

## **CHAPTER 3**

### **RESEARCH DESIGN**

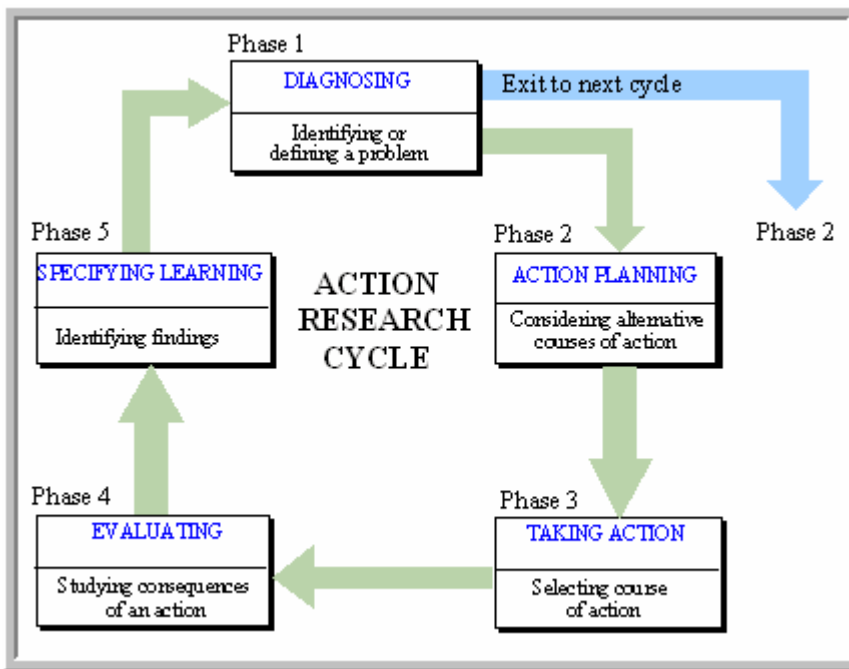
#### **3.1 ACTION RESEARCH METHODOLOGY**

Action research is a type of applied social research that differs from other types of research with regard to the closeness of the researcher's involvement in the action process. Action research has also been defined as research that is embedded in action (Coghlan & Brannick 2001). Action research has generated a great deal of interest in the field of education as it can be utilised in curriculum development and professional development, amongst others (Verma & Mallick 1999). This type of research was preferred because of its appropriateness in improving items used in measurement instruments, as the aim of this research was to develop a measurement instrument that will assist in test construction that will give us a more truthful picture of the measurement obtained from computer-assisted assessment.

The outcome of this research will have a definite impact on how educators will be doing assessments in the future. Verma and Mallick (1999) state that "action research is usually conducted with the aim of implementing a change in a given situation". Action research is considered by some people as an easy way of conducting research (Verma & Mallick 1999:93), but Nixon (1981) argues that action research is an extremely challenging form of inquiry:

Action research is an intellectually demanding mode of enquiry, which prompts serious and often uncomfortable questions about classroom practice. It requires a willingness on the part of educators to learn about their classrooms, and a desire to develop themselves professionally.

The research was conducted as action research as described by Susman (1983). He distinguishes five phases: diagnosing, action planning, taking action, evaluating and specifying learning to be conducted within each research cycle, as shown in Figure 21.



**Figure 21** Action research cycle

### 3.2 DATA-ACQUIRING PROCESS

The data required for the research project was obtained from two tests administered to students using the same question bank. This took place over a period of two weeks as suggested by Metsämuuronen (2002:51).

Both tests were conducted online. Data was collected from the two tests written on a computer. Objective items were used and the data was scored by the computer. This process is referred to as *test re-test* (same form).

The following terminology is used:

**Pilot test** refers to a test that was conducted to ensure the operational and logistic feasibility of the hardware and software. The results of the pilot test were not used for statistical analysis. **Test** refers to the first of the two tests that were conducted. The second test will be referred to as **re-test** throughout the study. The research is made up of four cycles, each consisting of the five phases within the cycle. Every cycle was concluded with a meeting which involved the assessment committee as well as technical experts. Feedback from these meetings provided input into the next action research cycle. The four cycles are:

- Cycle 1: Set up (ascertain) test environment.
- Cycle 2: Conduct a pilot test.
- Cycle 3: Administer a test.
- Cycle 4: Administer a re-test.

### **3.3 CYCLE 1: SET UP TEST ENVIRONMENT**

#### **3.3.1 Phase 1 Diagnosing**

As the purpose of the study was to establish the validity, reliability and fairness of item measurements attained by a Comprehensive Computer-Assisted Assessment Tool, its success depended heavily on the use of computers in conducting the study. The availability and reliability of technology are crucial components of the study. It was therefore important to establish what was required in terms of technology and human resources to assist in the study.

#### **3.3.2 Phase 2 Action Planning**

The two main role players on which the success of the research project would rely heavily were identified as the Centre for Institutional Development (CID) and the technical staff from the Information Technology Support Services department at the Vaal University of Technology (VUT). Technical assistance was required to uphold the reliability of the hardware needed. The CID department's role was to be responsible for the management of the assessment centre which is equipped with 100 computers dedicated for online assessment which were made available for the duration of the research project. A meeting was scheduled to discuss the technical and human resources and operational requirements needed for the research project.

### 3.3.3 Phase 3 Taking action

Representatives from the CID and the IT departments were asked to attend an initial meeting to engage in discussion with the researcher to establish what was required for the research. The following minimum hardware requirements were identified for the research project:

- one hundred personal computers with at least 128 MByte memory
- network connection among all of them with a connection speed of 100 MBs
- one personal computer, with a 1 GByte memory, to act as server
- a pointing device (mouse) at each computer as the program relies on the use of a mouse to interface.

Various requirements were identified to assist in the research project:

- A server had to be set up to host the CCAT program and database.
- The location of the server had to be accessible to the researcher.
- Connectivity was required from the server from various locations to update the question bank.
- All 100 computers had to be connected to the server via a local area network (LAN).
- One shared folder (100 MByte) was needed to install the program on the server with the necessary access, as well as read and write privileges from all computers in the centre.
- One shared folder was required with the necessary access, as well as read and write privileges from all computers in the centre where the database containing the results would be stored during the time that the students would be writing the test.

It was agreed that, to get the research project going, the primary focus would be on obtaining and implementing the required hardware. Members of the technical staff were informed of these decisions. Two weeks were allocated for implementing the above arrangements.

### **3.3.4 Phase 4 Evaluating**

Both hardware requirements and operational requirements were in place by the due date as decided on. Both folders were created and access rights through the Windows 2000 Server were set up correctly. The CCAT program was installed on the server as requested and no problems were encountered. Access to the server and the CCAT were tested by randomly selecting five of the 100 computers. Each of the five computers was used to access the server and to execute the CCAT on the server. The five selected computers tested correctly and logged on the first time the server was accessed.

### **3.3.5 Phase 5 Specifying learning**

The general findings from the first cycle were the following:

*Firstly*, a concern that arose from the current set-up was that it was not possible to simulate a real-life situation whereby all computers accessed the server simultaneously.

*Secondly*, it was also a reality that, although all the computers might have been working at the time, some might not work when the test was administered. It was logistically impractical to pre-inspect all aspects on every computer just before the test. Some might even break down during the test.

*Thirdly*, the log on procedure could be confusing to students. Although all five computers logged on, they used different procedures to log on. One way of logging on was by clicking on an icon on the desktop, and the other was to activate the log on from the start menu, and then to type in a TCP/IP address for the run command.

Apart from the three concerns mentioned, logistically everything seemed to be in place to support the research project. The concerns that had been identified were addressed as part of the next cycle.

## 3.4 CYCLE 2: CONDUCTING PILOT TEST

### 3.4.1 Phase 1 Diagnosing

The outcome of the previous cycle identified three main concerns:

- Would the network and server handle the traffic when all 100 computers logged on simultaneously?
- The reliability of the computers could only be tested under real conditions; if the computers broke down it would seriously jeopardise the outcome of the results obtained from the test. The test had to be conducted under ideal conditions as far as possible, to be able to consider the data valid.
- The log on procedure needed to be standardised.

### 3.4.2 Phase 2 Action Planning

After a meeting with technical expert (Ribeiro 2005) the following measures were put in place to address the above concerns:

The only time to test the network and server traffic handling capabilities would be when the pilot testing was done. Since it was a pilot test and if serious problems were encountered, they could be rectified in time and another pilot test could be conducted. The pilot test did not have any influence on the data required, as explained in 3.2.

The reliability of the computers could also only be tested under real conditions, and the pilot test would serve this purpose as well. Even if no computers were to fail during pilot testing, it would not guarantee that no computer might fail when the *test* was being administered. Everybody agreed on this. As the *test* and *re-test* group sample were expected to consist of fewer than 60 participants, this would give some leeway – if a student had problems with a computer, he/she could move to another computer. It was hoped that this would be an exception rather than the rule.

A standard log on procedure that was adopted, was that all computers would be set up so that the students would log on to the server by double clicking on an icon situated on the desktop.

Logistical arrangements for conducting the pilot test resulted in the following:

It was decided to select a group of first-year students who had not previously been exposed to online assessment, with the aim of observing whether they could cope with the technical skills required and to decide whether the user interface was sufficient for them to conduct the test. A group size of 100 was considered large enough to test the effect of a number of students accessing the server at once. A group of first-year students from the Faculty of Management Sciences was approached and in collaboration with an academic staff member from the faculty, a Vocational English test was prepared. These students were due to write the test manually in any case, so they were willing to write it online instead. A date and time were set for the pilot testing so as to allow time to prepare for the test.

### **3.4.3 Phase 3 Taking action**

Items for the test bank and the name list were received on time, and entered into the CCAT databases. On the day of the pilot test, members of the technical staff were available and all the computers were checked beforehand. The server was tested. Students were not allowed to enter the venue until everything was considered to be in working condition. Present to assist students were the educator from Vocational English, the researcher and a technical staff member.

### **3.4.4 Phase 4 Evaluating**

The students were given a brief explanation on how to connect to the server and log on to the CCAT with their student numbers. All 60 logged on simultaneously and then, unfortunately, the anticipated problems surfaced.

When the students started logging on to the server it became slower and slower until it eventually came to a standstill. Trying to shut down the server took a great deal of time because of the number of open files on the server. Eventually the server was restarted and all files were restored. The students were assisted to log on to the server in a sequential fashion, which was also time consuming. As soon as a student was connected to the server, he/she could log on to the CCAT with his/her student number and start the test.

### **3.4.5 Phase 5 Specifying learning**

Connecting all computers to the server posed a problem. More assistance during the writing of the test was recommended. Although students were not much skilled in the use of computers, they quickly grasped the concepts and all of them successfully completed the test. Only three students were not able to log on to the system as their names did not appear on the class lists that had been provided. An interview with Ramasodi (2006) regarding the server connection problem revealed that it was not a network problem as initially assumed, but rather the result of insufficient memory in the server. The technical staff undertook to investigate the problem and to upgrade the server if required.

## **3.5 CYCLE 3: ADMINISTERING THE TEST**

### **3.5.1 Phase 1 Diagnosing**

Apart from the technical problems experienced in the previous cycle, the possibility of plagiarism due to lack of invigilation was also raised by invigilators.

### **3.5.2 Phase 2 Action Planning**

It was decided that in future additional invigilators would be arranged when conducting the tests to collect data for statistical analysis, in order to ensure the highest level of data integrity. Furthermore, when students logged on to write the test, their photographs would be displayed on the computer monitor.



Although the memory of the server was upgraded, the researcher was advised to let the students log on to the server in groups of 10 with interval of one minute between groups. The technical team estimated that by following this procedure a maximum of 150 students would be able to complete a test at a certain time. This was more than what was required for the purpose of conducting the *test*.

### **3.5.3 Phase 3 Taking action**

To prevent the possibility of plagiarism two additional student assistants were appointed to assist with invigilation and to assist students with possible log on and other technical problems.

The technical logistics were in place and the Assessment Committee was requested to select a domain. Taking into consideration the study guide and the students' progress, Unit 1 from the subject Digital Systems 2 was selected. This unit focuses on Flip-Flops and related devices. Students would have completed this unit by the time that the *test* was to be taken. The following procedural arrangements were put in place:

- A date for the *test* was determined.
- A workshop was scheduled that provided guidelines on compiling good items.
- The duration of test was set to be 60 minutes.
- A number of 54 items would comprise the test; each item should have 4 distractors and only one correct answer per item.
- By using random sampling, a sample group was selected from two classes totalling 60 students.
- Class lists were obtained from the relevant educators and captured on the CCAT to enable students to log on and take the test.
- A due date was set for submitting the class lists.
- Relevant educators were requested to convey both the *test* date and the *re-test* date, venue and time to the students.
- The researcher informed the technical staff of the test dates.

The *test* was conducted under strict supervision.

Items were finalised by the Assessment Committee doing a pre-test item analysis as described in 2.7. The database was populated with the student records enrolled for the module to enable students to log on. The *test* was successfully administered to the students on the agreed date and time.

#### **3.5.4 Phase 4 Evaluating**

No problems were experienced in connecting to the server. Although all students did not log on to the CCAT simultaneously and therefore did not start writing the *test* at the same time, the CCAT only started timing the students after they had opened their individual tests. The Digital Systems 2 students were more computer literate and the use of the mouse to select the correct answer posed no problem to them.

#### **3.5.5 Phase 5 Specifying learning**

The *test* was considered to be very successful and the data was collected from the server after all students had completed the *test*. Technical staff gave support throughout the duration of the *test*. Minor technical problems occurred during the *test*. They were dealt with as they occurred. From observing the students as they were answering the items, it appeared as if their responses were satisfactory. However, the drawings had to be enlarged to ensure that they would be more legible. Data was taken from the server to do a preliminary analysis to eliminate or improve any incorrect items.

### **3.6 CYCLE 4: ADMINISTERING THE RE-TEST**

#### **3.6.1 Phase 1 Diagnosing**

Since the problems from the pilot test had been successfully resolved, this cycle was entered with much more confidence.

### **3.6.2 Phase 2 Action Planning**

Members of the technical staff were consulted the day before the administering of the *re-test* to confirm technical assistance and enquire about the state of the computers and server.

### **3.6.3 Phase 3 Taking action**

A new test was created on the server so that the data from the *test* and the *re-test* would be separate for analysis.

### **3.6.4 Phase 4 Evaluating**

The *re-test* was conducted with great success and the integrity of the data was ensured.

### **3.6.5 Phase 5 Specifying learning**

At a final meeting it was agreed that the pilot testing had been very valuable and had ensured the success of the progress of the research project.

## **3.7 CONCLUSION**

Results obtained from the *test* and *re-test* are subsequently analysed for reliability (Chapter 4) and validity (Chapter 5).