and flora,
2. Activities for the ecotourist,
3. Culture and community,
4. Accommodation, infrastructure, and facilities.

***The field work***

The students enjoyed the experience immensely and were highly motivated. They visited the natural and cultural resources, and were physically stimulated as they walked, swam in the oceans, rivers and rock pools, explored, and viewed game. For some it was their first experience of the sea. The group became acutely aware, first-hand, of the sensitive nature of ecotourism requirements as they viewed the natural features and took part in ecotourist activities (existing and proposed) - riding horses, paddling canoes; hiking; game viewing, bird watching, and spotting rare plant species. They clambered up to an elevated cliff-face cave, explored the shipwreck, visited historical mission churches, and scrambled around waterfalls. They also tackled what is known in the jargon as *adventure tourism* - risk-activities such as cliff-jumping and swimming out to an island. Some tobogganed down a 60º sand dune, but won't tell that to ecotourist purists. There wasn't time to go fishing.

***Real-world status***

The students had initially expected the field trip and associated projects to be academic exercises only. However, provincial nature conservation authorities viewed them with credibility. The reserve manager addressed them, explaining the background of the reserve and its rich heritage, as well as the problems facing it. An environmental education officer guided the class to ecological high points, an official took them on a tour of the facilities, and in small groups, they boated up the Msikaba River to the Mkambati Palms.

The regional director of nature conservation came from his head office inland to stay at the reserve and interact with the students, sharing experiences and viewpoints and discussing issues. He took them to lesser-known parts of the reserve and across the river boundary to meet operators of a successful community-based ecotourism venture running on neighbouring tribal land. Explaining that the provincial budget no longer allocates funds for research, and that the state is taking a reduced role in conservation, the director pointed out the current importance attached to research done by universities. Postgraduate programs and theses that address basic research and *ad hoc* topical issues are welcomed.

The reserve and current events in the surrounding regions were topical and newsworthy at the time. The Ecotourism field work coincided with a visit to the reserve by a television producer, who recorded the students' activities and interviewed them for national TV and radio programmes. This interest in their investigation and recommendations further enhanced the experience for the learners.

***Exposure to the options ...***

In the same way as academic input is required from tertiary institutions, investment input is required from the private sector. Public-private partnerships are viewed as the way forward to ensure that nature reserves remain viable, i.e. a joint approach to resource management. A few months prior to the students' visit, national government had examined development proposals, short-listed certain submissions, and awarded an external tender for the tourism and accommodation facilities. Anticipating privatization to be imminent, structural facilities had been permitted to slide into disrepair, although the accommodation was, in general, attractively furnished. Then tensions arose between the local community and the successful bidding company which, together with other exacerbating circumstances, resulted in the private company to which the tender had been awarded, withdrawing. So the *status quo* continued, on a low budget and with all functions remaining under control of the provincial nature conservation department.

An alternative approach was implemented on nearby tribal land, where a pilot-project for community-based ecotourism had been launched. The group visited this venture, and were addressed by the coordinator of the non-governmental organization (NGO) assisting the community. He believed that the national plan for an SDI (strategic development initiative) in this under-developed area was too grandiose, and suggested that small-scale community-based projects are preferable, along with local community enforcement of conservation legislation. Partnerships and co-operation agreements should ensure that projects survive and communities benefit. Self-employment, with locals taking responsibility for generating income by satisfying particular niche-markets, was a better option than large-scale resort-type developments. The forms of entrepreneurship envisaged were nature-, culture- and adventure-based. All were low-impact and sustainable. A local tribal stakeholder also spoke to the students - his excitement and enthusiasm for the venture clearly evident.

***Reports, recommendations and guidelines ...***

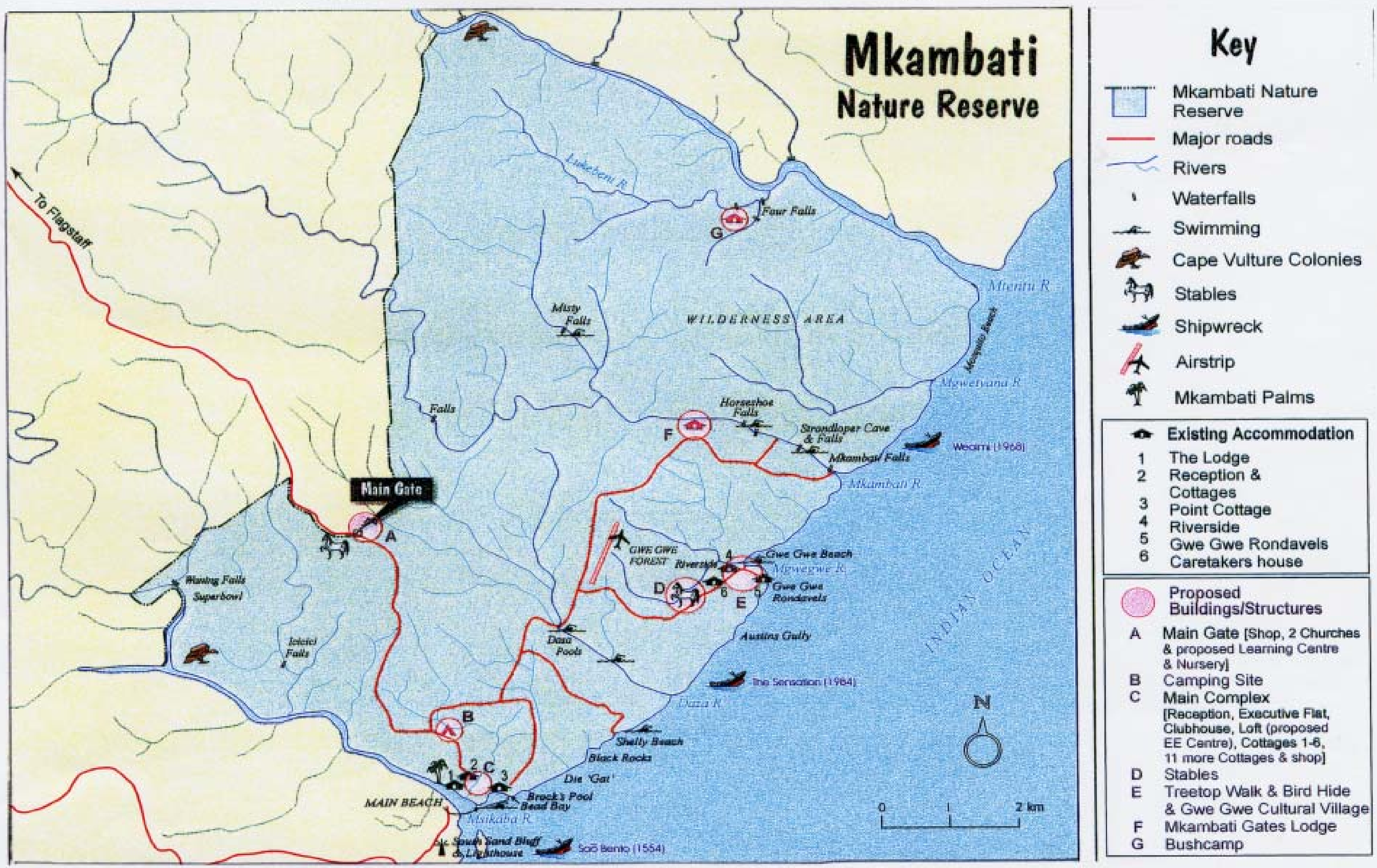
The students were thus exposed to different models and options, as well as many perspectives on the problem. They came to the opinion that the successful tender for privatisation (the one subsequently withdrawn) had not been in line with the true ecotourism, and were relieved that it was unlikely to materialize. The breakdown in negotiations, however, plunged the reserve's future into even greater uncertainty. The community issue remained complex, as locals complained that the reserve had the best land (a factor due to sound land-management policies). Another unresolved matter was identifying which local dwellers actually comprised the community, since villages as far away as 50 kilometres were anticipating benefits.

Against this background, the four groups commenced work on their research and recommendations. They had seen maps and a slide show in class before departure but, on-site, the natural environment and the complexity of the situation came to life. In the evenings groups met to discuss their approach. Resources were consulted, and out came the laptop computers. One group held a prolonged 'meeting' on the 12-hour journey back home. Once in Pretoria the task of negotiation and writing-up continued. Two months later reports containing proposals were submitted to the course lecturers, marked up, and returned to the students for further work. Usually, academic products are assessed, a mark is given, and the matter ends. However, nature conservation authorities had requested copies of the reports and guidelines, so they were extended and refined to a standard beyond the norm for student projects. The facilitator integrated the documents, adapted the styles to a consistent format, and incorporated further illustrations. The consolidated report was then presented to the authorities.

The Mkambati project was a stimulating, yet demanding, real-life experience for all concerned. The study was featured in two national television programmes, one of them centred around the students' investigation. At the end of the academic year, the class held a final meeting to watch a video of the TV programme. On this occasion the researchers' questionnaires were distributed and completed by all present. Others were distributed to those who had not been present. The survey therefore included all twelve student-participants, as well as an interview with the facilitator.

Figure 5C.2 is a map of the Mkambati Nature Reserve (Queiros, 2000b), indicating the main features. The map is followed by Figure 5C.3, which is a photo-spread to set the scene.

**Figure 5C.2 Map of Mkambati Nature Reserve** (Queiros, 2000b)






Mkambati case study 296

# Figure 5C.3 Setting the scene

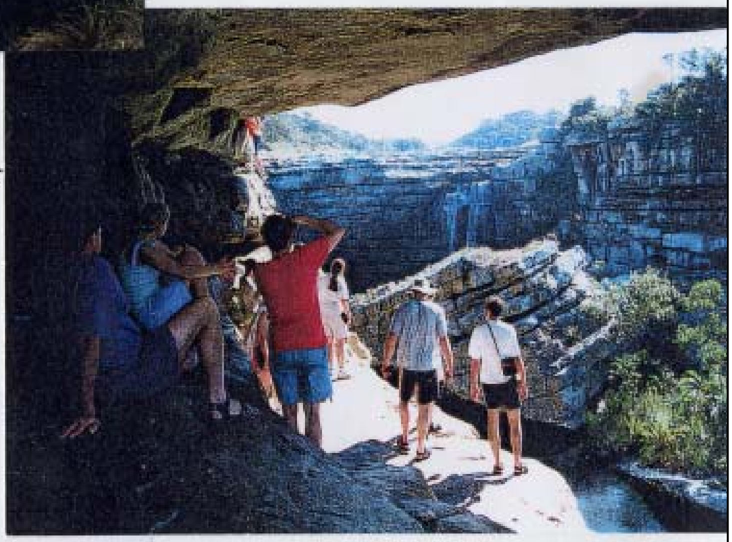
**Problems of the paradise that is Mkambati Nature Reserve: How both to promote viable, sustainable ecotourism and preserve a fragile environment?**

**Several factors make Mkabati unique ...**

Mkambati palm, *Jubaeopsis Caffra*, with its small coconut-type fruit is unique to the reserve, which is named after it. This tree is found nowhere else in the world.

Cape Vultures *Gyps Coprotheres* nest and breed on the tall cliffs of the Msikaba Gorge.

Management wrestles with the issue of Mkambati's carrying capacity - how many tourists should see this – and how close should they get?



Students investigate the Strandloper Cave high on a cliff face - with a view onto the Strandloper Falls and a huge natural rock pool, and debate the dilemma of how best to promote and yet preserve this natural and cultural heritage.
Note: *Strandlopers* were seashore cavemen.

When game viewing in a Land Rover late in the afternoon, the best view is from up top.

Where should vehicles be permitted - and where only hikers? What sort of roads? What about mountain bikes? These were some of the issues for which students suggested guidelines.

### 5C.1.5 Research design of the Mkambati case study

Within an overall approach of *action research*, as outlined in Chapter One, Section 1.5, qualitative and quantitative research methods are combined in this case study.

The descriptive data in the six 'Initial discussion' subsections: 5C.2.1.1, 5C.2.2.1, 5C.2.3.1, 5C.2.4.1, 5C.2.5.1, and 5C.2.6.1, is generated by *qualitative ethnographic research*. The researcher participated personally in the field trip, obtaining rich *observational data* on-site, observing activities and informally interviewing learners and facilitators.

The information in the six brief subsections with the 'Viewpoint of the instructor-designer': 5C.2.1.2, 5C.2.2.2, 5C.2.3.2, 5C.2.4.2, 5C.2.5.2, and 5C.2.6.2, was also obtained by the researcher *interviewing* the lecturer/facilitator after completion of the project, to obtain her insights and in-depth understanding of the situation.

The primary data collection method for the third set of subsections, 'Findings from the learner-survey': 5C.2.1.3, 5C.2.2.3, 5C.2.3.3, 5C.2.4.3, 5C.2.5.3, and 5C.2.6.3, was a *qualitative* and *quantitative, empirical,* but *non-experimental, survey*. The researcher conducted a *questionnaire* survey with the group in its entirety, i.e. with all twelve participants. The survey was focused on the underlying learning theories and characteristics of the project. The questionnaire, as a whole, is available in Appendix C, and questions are also shown in appropriate subsections within the text. The data in Section 5C is not statistically analyzed, since this would be an inappropriate way to deal with rich descriptive data. Nor are percentages shown, due to the small population. Table 5C.1 shows profiles of the learners surveyed.

**Table 5C.1 Profiles of the learner population surveyed**
(n = 12)

| Characteristic | Subdivision | |
|---|---|---|
| **Gender** | Female 5 | Male 7 |
| **Full-time / part-time** | Full-time 10 | Part-time 4 |
| **Prior qualifications** | 3rd-level bachelors degrees 8 | Honours/ 4th-level degrees 4 |
| **Ethnicity** | White 9 | Black 3 |

## 5C.2 Investigating Mkambati 2000 - using the Hexa-C Metamodel

The practical fieldwork project is investigated with respect to application of learning and instructional theory, using the HCMm framework as a tool.

Sections 5A and 5B, related to the FRAMES and RBO case studies respectively, were structured by first examining conformance to the more theoretical elements of the HCMm, and then paying attention to the HCMm aspects that relate to its practical features and characteristics. For the Ecotourism project, the sequence of these aspects is reversed - addressing first the three practical characteristics (creativity, collaborative learning, customization) and then the three theoretical approaches (components, cognitive learning, constructivism) underlying the type of instruction and learning. Investigating creativity and motivation first, helps to portray the circumstances and to set the scene for the subsequent sections.

### 5C.2.1 Creativity

In examining creativity and motivation within a learning environment or event, one would look for aspects such as Dick's (1995) conditions for creative instruction. Several of these are explicitly-designed features, not relevant to a field trip or project. Features appropriate to investigate in the Ecotourism project are the matching of learner-interests, motivation in the learning event, and innovative aspects of the event. In an instructional context, creativity is strongly connected to motivation - engaging and engrossing learners, and also to affective aspects - the emotions/attitudes/values of learners as they continue in a learning experience. The discussion subsection and the facilitator's viewpoint address motivation and learner-attitudes, while the learner survey investigates both motivation and innovation.

#### 5C.2.1.1 Initial discussion

The students were highly motivated by their experiences on the field trip. As mentioned in the text box, they participated in stimulating activities and became acutely aware of the sensitive nature of ecotourism. They realized that their combined expertise could be used to the benefit of all stakeholders and could impact on all the elements of the ecotourism tetrahedron. They could:

- contribute to the preservation of fragile, pristine topography;
- make a difference to quality of life for local communities;
- strive to balance the delicate divide by suggesting an approach for the tourism industry that would realize returns, retain harmony with the natural environment, and be acceptable to the local community; and
- develop rewarding participatory experiences for local and international ecotourists.

# Intrinsic motivation due to real-world worth

They had viewed the project as an academic exercise, and were pleasantly surprised to find that the authorities held them in high regard and keenly anticipated their findings. Their proposals would be studied by the region's future decision-makers. This factor generated a **high level of intrinsic motivation** among the students. They had not expected to practice the art of reflective, respected practitioners until they were mature professionals (Schön, 1987). The television and radio programmes featuring clips of their activities and investigation were further motivations.

The project was not a real-world simulation - it was real-world, real-life!

### 5C.2.1.2 Viewpoint of the instructor-designer

> The students were highly motivated – personal involvement and actually being in the reserve made them passionate about the area. This increased as they saw more of it. The importance then of writing the right proposal for the reserve became important to them personally. They wanted to see the place developed correctly. Definitely an *emotive* experience which influenced their learning, and their desired outcomes. The passion of the students reflected an intrinsic motivation - that this was important to them personally.
>
> Evening discussions were also very lively with vigorous debate - I think these sessions encouraged learning as the students really had to understand complex issues and grasp all the inter-related variables. They had to interpret the dynamics of the situation and decide on their own beliefs.
>
> They were excited about the task and completely engrossed in it.

### 5C.2.1.3 Findings from survey of the learners

The survey incorporated several questions on the aspects of motivation, creativity and innovation. There was no prompting and the considered responses were spontaneous:

3.1 What motivated you in this learning experience?

3.2 The requirements in this project were innovative and non-conventional.
*Describe what you experienced as innovative, and how you feel about the approach.*

3.3 How did you feel about this project and the problem-solving approach?

**For example, did it engross you, hold your attention, stimulate you, or did it frustrate you, bore you, cause you to lose interest, etc?**
**Answer for: before the trip / at the nature reserve / during write-up time afterwards.**

Responding to Questions 3.1 and 3.2 on motivation and innovation, several students dealt with the real-world nature of the problem. Tables 5C.2 and 5C.3 set out their views and comments on motivation, creativity and innovation in the learning experience.

| **Table 5C.2<br>What motivated you in this experience?** | | **No of students (n = 12)** | |
|---|---|---|---|
| Possibility of recommendations being used | Our input might actually be used / market-oriented exercise / social and economic benefits for stakeholders / chance of influencing future developments / solve a real-world problem / management took us seriously | 8 | |
| The natural environment | Potential as an ecotourism destination | 3 | 7 |
| | Crossing the river and experiencing the community where ecotourism was a reality | 1 | |
| | Unique beauty / desire to maintain pristine surroundings | 2 | |
| | Seeing the sea and swimming in it! | 1 | |
| Academic motivations | At the end I was motivated to finish because of my other academic work pending | 1 | 2 |
| | Prospect of high quality product, good marks, bursaries, co-authoring a publication | 1 | |

| **Table 5C.3<br>What did you find innovative in this approach?** | | **No of students (n = 12)** | |
|---|---|---|---|
| Nature of the Project | Kind of problem we will encounter in a country in a situation of transformation / tourism from ecotourism perspective / Marketing - not just tourism, but marketing an ecotourist destination | 3 | 5 |
| | Real project / might be used / practical value / final product was a quality, consultant-type document | 2 | |
| Nature of the learning | The way we had to think / integrate / use an open-minded approach / personal experience of the problem - not just a given scenario | 5 | 7 |
| | Discussion and debate between class members | 2 | |
| Helped us to be innovative ourselves / think laterally | | 4 | |

In the open-ended responses, most gave more than one motivation. As well as appreciating a real opportunity to put theory into practice, they were impressed by the natural surroundings and their potential:

- ***Inspired by the natural environment***
  *The opportunity to present such a unique destination to others. /*
  *The reserve itself - one of the most beautiful places on earth. / An adventure and a challenge ...*
- ***Own creativity fostered by a novel experience***
  *The chance to use my theoretical knowledge in combination with creative faculties to try and solve real-world problems. / I learned to think creatively to solve a real-world problem. /*
  *The solutions we postulated as feasible tourism guidelines were innovative ideas. /*
  *We used our past experience as well as the authentic thinking stimulated by the experience.*
- ***Strategic exploration of errors - self-regulation and metacognitive adjustments***
  *It was a novel experience learning how to combine one's own knowledge and interest with the subject of the group one worked in. It allowed us to experiment with our ideas, which were not always correct.*

Only one comment (Table 5C.1) dealt with the extrinsic motivation of a high grade. Most were intrinsically motivated by the value of the experience and the chance to make input into a real-life situation. The upcoming subsection 5C.2.3.1 on customization of the experience, will refer to students 'passionate' about a cause - a factor which induces high motivation.

- ***Intrinsic motivation***
  *I found it innovative to do a project which would be of practical use. Students' practical work usually retains an element of amateurism and adds little value to the organisation. Developing a market-style presentation was also unusual for most of the students. We could have simply presented an academic treatise (which is what the first draft looked like), but we reworked it to produce a final report which was a quality consultant-type document.*

Motivation changed over the duration of the project, fluctuating from the initial high during the actual field trip. The responses to Question 3.3 showed common emotions **prior to the field trip** (not tabulated), namely, keen anticipation and excitement, with only one student feeling unmotivated, considering it just another subject. **During the trip**, the affective-cognitive connection was firmly in place, inspiring the students to address the issues. They all experienced positive emotions, categorized in Table 5C.4.

| **Table 5C.4**<br>**Emotions at the nature reserve during the project** | **No of students (n = 12)** |
|---|---|
| Stimulated / engrossed / captivated by scenery / An adventure! / It changed my attitude - I want to develop beautiful places in a sustainable way in future | 8 |
| Interested / enjoyed it / informative | 3 |
| New comprehension – it bridged the gap between class knowledge and a real-world situation / theory-practice | 2 |
| Flabbergasted by complexities / Frustrated by problems | 2 |

A representative, all-encompassing comment was:

*A well structured experience - ample opportunity for absorbing the essence of the reserve, as well as time for discussion and reflection. I felt interested and engrossed at all times.*

**During write-up time afterwards**, conflicting emotions emerged. No longer experiencing the stimulating atmosphere of Mkambati, learners' motivation decreased. They were equally divided between those whose attitude remained positive and those who tended to the negative. Table 5C.5 lists the emotions in decreasing order of satisfaction:

| **Table 5C.5 Motivation at write-up time** | | **No of students (n = 12)** | |
|---|---|---|---|
| **Positive** | Challenging / rewarding / visionary | 4 | 6 |
| | Did not find it difficult | 1 | |
| | Frustrating, but rewarding when finished | 1 | |
| **Negative** | Struggled to find answers from the theory that would solve the complexities | 1 | 6 |
| | Initially challenged, then bored | 1 | |
| | Frustrated / took too long / difficult to fit it in with other obligations | 4 | |

The process of writing the reports and recommendations was a major task, carrying heavy responsibility due to the possibility of implementation. In the opinion of a mature learner who was an experienced professional:

*It was a challenge to write up the guidelines in a way that was realistic and meaningful, but it was a positive experience to apply theories practically in a real life situation.*

## 5C.2.1.4 Concluding discussion

The aspect of creativity that emerges most strongly from this survey data, is the students' motivation and enthusiasm, motivation engendered by the perceived worth of the experience and the value of being able to play a real-world role. The lecturer's belief that personal involvement in the problem situation made learners passionate about doing their task well, was borne out by the findings.

The investigation showed that not all students maintained their initial high motivation. For about half of them, it waned towards the end, as the extent of preparing reports for submission to the authorities - involving more commitment and refinement than the normal academic activity - impacted on other obligations. Students frequently handle deadlines under pressure by submitting lower-quality deliverables (and obtaining lower grades), but that could not be done in this case. Thus the very factor that caused high motivation during the field part of the trip, i.e. the real-world nature of the project, was perceived as an obstacle during the report-writing period.

Deadlines and high quality are part of real-world pressure. However in the real-world, there is a major motivating incentive, which did not accrue to the students - the prospect of remuneration for services rendered! However, real-world learning experiences cannot exact real-world deliverables without offering some personal benefits. Case Study Two showed how RBO also exacted real-world products, but in several cases with a tangible benefit, in that students developed artefacts they could use in their professions to simplify duties or enhance their work. In the case of the Mkambati Project, the benefit was gaining expertise that had a career value.

The perceived worth of the experience was high. The facilitator's desire to present an innovative project with all the dynamics, variables, and complexities of the real world was achieved. No mere academic exercise could have resulted in the same level of learning or prepared the class better for the realities of consulting in the workplace.

## 5C.2.2 Collaborative learning

In Section 2.5.1 the difference was explained between collaborative and co-operative learning. This section investigates the use of both in the Ecotourism project, as the class was structured into a group of groups with separate but related aims. Johnson and Johnson's (1991) key elements of co-operation are used to structure part of the evaluation in 5C.2.2.3.

### 5C.2.2.1 Initial discussion

As previously stated, the students worked in four groups of three, the topics being:
fauna & flora; ecotourist activities; culture & community; and accommodation &facilities.

Each group undertook its own study. Researching and writing up each topic involved expert knowledge of the domain, analysis, and a comprehensive written report with suggested guidelines. The format and presentation had to such that the four reports could be integrated into a single document compiled by the facilitator, an aspect which she mentions in 5C.2.2.2.

- ***Collaborative and co-operative learning***

The overall exercise could be described as *meta-collaboration* - a group of groups - since the four projects had to interrelate in a consistent way, so as to be compiled into a single integrated, holistic document for submission to the authorities. It can also be viewed as an integration of collaboration and co-operation, in that the small groups worked *co-operatively* to achieve a single aim and generate a single product, using each member's capabilities to complement one another.

#### 5C.2.2.2 Viewpoint of the instructor-designer

Students had to work in four collaborative groups. I suggested the four topics and they chose the group of their preference, the only condition was that there had to be three in each group.

I think the fact that it was such a prolonged, intensive project was a challenge to them in terms of group learning - a short team project is easy! In a long one, your powers of negotiation and feeling comfortable in a team are tested. One group requested that I include a team peer-evaluation (to affect the final mark) because they felt that a member was not playing his/her part. I would do this in future, but couldn't change the system at that stage. As the lecturer, I did not pick up problems in the other groups, but there may have been issues of which I was not aware .... perhaps responses to the questionnaires will indicate this.

Another challenge was having four groups, but yet aiming to generate a unified report in which each group's work complemented the other groups' and did not contradict anything. We started shaping each sub-project **as part of an overall group**, and trying to maintain linkage.

#### 5C.2.2.3 Findings from survey of the learners

Open-ended questions determined the learners' impressions of their collaborative work:

| | |
|---|---|
| 5.1 | How did you experience the teamwork in this problem-based learning? Please elaborate. |
| 5.2 | What is your opinion about joint accountability and a team mark? |

The responses to Question 5.1 were mainly positive, as learners recognized the worth of integrating diverse disciplines and skills within a context of teamwork. Their spontaneous comments are classified under some of the key elements of co-operative learning (see 2.5.1.2).

- ***Empowerment of individual learners***

*... unique, because we came from very different backgrounds, and classmates contributed to broadening our view of the situation. /*
*We delegated tasks, then peer-reviewed our performance in brainstorm sessions. /*
*We had good discussions and debate ...*

- **Positive interdependence**

They realized the responsibility that comes with teamwork, acknowledging that individual efforts affect group-performance, that schedules must coincide, and that some team members carry a greater load:

*It makes you work harder, because what you do affects others. /*
*Our deadlines were met and each recommendation was a product of three minds. /*
*We could each do something we are good at!*

*I grew up in a culture that emphasizes individualistic learning and achievement. This contradicts the spirit of teamwork. But I understand and really appreciate the value of groupwork. The experience allows learners active involvement. They could be creative and it culminated in multifarious ideas, contributed by students of diverse cultural backgrounds.*

- **Positive interdependence** *(continued from previous page)*
  *Non-performance by one can jeopardize overall quality. /*
  *I struggle with time management and operate by crisis management, so I probably don't give my best, which might have been a bit tough on my team. /*
  *In any team some pull their weight more than others.*

In response to Question 5.2, there were strong reservations regarding joint accountability and team marks:

- ***Joint accountability***
  *Joint accountability works when team members have authority to hold others accountable. As students at the same level, none of us had that authority.*
  *Peer-review would help - marking others on participation and input, as a contribution to the final mark. /*
  *I strongly disagree with a joint mark!*

  Some, clearly achievement-oriented, prefer working alone. For example:
  *Joint accountability sometimes gets in the way of personal ownership.*

The students' opinions on collaborative learning are quantified and integrated in Table 5C.6, showing that eight of the twelve perceived the benefit of collaborative work. However, from the reservations in three of the rows, it is clear that collaboration was not problem-free. In particular, six students pointed out that not all participants put in equal efforts.

| **Table 5C.6 Views on collaborative learning** | | **Number of students (n = 12)** |
|---|---|---|
| Collaborative work is good / helpful / constructive | | 8 |
| Integration of different ideas | Positive: value of integrated ideas | 4 |
| | Negative: difficult to integrate the contributions / I prefer to work alone | 4 |
| Joint accountability | Positive: the responsibility makes you work harder | 3 |
| | Negative: some put in more effort than others | 6 |
| | You need a good, enthusiastic leader | 2 |
| Ran out of enthusiasm at the end / Just wanted to get finished | | 2 |

Positive remedial suggestions were made by an experienced adult learner:

> *It would be useful if in the planning stages, groups are encouraged by the lecturer to discuss how they will work together and set norms - perhaps guidelines such as:*
> - *How do we want to work together?*
> - *What do we do if someone does not work to the deadlines?*
> - *What kind of standards are we setting as a group?*
>
> *University teamwork is a way of preparing the learner for work in the real world. However in the real world, there is always an appointed team/project leader responsible for holding and pulling things together - and holding others accountable. Other team members have contractual obligations, which - if they do not meet on time and to quality - could cost them their jobs. No student has this sort of authority over another.*

Finally, there were impromptu comments relating to meta-collaboration - the group-of-groups. An interesting point made by a learner with a multi-disciplinary background, was that she would have liked an opportunity to give input to other groups as well - she felt restricted by confinement to one. Also in reference to meta-collaboration, another learner advocated pertinently:

> *I would have liked to be more aware of the work of the other groups. We should possibly have, as a whole class, discussed each section in brainstorming sessions right at the beginning.*

### 5C.2.2.4 Concluding discussion

The evaluation of collaborative work in the Ecotourism project revealed several complexities. This group work was distinguished from conventional collaborative and co-operative work by its meta-collaborative nature, in that the groups were producing parts of a whole. The facilitator had to view the project holistically and integrate the separate reports/recommendations into a single document, ensuring that proposals and suggestions did not duplicate, infringe upon or contradict others.

This integration and establishment of internal consistency demanded much work on the part of the facilitator, which could have been avoided if tight norms and practices had been set up in advance. On the other hand, a rigid format would have inhibited personal interpretations and complicated the incorporation of specialist material, imposing artificial boundaries at odds with the constructivist nature of the project.

The point was strongly made (six of the class) that not all put in equal efforts. The same matter was raised in RBO (Section 5B), but did not appear to be an issue. Why was it an issue in the Mkambati Project? Probably because team marks were awarded. The more motivated/committed students would not accept lesser efforts on the part of fellow-learners that might impact on their own grades, so they compensated to ensure high quality products. Peer-evaluation and self-evaluation as part of the final mark, with individual grading for each learner, would mitigate against this problem

The nature of the responses shown in this section and others is one of the benefits of qualitative research. A multiple choice questionnaire does not elicit this type of data.

Due to the cross-disciplinary nature of the group, the project capitalized on heterogeneous strengths. Three of the students were already professionals, and the others had a wide variety of knowledge and expertise, although not to the competency level of practicing consultants. Complementary skills, serious efforts and the facilitator's work in preparing the unified document, resulted in an end-product with high utility. The provincial authorities expressed sincere appreciation and placed it on their intranet, stating that it contained aspects which could be implement. The project also achieved its academic ends - due to their extensive and intensive efforts, all four groups earned distinction marks.

## 5C.2.3 Customization

This section of the evaluation investigates how Mkambati 2000 customized learning to the needs of individuals. Learning is said to be customized when an individual can use a learning event so as to attain effective and meaningful learning, but in a way that is also personally optimal. The project is also examined to investigate learner-centricity.

### 5C.2.3.1 Initial discussion

In the social- and human sciences there is an occurrence less encountered in other disciplines, namely, certain students who take a direction of study because of a personal passion or sense of mission. In her participation and observation, the researcher noticed how some of the Ecotourism students viewed their studies as more than academic formalities. Being individuals passionate about a cause, they approached the course with a sense of long-term purpose. Some of the issues that evoke strong sentiments are the environment, the development of disadvantaged communities, and public-private partnerships. For such individuals, the Mkambati 2000 Project drew out their best, as they applied their learning and experience to the problem, and made proposals in line with their personal vision and beliefs.

Learning was customized as students found roles within their groups, gaining new learning, but in a way that was also personally meaningful. They used their varied skills - photography, report-writing, proposal formulation, technical computer skills, and most important, their professional expertise in various disciplines. The key factor in customization was the **application of individual diversity**, in a way that brought personal fulfillment.

The photo-spread that follows in Figure 5C.4 shows some of the variety at Mkambati, indicating how different individuals could pursue their specialities. The learners were able to invest their own interests and expertise into the project, within the contexts of the four topics given in Text Box 5C and in Section 5C.2.2.1.

# Figure 5C.4 Customizing the project to learners' interests

**History and culture:** Exploring the wreck:
Which ships - of what nations - were wrecked near Mkambati over the centuries? Why so many Wild Coast wrecks? What happened to survivors ...?

Adventure activities: Secret waterfalls in riverine forest, secluded bathing, cliff-jumping, 'kloofing' (canyoning)

Fauna and flora: A novel angle for viewing rare samango monkeys in their forest habitat. Should tourists roam Mkambati freely to savour it? Should there be interpetive trails? Or should these activities be guided tours only ... ?

Zoologists, ecologists and environmental management students ponder the unusual occurrence of a large herd ofeland silhouetted against the ocean. Is Mkambati over-stocked? If so, what alternatives can address the matter? The carrying capacity issue relates to game as well as to tourists.

#### 5C.2.3.2 Viewpoint of the instructor-designer

The learners could personalize the project to use their own expertise and skills. It was their prerogative - with guidance from the lecturers - to decide on the sources used in their research, the content of their projects, and the guidelines they suggested regarding the way forward for Mkambati.

We did have problems with the negotiated goals. Students did not realise that, after handing in the first draft, they would be required to do so much more work on it. I thought that had been communicated, but it appeared that they were tired of the thing by then, and just wanted to finish at the point they chose - like students normally do! To them it seemed like lecturer-control, not learner-control, but we had to improve the products for real-world presentation. The bonus was, of course, was that the extra work gave them higher marks.

#### 5C.2.3.3 Findings from survey of the learners

The following questions surveyed the extent of customized learning, investigating how the learning experience matched students' preferences and how they could personalise the problem-solving to their own style and expertise:

| | |
|---|---|
| 4.1 | What are your personal learning preferences?<br>In what way did this experience match / mismatch these experiences? |
| 4.2 | Were you able to personalise this problem-based learning to your own particular style, needs, passions, expertise, etc.? Please elaborate. |
| 4.3 | Which computer systems did you use? |
| 4.4 | Did you experience the project as learner-centered? Please explain. |

All except one responded that they had been able to personalise the learning experience to their own requirements. Table 5C.7 sets out elaborations of responses to Questions 4.1 and 4.2, indicating that students particularly enjoyed the opportunities of contributing their personal ideas to the debate and pursuing them as the reports and recommendations developed. Another major factor in satisfying learning preferences was the chance to slot into a group that approached their own subject/discipline within the context of ecotourism.

| **Table 5C.7**<br>**Views on learning preferences and personalisation of the project to own style, interests, and expertise** | **Number of students (n = 12)** |
|---|---|
| Hands-on practical / apply theory to practice | 4 |
| Opportunity to contribute own ideas / personal interpretation / work in my own way / freedom to express opinion / we decided on content | 7 |
| Enjoy discussion / brainstorming / interaction / negotiation | 4 |
| Could use my subject-matter expertise /<br>Chose a group that interested me | 6 |

The students also raised other pertinent issues:

- ***Preparation for the future:***
  *The personal consultations, e.g. with management, were good training for what will be required in employment. /*
  *To do something real - that people could use - it was an opportunity to make a contribution. /*
  *We had to do our* *<u>own</u>* *research - we really did learn.*

- ***Real-world problem-solving:***
  *It was an opportunity for logical, deductive problem-solving after reviewing all aspects and pros and cons of the situation. /*
  *We were exposed to what really happens and contrasting it with what could happen.*
  (Note: the above refers to the difference between reality and the textbook model.)

  *I have empathy with disadvantaged communities and have done volunteer student work, but this is a real chance to make a difference and contribute to upliftment and a work ethic.*
  (This is a comment made during the reseacher's personal discussions with a learner.)

- ***Facing real-world complexities***
  Students in the group that investigated culture and community admitted they had struggled - their topic was a complex issue in uncharted, controversial territory.

When asked in Question 4.4 whether they experienced the project as learner-centred, ten replied in the affirmative. Of the two who disagreed, one interpreted the question in a positive light:

*It was problem-centered; our part was to solve it.*

The other expressed a major reservation:

*I felt that we were 'used'.*

This section (Question 4.3) also investigates the computer packages used as tools. Table 5C.8 presents the findings. Bearing in mind that the teamwork capitalized on delegation and strengths, it is likely that the four who used graphics, represent all four teams. The different kinds of software used indicate individual preferences and strengths, for example, one of the spreadsheet users was the student who made the observation regarding 'logical, deductive problem-solving'.

**Table 5C.8**
**Software packages used in generating collaborative projects**

| Word processor | Database | Spread-sheet | E-mail | World Wide Web | Graphics Packages | Other (specify) |
|---|---|---|---|---|---|---|
| 10 | 2 | 2 | 7 | 9 | 4 | - |

### 5C.2.3.4 Concluding discussion

The type of customization applied in the Ecotourism project is different from the traditional views of customized learning. Learning was customized:

- Not by using a customizable computer system;
- Not by doing own choice of activities - own sequence, quantity, content, mode, etc (as in FRAMES);
- Not by customizing a generic task to develop a product in line with their interests (as in RBO); but
  - by learners finding their role in the group - using their specialized expertise to tackle defined goals and develop stated products within a team context, each contributing to the product by using what he/she knew best.

Although the Ecotourism students had to grasp the complexities of the problem in hand, they did not experience the same learning-gap or stress as some of the RBO learners, who had to learn new skills and concepts before they could make progress. The class was eager and able to build on their prior learning and on their new knowledge of ecotourism, as they set out to propose solutions. Furthermore, the learning event provided an opportunity to build on value systems and indulge personal passions. This contributes both to intrinsic motivation and to customization of the experience, and holds great real-world value and future career benefits.

Using a botanical analogy, a learner suggested that the project was 'mutualistic', meaning that, on the one hand, the problem provided the students with a practical learning experience, and on the other, the results were useful for management at the reserve.

Once again, an inter-relationship between learning theories was in evidence. The customization that occurred in the project - allowing each learner to contribute what they knew best from their former specialities - could not have happened outside of collaborative work.

## 5C.2.4 Components

The Ecotourism project itself incorporated no explicit teaching of basic theory, only practice, since the field trip and subsequent write-up were viewed as practical application of prior learning. The knowledge acquisition process of the underlying theory is outside the scope of the learning event (although within the scope of the Ecotourism course as such). There was no basic instruction along the lines of Merril's (1983) CDT, since it was assumed that basic skill- and knowledge components were in place as existing foundations. This section, therefore, only briefly examines the nature of the basic knowledge and the way in which it was communicated.

### 5C.2.4.1 Initial discussion

Mkambati 2000 involved three kinds of knowledge. Students came into the project with two of them, and acquired the third during the field experience:

(i) Pre-existing specializations, related to their various former degrees;

(ii) knowledge of ecotourism; and

(iii) awareness and understanding of the particular problem.

In the first and second fields, basic components of learning preceded the field trip, and are outside the scope of the project and questionnaire. Ecotourism theory and the practice of Ecotourism were taught during class lectures and discussions before the trip.

Before the project students were given basic material about the reserve, and were required to research their own angles. They took their class notes and their own research material on the field trip, and were therefore equipped both with the rudiments of ecotourism and the subject-specific theory and practice of their own areas of specialization. The kind of learning actually experienced on the project was holistic and circumstantial. The students had to absorb and assimilate various issues, an integration of material that cannot be viewed as transmission of components.

### 5C.2.4.2 Viewpoint of the instructor-designer

> The basic building blocks of the ecotourism discipline, as communicated in the fourteen weeks of class-learning, are multi-disciplinary, requiring much integration.
>
> In order to go on the trip, class attendance was vital. Each student had a chance to present a section of the course and hand it to their fellow students a week before presenting, allowing time for the fellow-students to peruse the document and prepare questions. Whether they actually do that is not always clear! We also had guest lecturers; one in particular is an expert in the practical implementation of ecotourism, and he set out the main practical principles.

### 5C.2.4.3 Findings from survey of the learners

N/A - no survey questions related to component-based instruction.

### 5C.2.4.4 Concluding discussion

No explicit knowledge or skills components were communicated during the field trip or write-up, since these had been presented in the prior class-learning sessions, often by learners themselves. Mkambati 2000 presented an opportunity to contextualize and consolidate prior knowledge.

## 5C.2.5 Cognitive learning theory

An investigation of cognitive learning should examine how new knowledge is integrated with prior learning, how learning gaps are bridged, how learners handle planning and self-regulating, and develop critical thinking skills. This section also examines the application of cognitive flexibility theory (Spiro, Feltovitch and Coulson, 1994) and the cognitive-affective connection (Tennyson & Nielsen, 1998) in the Mkambati learning event.

### 5C.2.5.1 Initial discussion

As pointed out in Section 5C2.4 on components, there was no explicit teaching during the actual project and fieldwork period; rather, there was hands-on experiential learning. There was also intensive interaction with the resource base (the natural and cultural environment) and with stakeholders, which stimulated cognitive processing and critical, creative thinking.

- ***Active planning, participation and self-regulating***

The students were actively involved in researching their topics and generating deliverables, although guidance was available from the facilitator as required. Each group embarked on extensive literature/resource surveys, including documents and previous research specifically on Mkambati. They were responsible for their own progress, and different groups progressed at different rates.

- ***Integration of new with prior knowledge / mental schemata***

New knowledge relates to prior learning in different ways. Sometimes advanced knowledge builds on basic knowledge in the same domain, and sometimes it entails completely new subject matter in a different domain, but associated with the prior learning. The Mkambati project involved both types:

- As individuals, some of the students could apply their own personal discipline directly to their group topic, giving their specialized expertise to the multi-disciplinary challenge, but also gaining new and broader contextualized knowledge in that domain on a just-in-time basis.
- As a group, they learned new Ecotourism concepts, and applied their varied former learning, reorganizing and integrating internal knowledge structures.

- ***Cognitive flexibility theory***

Cognitive flexibility theory (2.3.4.4 and 2.4.5.2; Spiro, Feltovitch & Coulson, 1994) is a cognitive-constructivist approach concerned more with the assembly of mental schemata than their retrieval. Flexibility theory emphasizes transfer of knowledge and skills beyond the initial learning situation, using information from multiple perspectives and case studies to present varying examples. It supports the use of interactive technology, and has primarily been applied in history, biology, and medicine. The Mkambati learning event satisfies the main principles of cognitive flexibility theory:

1. Students were exposed to *multiple representations* of content in their learning activities as they used varied sources of information and guidance: class notes and lecturers' expertise, libraries, web-searches, and talks by / interviews with stakeholders in the nature reserve. They also encountered an excellent case study on their visit to the bushcamp and community ecotourism venture just outside the reserve border.
2. The content domain with its complexities and controversies was *not over-simplified***.**
3. Class lectures prior to the field trip had set the context by incorporating *case-based studies* in general and, in particular, by holding a slide show of the reserve and distributing introductory maps and documents.

### 5C.2.5.2 Viewpoint of the instructor-designer

The experience required in-depth planning by learners of their team project - setting goals and deadlines, being in charge of something that had to be good, because it was to be a real-life submission. Feedback was given to students on their first versions, and then they were sent back to work on it again on their own. This required self-discipline and time-management, skills that are frequently under-developed in students.

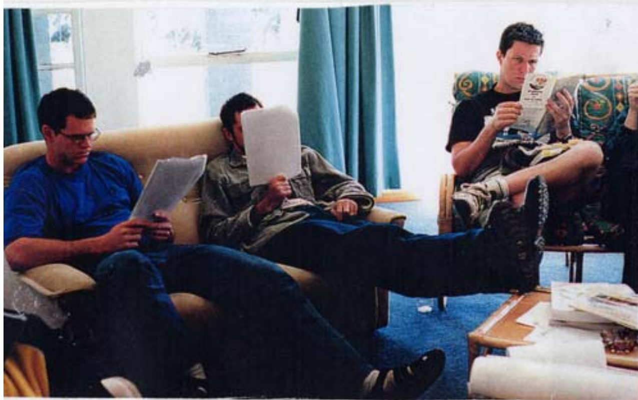
The key to the project was integration, both in terms of:

- Integrating a wide variety of study fields/topics - the enormous scope of ecotourism in practice was confusing for them at first - combining ecotourism issues of history, anthropology (tribal culture), zoology, botany, architecture, geography, ecology, sustainable development, etc. with their prior knowledge, when each of them had expertise in some field/s, but little knowledge in others, and most of them were not yet experts in any one of the fields; and
- Integrating what was learnt in class and in other courses with what had to be done in practice. I think they struggled at first to put theory into practice in the on-the-ground Mkambati situation, but later became more comfortable with the process.

Two of the pictures in the next photo-spread, Figure 5C.5, show how we spent the evenings. After thought-provoking sessions of information, briefings and discussion, they would settle down to serious work, relating their own knowledge to the specifics of the problem on hand. In the first day or so, they mainly read and worked alone, studying documents on Mkambati and the ecology of the region. Then – more and more – they worked in their groups, as they converted their knowledge and reasoning into meaningful contributions.

The task called for planning, communication and articulation of ideas. But more than just communicating with their teammates, some students had the chance to communicate nationally as they were interviewed for a TV program on the Mkambati Project and the issues it addressed.

## Figure 5C.5 Integration and issues



**Integration:** Out come the maps, articles, and previous proposals for Mkambati, etc. Out come notes, and jottings made while listening to stakeholders.
Read and ponder – integrate and assimilate - then jointly make proposals and suggest guidelines.

**Issues:** Pause a while and consult the charts on the wall. Wrestle with the issues – which compromises are pragmatic and which are risky?

**Issues:**
Students interviewed for national television:
'What is your opinion on the way forward?'
'What kind of accommodation …
How appropriate is the house behind?'

**After wrestling – resolution ?**
Not quite. Satisfied with fieldwork well done, the group paused and posed for the traditional photo. But frustration still lay ahead ...
Tough decisions had to be made, group consensus achieved, all contributions had to be forthcoming, then worked into a single coherent, cohesive, consistent document of ecotourism guidelines.

### 5C.2.5.3 Findings from survey of the learners

Several questions investigated how cognitive learning occurred during the project.

| | |
|---|---|
| 2.1 | Describe how the knowledge and skills required of you in the project related to your own prior learning (i.e. what you know from previous study). |
| 2.2 | In situations where you lacked prior knowledge, how did you bridge the gap? |
| 2.3 | Problem-based learning is open-ended. It has no fixed ending stage, and is flexible in terms of the type and quantity of content. How did you find this in terms of deciding how far to take your section of work, and how did it impact on scheduling and monitoring your time, your other priorities and obligations, self-discipline, etc? |
| 2.4 | Did you at any time experience overload and/or anxiety? Please elaborate. |

Questions 2.1 and 2.2 dealt with prior learning and experience, and their relationship to ecotourism. The learners had rich and varied backgrounds. There was a social worker, a landscape planner, and geographers. Others were graduates in fields such as tourism management, botany, chemistry, anthropology, cultural history, and sociology. During 2000, they were honours- or masters-level students taking degrees in varied fields - agronomics (agricultural economics), tourism management, general ecotourism, environmental management, and the new masters degree in environment and society. Each discipline had to be applied and integrated into the new framework of ecotourism.

- ***Integration and bridging of learning***

  Class strength lay in its team expertise. Students reveled in the opportunity to apply their knowledge to a practical situation. Describing how their prior leaning related to the demands of the project, students compositely listed their knowledge and skills (Question 2.1) as:

  - *Sustainability of the resource base,*
  - *economic viability,*
  - *preparing documentation for decision-makers,*
  - *tourism accommodation models,*
  - *use of indigenous materials,*
  - *spatial planning and interrelations,*
  - *flora,*
  - *general problem-solving strategies,*
  - *heritage and culture of communities, and*
  - *community development projects., i.e. upliftment for the disavantaged.*

Where necessary, learning gaps (Question 2.2) were bridged in various ways:

| **Table 5C.9**<br>**How I bridged learning gaps** | **Students**<br>**(n = 12)** |
|---|---|
| Group interaction / Asked my colleagues | 4 |
| Asked questions of the lecturer | 4 |
| Readings on ecotourism / Library resources | 3 |
| Discussions with professionals | 3 |
| Personal research | 2 |
| My own creativity / Improvised | 2 |
| Policy documents on the Internet | 1 |

The next aspect of cognition investigated (Question 2.3) relates to self-regulation of the learning process - planning, scheduling and monitoring the progression of the work. Several learners found the extent of the project more than they had anticipated. Their fairly detailed answers (provided descriptively, rather than tabulated) can basically be classified into six positive views, five negative attitudes, and three remarks about the type of content.

- ***Planning and self-monitoring***

  The six positive approaches indicated pre-planning and structured organisation. Learners had discussed their intentions with the facilitator and the group.

  > *I felt I knew what was expected to develop a quality product. /*
  > *... it depended on our self-discipline. /*
  > *We had to set a deadline and work our schedules accordingly.*

  The five who made negative comments were uncertain about the depth/detail required in the report, and some of them objected to the extra effort involved for real-world submission. This impacted on other academic commitments. One admitted a tendency to crisis management, which had delayed products and impacted on his group. There was also disagreement as to how far students should go in the content of the documents. Some felt that they should suggest ideas, but stop short of in-depth professional analysis and specific guidelines, while others wanted to generate a consultant-type document. One felt:

  > The kind of solutions proposed should be flexible, so they can adapt and change to relevant situations.

The last question, Question 2.4, addresses the related field of affective aspects (2.3.4.1; 2.5.3.2), inquiring whether learners had, at times, experienced overload and/or anxiety. Ten responded in the affirmative.

<table>
<tr><th>Table 5C.10<br>Elaborations on overload/anxiety</th><th colspan="2">Students<br>(n = 12)</th></tr>
<tr><td>Had other obligations / Impacted on my other studies</td><td>4</td><td rowspan="4">10</td></tr>
<tr><td>Took longer than expected /<br>Were told to expand our project</td><td>3</td></tr>
<tr><td>I was not familiar with what I was doing /<br>Would have liked the final product to be up to a higher standard</td><td>2</td></tr>
<tr><td>I had to do extra work to ensure a good product</td><td>2</td></tr>
</table>

One learner expressed a particular concern:

*I wish we had been able to visit the host communities (the dissatisfied ones) ...*
*I am anxious about the eventual representativeness of our recommendations regarding them.*

Reserve management had explained local tribal grievances to the students, but considered a visit unwise, since it might exacerbate the problem of over-ambitious expectations. Another learner (in response to a different question) saw the community aspect as an opportunity for lateral thinking:

Issues such as community relations gave one the challenge of applying his/her own mind to address the issue, as it is not theoretically conventional in nature.

### 5C.2.5.4 Concluding discussion

An important aspect of cognitive learning is the integration of new knowledge with prior learning. The relationship of new to prior knowledge varies from one case to another. For example it can be:

- *The same subject domain* where new knowledge is advanced material that builds on basic knowledge in the same content area, as in FRAMES.
- *A different subject domain* so that new subject matter must be mastered and related/applied to prior knowledge in another content area, as in RBO.
- *Similar domain, but applying theory to practice*.

The Mkambati 2000 learning event combines them all. The students represented prior learning in a variety of fields, each of which was a suitable foundation for the new discipline of Ecotourism. Each learner had to integrate his/her own background into this new expertise - in a research context - and apply it actively to the problem in hand. This was successfully achieved.

Planning and self-regulating of the report-writing progress was more complex, and was closely related to the affective-cognitive connection which varied over time. The survey reveals that attitudes which had been highly positive at the nature reserve, were less so during the prolonged write-up. Some learners did not appreciate the magnitude of effort required to produce a professional-type document, particularly since finalization coincided with preparation for exams. Ultimately however, what they learned had a high career value and each received written certification from the university and acknowledgement from the provincial authority of their contribution to an authentic exercise.

The Mkambati learning event encouraged critical thinking, particularly with respect to uncharted issues, such as community benefits and shared usage by local tribes-people of the reserve property. Further contentious matters, highly debated, were the nature of the accommodation - resort-type or eco-type - and the associated target group of tourists. The final proposals on these aspects were the result of reative compromises.

Integration of learning theories is again evident, as the investigation shows how cognitive learning in this project overlaps with customization, in that each participant's prior learning was the means of customization, as they focussed their contributions on their areas of specialization. Furthermore the cognitive-affective connection relates to the aspect of motivation addressed in 5C.2.1. The difference between the affective aspects of motivation and the affective aspects of the cognitive-affective connection is that the former relates to the role creative instruction plays in engaging and encouraging learners, while the latter comes into play once a learning event is underway, particularly at the stage where steep learning gain is expected of the learners.

## 5C.2.6 Constructivism

Features considered in this section of the investigation are real-world authenticity, personal knowledge interpretation, and the problem-based nature of the event. These issues are investigated as well as the foundations of grounded design (Hannafin *et al*, 1997) in the project. Constructivism is most appropriate for ill-structured domains, and the situation at the nature reserve is examined to match it against Jonassen's (1999) properties of ill-structured problems and Hannafin *et al's* (1994) characteristics of open-ended learning. Section 5C.2.6.2 is the most extensive of all the 'lecturer/facilitator viewpoint' subsections, as it depicts what made the Mkambati 2000 Project unique.

### 5C.2.6.1 Initial discussion

This section sets out the researcher's general impressions, as an observer-participant, of constructivist learning as implemented in the Mkambati 2000 event.

- ***Authentic real-world context***

While at the reserve, students spent time with stakeholders such as nature conservation officials, locals involved in successful ecotourism developments, and tourism operators. They heard about the issues from all perspectives, and became aware of roles played by local community needs and land rights, as well as the viewpoint of business that investment should realize returns. Learning was problem-driven (see 3.4.4.2 and 3.4.4.4; Jonassen, 1999) as the students:

- Were exposed to the complexities and multi-faceted nature of the problem, gaining new conceptual understanding,
- found out how and why situations deadlocked and proposals stalled, and
- learned advanced domain content in order to solve the problem.

They took ownership of the problem and reflectively explored the situation. They acquired new skills in decision-making, negotiation, accessing resources, and technical expertise. In generating proposals for presentation to the regional authorities, they did real-world work in a similar way to Steyn's (2001) learners, who were involved in a real-life development (Section 2.6.4).

- ***Values***

For this kind of more-than-just-academic learning to occur, students must be value-driven and self-motivated. As mentioned in 5C.2.3.1, some were passionate about a cause - doing post graduate studies as positive activists, with the desire to make a difference.

- ***Active participation***

Constructivist learning involves seeking and selecting relevant information, integrating it with existing knowledge, then organizing and applying it. Learning and literature have true relevance when applied hands-on. The researcher observed how, in the course of the fieldwork, the Ecotourism students formally interviewed and informally held discussions with stakeholders. They extracted relevant information, interpreted it in light of their own experience and research, and built new experiential knowledge over and above the formal domain content. Learner-initiative was encouraged, and this opportunity to state, explore, and debate their own ideas contributed to enthusiasm.

- ***Properties and learner-ownership of an ill-structured problem***

The purpose of the project was to present proposals for the way forward, based on the fundamental principles of ecotourism - yet addressing the unique complexities of the situation. System dynamics were fluid, due to the breakdown in negotiations with the successful tendering company, as explained in Text Box 5C. The future of the reserve, which had apparently been resolved, was once again uncertain, contentious, and topical - receiving attention in the popular press. Hence the genuine interest of the authorities in the students' proposals.

The situation - entailing conservation, botany, ecology, sociology, development of impoverished communities, business management and marketing, hospitality, adventure tourism, and ecotourism - complies with properties of ill-structured problems (section 3.4.4.2; Jonassen, 1999), namely:

- Unstated goals and constraints,
- multiple solution paths or no solutions,
- multiple criteria for evaluating solutions,
- uncertainty over which concepts, rules, and principles to use - or even - no general rules and principles for predicting the outcome, and
- the requirement that learners make and defend judgements.

When central issues are ill-structured, many aspects must still emerge and be defined by learners themselves (Jonassen, 1999). In this context, the four groups, under guidance from facilitators, took ownership of the problems, performed structured inquiry, and proposed solutions/guidelines in the focus areas (fauna & flora; activities for the ecotourist; culture & community; and accommodation, infrastructure, & facilities).

- ***Learner frustration***

Learner-frustration can be a feature of constructivist learning. The high point of Mkambati, namely, the real-world interest in the students' proposals, became a source of frustration when it forced a set of norms and a degree of excellence beyond the usual standard of students' products. The real-world exercise was excellent exposure and a valuable learning experience. It required time and energy commitment beyond the efforts usually spent on an academic exercise, but resulted in distinction marks for each group, when assessed by their university instructors.

- ***Grounded design***

For a learning system to be based on a grounded design (Sections 3.1.2 and 3.4.3.3; Hannafin *et al*, 1997), the foundations must be aligned to maximize coincidence and shared functions. The Mkambati 2000 learning event is examined with respect to five foundations, as was RBO in Section 5B.2.2.1:

1. *Psychological foundation*
   Learning in the project is related to *cognitive flexibility theory* as described in 5C.2.5.1 which focuses on the nature of learning in complex, ill-structured domains. Cognitive flexibility refers to the ability to spontaneously restructure one's knowledge in adaptive response to radically changing situational demands.

2. *Pedagogical approach*
   As in the case of RBO, the pedagogical foundation is *anchored instruction*, occurring in an authentic and holistic real-world setting, without any simplification of issues. Scaffolding, over and above prior learning, was provided in the form of multiple sources and reference books (marine ecology, fauna and flora, etc). The room used as a work area at the reserve was stocked with information on matters such as the SDI (spatial development initiative) envisaged for the region, material on loan from the authorities - such as submissions by consortiums who had tendered for the (now defunct) upgrade and development contract, and a proposal by a special-interest group to convert the reserve and its region into a national park. Large-scale topographical maps, Wild Coast hiking trails, relevant brochures, and marine-life charts were fastened to the walls, giving the appearance of a 'command centre'.

3. *Technological foundation*
   Laptop computers were brought along for note-taking and draft reports. During the subsequent report-writing period, technology was used as productivity tools - information was accessed from the Internet; databases and spreadsheets were used to manipulate and present information. A graphic presentation was also made on CD medium.

4. *Cultural considerations*
   As with RBO, the organisational culture and the norms and standards of the University of Pretoria were adhered to for assessment and grading of the four projects. Further cultural considerations were those relating to the host community, since all proposals had to exercise sensitivity to the locals and incorporate realistic benefits and policies regarding right-of-use. The culture of collaborative learning and team work played a major role in shaping the way the project unfolded - both in positive and negative respects.

5. *Pragmatic foundation*
   The project itself was highly constructivist, but when viewed in the context of the entire semester course which included decontextualized componential knowledge, the process demonstrates accommodation and balance, and uses all six elements of the HCMm. The prior class-based participative instruction served to lay a foundation for the ambitious field project. Just-in-time learning, only, would have been inadequate.

- ***Problem-based learning and open-ended learning***

Mkambati 2000 was an implementation of problem-based learning (see 2.4.5.4 and 3.4.4.4). The instructors did not generate or simulate the problem - it is an authentic real-world situation with complexities and uncertainties, and it entails multiple parameters. Characteristics of open-ended learning as set out in section 3.4.4.3 (Hannafin *et al*, 1994), are evident:

1. *Experiences on the field trip were embedded in context and experience* - such as exposure to natural environmental features and ecotourist activities (Text Box 5C), perception of negative problem-fraught aspects, and the positive contact with a local community involved in a self-employment ecotourism venture.
2. *Individual mediation of understanding* - learning was customizable to students' interests - allowing individuals to contribute according to their expertise and abilities, as described in Sections 5C.2.3.1 and 5C.2.5.3.
3. The process was *qualitatively different from the traditional instructional/learning venture*. To achieve the complex performance goals (Text Box 5C; Sections 5C.2.1 & 5C.2.2) and to engage in meaningful problem solving required:
   - Sound theoretical knowledge,
   - ability to apply that knowledge practically and circumspectly,
   - a wide variety of information sources (multiple perspectives), and
   - competent use of tools and resources.

- ***From personal interpretation to construction of a product***

Each group took ownership of its particular subproblem. Individual and group-interpretations were made, based on knowledge and personal experience. The interpretations and opinions were formulated as reports, proposals and guidelines, then collated and compiled into a single document of ecotourism planning guidelines in a consistent format, which was presented to the regional department of nature conservation.

### 5C.2.6.2 Viewpoint of the instructor-designer

*Learning was highly active:*

- Students had to find their own resources. They are given an extensive bibliography on ecotourism - but the project took them beyond its scope into related disciplines;
- After initial discussions during the field trip, they planned the reports on their own, until the stage when their first drafts were returned for changes advised by the lecturers. However, I was always available for queries and advice on resources, etc. One group in particular stayed close to me while preparing their document - the accommodation and facilities group.
- They actively explored the reserve to see for themselves what could be done there. The relatively long period (a full week) spent there was essential to the exercise.
- Lively interaction took place in the group discussions each evening, based on the places/issues they had seen/learnt that day. The ever-present challenge was how the principles of ecotourism could be applied right there in the reserve.
- The evening discussions were geared to the process of students having to work within a group within another group (as mentioned under the aspect of collabarative learning). However, as I moulded the final combined report later, I encountered a lot of overlap and inconsistencies which had to be sorted out.

*Definitely problem-based:*

- The students were given an authentic situation - the problem being that Mkambati has so much potential for ecotourism, yet nothing is really in place.
- They had to actively, and integratively, come up with solutions. The fact that we were giving the report to the provincial nature conservation department added an important dimension - this was a real task and with that came the responsibility that it had to be good - not just another student project. The students realized this, but were frustrated when they had to do a second draft - I don't think their commitment to a real-life cause went that far, because of their other pressures and responsibilities. I suppose that in the real world of professional consultants, the incentive of payment is a driving force!
- The evening working environment had the look and feel of a real-world operations room - piles of reference books, documents on loan from management, walls covered in charts, and large scale maps. We brought along different kinds of maps including various series from the Government Printer in Pretoria - some of them were maps that nature conservation authorities had not seen before and they were most interested.

*Open-ended:*

- The final products/ideas suggested by the groups - although there had been guidance along the way - were their own work. If two groups had done the same topic, each would have interpreted it differently and proposed different recommendations, i.e. there was no single solution, no right or wrong.
- Some ideas had to be re-visited and revised, due to constraints on them. For example - difficulties with local community made it complicated to suggest their involvement in certain ways. As I mentioned, we (the facilitators) gave much support in the process - mainly at the reserve, but depending on the students - some consulted us personally afterwards to discuss their suggestions, or made telephonic/e-mail contact.

*Authentic, unique, and complex:*

- I do not know of any other postgraduate project like it.
- Very complex due to the interdisciplinary nature of the problem and the intricacies of the Mkambati situation.

### 5C.2.6.3 Findings from survey of the learners

The following survey questions relate to constructivism and problem-based learning:

1.1 How did you find this experience of constructivist learning?
Please describe your emotions honestly.

1.2 Describe both strengths and shortcomings, in your opinion, of this particular experience of problem-based learning - they may relate to any aspect or any stage of the project.

1.3 What sources of information did you use:
before the trip / at the reserve / during write-up time afterwards?

The responses to Question 1.1 show appreciation of exposure to genuine constructivist learning in an ill-structured domain, in contrast to the usual academic experience of solving hypothetical problems. In a learner's words:

> *The challenge was to be able to work independently in a context with a high degree of uncertainty when theory and practice did not meet.*

Other elaborations are classified into categories and shown in Table 5C.11.

| **Table 5C.11**<br>**Learner comments on aspects of constructivist learning** | | **Students**<br>**(n = 12)** | |
|---|---|---|---|
| Theory to practice / Real context | Could apply ecotourism theory / combined real scenario with sufficient theoretical background | 5 | 8 |
| | Applied and explored various planning approaches used in tourism industry | 2 | |
| | Creative problem-solving | 1 | |
| Knowledge construction - Collaborative and individual | Accommodation of diverse ideas / collectively responsible / Interaction was the key | 5 | 7 |
| | Active participation / Problem-solving / Could express own ideas creatively | 2 | |
| Personal experience | Healthy experience / interesting / Thoroughly enjoyable | 4 | |
| Fuzzy, ill-defined aspects | Community relations not addressed in conventional theories | 1 | |

Question 1.2 addresses strengths and shortcomings of the event. In describing *strengths*, students spontaneously mentioned aspects that correspond with key features of contemporary cognitive and constructivist philosophies; these are listed in Table 5C.12 against the characteristic features:

**Table 5C.12**
**Correspondence between constructivist features and learner-responses**

| Constructivist feature | Strengths mentioned by learners |
|---|---|
| Multiple perspectives | Gained a broad base of understanding due to:<br>- Doing research one's self<br>- the different views of teammates<br>- students teaching each other. |
| Real-world problems<br>Contextualization | An authentic problem situation:<br>- own work / own opinion has value<br>- guidelines may influence future decision-makers<br>- deal with problem directly<br>- gained perspective on complex situation<br>- crucial exposure to real context<br>- a challenge to think up new but viable solutions! |
| Learner-centered | Able to express own opinion / Could work independently |
| Creativity and innovation | Helped us develop intellectually and develop creative solutions / Informed decision-making / Motivated to be creative |

The *negative* responses relate mainly to aspects already mentioned, and show that a constructivist paradigm calls for learner-adjustment. Value was added to the reservations by (voluntarily suggested) remedies, which are listed in Table 5C.13 alongside the identified shortcomings.

**Table 5C.13**
**Shortcomings identified and suggested remedies**

| Weaknesses identified in learners' experience of problem-based learning | Suggested remedy |
|---|---|
| Writing up guidelines was complex.<br>Needed more feedback from lecturers regarding the changes made to our documents. | A standard framework would have helped /<br>We needed briefing on the kind of information that decision-makers need. |
| Frustrated by nature of the issues.<br>Stress and high workload. | Needed more time (Researcher: other learners would not agree with solution above - they wanted less work!) |
| Huge project - took too much time. | Pre-planning should indicate the exact extent. |
| Group members did not all contribute equally.<br>Not adequately equipped to handle it. | Evaluation should not be the same for all. /<br>Peer review needed - to contribute to the mark. |
| Disagreement within group. | Should be channeled into constructive criticism |
| Group work is tedious and time-consuming.<br>Some group members required direct instruction from others. | Sometimes I would have preferred a straight lecture. |

### 5C.2.6.4 Concluding discussion

All three subsections indicate that this project is an illustration of classic constructivism. It supports problem-based, open-ended learning in the context of a poorly structured domain. The key features of constructivist learning such as active involvement of learners, freedom to contribute ideas and negotiate solutions, personal interpretation, and collaborative problem-solving are strongly evident.

The problem drove the learning and concretized the abstract:

> *Being onsite gave you a different perspective on theoretical jargon.*

Furthermore, a Tourism Management graduate, accustomed to conventional tourism models, stated:

> *I appreciated exposure to 'destination-specific variables' at a unique kind of destination*.

And a final comment:

> *It was great fun!*

Learners expressed reservations about certain shortcomings, one being uncertainty regarding the format, depth, and extent of the four final reports. Establishment of a standard framework to simplify write-up would not be a valid constructivist approach, since constructivism is not a prescriptive philosophy. Under the circumstances of meta-collaboration, however, such a framework might have been a pragmatic accommodation to simplify the unification of four documents into one.

The reservations relating to groupwork are valid; the problems mentioned are standard occurrences within collaborative learning and teamwork, and refinements to address them were proposed in 5C.2.2.4. The extent of work was undoubtedly more than envisaged by both facilitator and learners, and has been addressed in previous sections, particularly in 5C.2.5.4. All twelve students acknowledged the worth of the experience and in the long term, are likely to forget the peak-period pressure and appreciate the real-world career value.

This inquiry into constructivism in the Mkambati learning event shows that the field trip and project can also be viewed as an exercise in life-skills, as learners interacted with the facilitator, the 'clients', and one another, to grasp the problem and propose solutions.

## 5C.3 General

This section attempts to define the five facets of the wider learning environment of Mkambati 2000 and also briefly mentions the use of computer technology in FRAMES.

### *5C.3.1 Facets of the Mkambati 2000 learning environment*

Table 5C.14 shows Perkins' (1991a; Section 3.5.4) five facets of a learning environment and their associated resources and implementations in the Mkambati learning experience.

**Table 5C.14 Facets comprising the Mkambati 2000 fieldwork project** (Perkins, 1992)

| Facets that comprise a learning environment | Corresponding implementation in Mkambati 2000 |
|---|---|
| Information banks<br>(some of which are part of the event's greater environment) | Reference books and class notes<br>Conceptual models and maps<br>Websites<br>Stakeholders in the nature reserve |
| Symbol pads | Laptop computers<br>Notebooks<br>Maps-under-construction<br>Cameras and binoculars |
| Construction kits | Software tools and packages |
| Phenomenaria | Internet and World Wide Web<br>Real world natural environment<br>Nature conservation officials, community, and tourists |
| Task managers | Facilitators<br>Nature conservation officials<br>Individual learners<br>Co-learners |

### *5C.3.2 Technology in Mkambati 2000*

The Mkambati project, unlike the other two case studies was not founded on technology as an integral medium of communication. RBO is part of a degree in Computer-based Education, and FRAMES is a learning aid for a distance-education module, whereas Ecotourism is a contact-teaching course. However, it is required that students be familiar with software such as word processing, databases, and spreadsheets. Although none of the learners, who were registered for postgraduate degrees in a variety in faculties, were doing explicit computing-related courses, they evidenced sound competencies in the software packages they used as tools to manipulate, integrate and display information, and as aids in problem-solving, decision-making and communication.

## 5C.4 Conclusion to evaluation of the Mkambati Project

The final case study investigated the problem-based Mkambati 2000 learning event, incorporating fieldwork, report writing, and recommendations. The findings show that the learning event was well-designed, planned and executed, and that it achieved its aim (see Table 5.1) of bridging the gap between theoretical class-based learning and real-world hands-on practice.

***Integration in Mkambati 2000***

Different practical competencies, e.g. technological know-how, writing skills, and leadership ability, were applied in a holistic, collaborative, cross-discipline, and highly constructivist problem-solving exercise. The study and research incorporated elements of the:

- Human sciences,
- natural and environmental sciences,
- economic and management sciences, and
- man-made environment.

Five of the elements of the Hexa-C Metamodel, namely creativity, customization, collaborative learning, cognitive learning, and constructivism were strongly in evidence. Collaborative work was controversial. Some students put in more effort than others to ensure quality in the final products. Others may have been weaker students or else took a pragmatic view, being prepared only to devote a certain amount of time and effort. The team mark was a source of contention. Peer- and self-evaluation to contribute towards final individual grades could alleviate this problem. However, the experience was a foretaste of teamwork in the business and professional working environment. It is valuable exposure, and those who played major roles recognized the personal-growth factor.

Academically, learners were less threatened than in the other two evaluations. The challenge was posed more by the complexities of the application, than by inadequate knowledge and skills on their part (apart from the uncharted territory of the community aspects). Learners made in-depth investigations and applied lateral thinking in their efforts to solve an authentic problem.

***Real-world worth***

Value-driven learners were intrinsically and extrinsically motivated by the chance to do something real. It was a new experience to serve as consultants for a 'client organisation', the provincial authorities, who regarded them with credibility. However, when real-world academia becomes real-life in the workplace, final documents require a near-professional standard. Although the ultimate coordination and integration were the responsibility of the facilitator, it enforced high quality on the learners' deliverables and impacted on their other studies. It was demanding yet rewarding, and the efforts were worthwhile. After receiving the document of ecotourism guidelines, the regional director of nature conservation commented, 'It's wonderful to have a report we can use'. As with RBO, there are market-oriented benefits and long-term career value. Figure 5C.6, an extract from a student's interim project, sets out his impressions and the desire of these post graduate learners that their academic efforts might 'make a difference' in a pristine and fragile natural environment.

**Figure 5C.6 The mission of Mkambati 2000 - in learners' terms**
(Source: Pretorius, 2000)

**Outdoor classroom on the Wild Coast**

The relatively unknown Mkambati Nature Reserve on the Wild Coast, nestled between the Msikaba and Mtentu Rivers, was the venue this past week for a post-graduate practical excursion. Twelve students studying Ecotourism in the Department of Tourism Management at the University of Pretoria were putting theory into practice by developing ecotourism planning guidelines for this spectacular reserve.

The students, along with two lecturers, spent one week exploring the waterfalls, rivers, beaches, vulture colony, gorges, and fauna and flora of the area. Particular focus was placed on improving the accommodation, learning about the complexities of community involvement around the reserve, developing venture activities, and investigating means of interpreting the reserve to visitors.

Vital input was given by Mr Div de Villiers, Regional Manager Eastern Cape Nature Conservation and Mr Vuyani Mapiya, the manager of Mkambati. An extra dimension was added by Mike Proctor-Simms from the SABC who was interviewing on various aspects pertaining to the Wild Coast particular the issue of illegaL cottages erected on prime spots. In many cases, cottage owners are causing severe damage to the environment.

A highlight was a trip by canoe across the Mtentu River to visit a tented bush camp for tourists on the Amadiba Adventures horse trail from Port Edward. The students chatted to Eddie Russell, who has been instrumental in setting this up. It's an impressive Ecotourism operation - small-scale, with clear benefits to the surrounding communities and unobtrusively designed.

It is operations such as these that will keep the Wild Coast as special, unspoilt and unique as it is now. Places like Mkambati Nature Reserve play a vital role and need to be sensitively developed as well as economically viable. It would be a tragedy if the wrong type of development occurred along the coastline, turning it into yet another Kwa-Zulu Natal South Coast.

Asking the students what had stood out for them during their visit, they mentioned having a greater passion to conserve, as well as the importance of environmentally sensitive design and orderly spatial development. Others mentioned community involvement, the vitaL need for interpretation for visitors and the desire to keep Mkambati affordable. Overall, everyone felt that they had stumbled across a very special place, which, along with the entire Wild Coast needs to be sensitively and appropriately developed.

Back in Pretoria the students are getting stuck in as they finalise their ecotourism guidelines for the Mkambati Nature Reserve that will be presented to Eastern Cape Nature Conservation. They sincerely hope that their efforts can make a difference in this wonderful (yet endangered) part of South Africa.

As was the case in the investigations of FRAMES and RBO, interrelationship and overlaps were identified between the elements of the HCMm framework and are addressed further in Chapter Six.

***Finally ...***

The questionnaires ended with a general category in which the learners could comment on the value of the project (i) to them as an individual, and (ii) to the class. There were therefore 12 x 2 = 24 comments, and all twenty-four were positive:

> *Excellent learning experience / invaluable, real-world experience / practical exposure, enriching and meaningful / Learners could use initiative much more than in other courses.*

Four mentioned the value of teamwork, five the theory-practice relationship, and five the value of the experience as a market-oriented, professional development exercise. Finally, there is the worth of implicit training in life-skills and social development, embedded within formal learning, in line with the **values** incorporated within Reigeluth's (1999) 'new', learning-focused paradigm (Sections 2.6.5 and 3.6.2). A student from a formerly disadvantaged group spontaneously addressed this as he concluded his questionnaire:

> *Projects of this magnitude should be highly encouraged. For example, we get the opportunity to:*
>
> - *Know and appreciate one another*
> - *drive together, cook together, eat together*
> - *study together, hypothesize together*
> - *hike together, swim together, partake and participate together.*
>
> *The list is never-ending, depicting or epitomizing the spirit of togetherness and teamwork. I owe my gratitude to the organizers.*

## 5.2 Conclusion to the chapter

The research described in this chapter entails case studies, which used (primarily) qualitative methods to evaluate three learning events from the perspective of contemporary learning theory / instructional practice. The six elements comprising the framework of the Hexa-C Metamodel were used as tools to investigate whether and how each was implemented in the learning event, and what impact it had. It was found that the instructional design in each of the three events **solved the problem it set out to address** and, in general, **the theories and characteristics embodied in the HCMm were evident in the learning events**. Responding to the second research question, the investigation according to the theories and practices incorporated in the HCMm revealed notable information about the practice of effective learning. Furthermore the study demonstrated the versatility of the HCMm in eliciting valuable data in three very different learning events - different in purpose, content, and context.

***Learning-focused theory***

Despite the differences between them, all three learning events also show characteristics which correspond with aspects of Reigeluth's learning-focused instructional theory (Sections 2.6 and 3.6). In Section 2.6.3 reference is made to learning environments that offer appropriate combinations of challenge and guidance, empowerment and support, self-direction and structure. Reigeluth proposes flexible guidelines for instructional situations in which learners:

- Take more initiative and responsibility for learning;
- Work in teams as well as individually on authentic, real-world tasks;
- Are able to choose from different sound methods to support learning;
- Use advanced technology as an integral part of the learning process;
- Are allowed to persevere until they reach appropriate standards;
- Participate in peer-teaching, using well-designed resources; and
- Operate in situations where the teacher acts as a guide and facilitator.

It is clear from the findings of Sections 5A, 5B, and 5C that all three case studies: FRAMES, RBO, and the Mkambati Project, comply with each of these seven conditions. It would appear **that learning events which manifest elements of the HCMm, do indeed conform to the new learning-focused paradigm.**

Chapter Five, therefore, used the framework as a tool to examine learning events. Chapter Six, conversely, uses the learning events to investigate the elements of the tool and describe ways in which each of the six can be implemented. This answers the third research question, by setting out what the practice of learning and instruction, in turn, reveals and informs about the theories and characteristics of the HCMm framework.