

## CHAPTER 6

### A LARGE-SCALE READING INTERVENTION PROGRAMME

#### 6.1 Introduction

At school, it is usually assumed that children learn to read. By the time they enter tertiary level education, they need to be able to read in order to learn. From interaction with students, and from the results obtained in Phases I and II of the reading intervention programme described in Chapter 5, it became clear that many Mathematics Access Module students entered their studies with severe reading difficulties. Phase I (2000) was an exploratory phase, and in Phase II (2001) a contact intervention programme for volunteer students was introduced. The results of Phases I and II suggested that reading remediation could be a means of improving performance in mathematics.

Results obtained from a face-to-face intervention programme involving a small group of volunteer students are not necessarily transferable to an entire group of dispersed students studying through the medium of print. This led to the introduction of Phase III of the reading intervention, and to the third and fourth cycles in the set of action research cycles focusing on the relationship between reading and mathematics.

Chapter 6 now describes Phase III, and the related research. The aim of this phase was to investigate whether and how a reading intervention programme could be extended to *all* Mathematics Access Module students, via official tuition channels. Phase III was started in 2001 and implemented in 2002. Two separate research cycles were related to this phase, following from the two cycles described in Chapter 5. One cycle related to the activities that took place in 2002, and the other to the activities of 2003.

In Chapter 6 we consider the reasons for choosing video as an intervention medium, and note some of the limitations regarding the use of video in the UNISA context. We then consider the methodology for the next two action research cycles in this set: methods used to obtain relevant background information, the design and production of the video and video workbook, the provision of related reading activities, and methods used to obtain information to evaluate the video and students' reading skills in 2002 (Video 1 and related reading activities) and 2003 (Video 2 and related reading activities). Finally an attempt was made to measure the impact of the

video by establishing whether the student cohorts in 2001 (no exposure to video) and 2002 (first exposure to video) were comparable, and to then consider the examination performance of the two groups (since all other parameters were unchanged as far as possible<sup>1</sup>). The results of the evaluations are discussed, leading to a further action research cycle.

## 6.2 Choice of intervention medium for Phase III

### 6.2.1 Reasons for using video as an educational medium

In order to implement a reading remediation strategy, it seemed illogical to give weak readers more to read. What options were then available? Bates (1990, in Thompson, 1994) developed a useful acronym on which to base media selection, namely ACTIONS. Table 6.1 reflects some ideas relevant to media selection, and arises from a Research in Distance Education (RIDE) workshop held in Australia in 1993 (Thompson, 1994).

**Table 6.1:**  
**Issues to consider in media selection**

<b>A</b>	<b>C</b>	<b>T</b>	<b>I</b>	<b>O</b>	<b>N</b>	<b>S</b>
Access	Choice	Tool	Interaction	Objectives	Need	Support services
Appropriate	Costs	Training	Integrated	Opportunity	Nurturing	Support structures
Audience	Community	Time	Institutional	Order	Negative	Solution
Accustomed	Communi- cation	Teaching function	Instruction	Organisation	Necessity	Simplicity
Alienation	Critical mass		Independent	Other	Networking	Suitability
Assumptions	Changes		Indulgence		Novelty	Students
Attitude	Complexity		Inter- dependency			Sincerity
Adaptability	Cross-cultural needs/factors		Imposition			Satisfaction
Administra- tion						Super- ficiality
						Saving
						Speed

<sup>1</sup>Note that both groups of students were at the same time exposed to the alternative assessment project, which will be discussed in Chapter 7.

Comparing the issues noted in the table with the characteristics of the target group led to the identification of certain relevant combinations. For example, it would be important for students to have *access* to the medium chosen; the *costs* involved should be taken into consideration so as not to exclude anyone; the *time* involved should not be too severe, given the time demands inherent in the existing study programme, and so on.

Rowntree (1997) provided a set of criteria for the evaluation of available media, among them the following. Do the desired learning objectives dictate certain media? Which media can be physically available to the students concerned? Will some media in particular motivate students more than others? Do students have the skills required to use the media? Which media are affordable (for students and the institution)?

There are many available media apart from print, such as audio cassettes, web-based teaching, video, and computer-mediated instruction. Taking into account considerations such as those mentioned above, video appeared to be the most applicable way of teaching reading to large numbers of dispersed students from a wide variety of socio-economic backgrounds, in a cost-effective way.

Video is recognised as an effective tool for reaching dispersed students, and for teaching those who have limited English language skills (Adams & Hamm, 2000). Furthermore, video as an educational medium is widely used in distance education (see for example Bates, 1991; Kulandai Swamy, 1995).

A further reason for considering video for Phase III was the fact that Video Supplemental Instruction (VSI) had been effectively used at the University of Port Elizabeth (UPE). The phrase 'Video Supplemental Instruction' was used to describe an intervention at the University of Missouri-Kansas City, which was then introduced at UPE with the assistance of the Delta Foundation (Koch & Snyders, 2001). VSI is based on student involvement, collaborative and active learning, and requires the use of interactive technology. Video can be used most effectively when the power of video technology and the skills of appropriately trained facilitators are combined to assist students in mastering difficult concepts and developing reasoning and learning skills (Delta Foundation, 2001). At UPE the learning benefits of the group using video material under the guidance of a non-subject specialist were equivalent to the benefits of those in contact sessions with the lecturer (Koch & Snyders, 2001).

One of the attractions of video is its potential interactivity. Interactive strategies are the techniques designed to encourage students to become involved and participate actively. While watching a video, students may want help, may want to ask for directions or clarification, or may want to review a certain section. The extent to which user-initiated requests have been anticipated and provided for determines the level of interactivity achieved (Bergman & Moore, 1990). Video has, however, not necessarily lived up to expectations, and although it is a potentially interactive medium, it is often used in a passive way (Ramsden, 1992). Video has the potential to be interactive, but it is recognised that students may need assistance in using the medium optimally.

Some of the more useful characteristics of video, and the implications these have for interactivity, are shown in Table 6.2 (Bates, 1990).

**Table 6.2:**  
**Video characteristics and their implications**

Characteristic	Implications
Pause, rewind, replay	Interaction with 'substitute' real life experience
Fast forward, search, stop/start	Pace adjustability, and option to repeat, enhances comprehension of visually dense material
Short sequences	Facilitates reflection, analysis, integration
Distinction between different sections	Enhances student control

### **6.2.2 Some limitations relating to the use of video in the UNISA context**

#### ***Production constraints***

Budgetary constraints imposed certain limitations on the video production process. The video was produced twice, the first time in 2001. Lessons learned in the process were applied in the production of the second video, in 2002. For convenience the videos will be referred to as Video 1 and Video 2. Video 1 suffered from a lack of expertise from all concerned (neither the lecturers, nor the audio-visual staff, nor the students who volunteered to assist, had been involved in a video of this nature before); furthermore, funds for a suitably trained video presenter were not available and the lecturers involved in writing the video script were required to take on this role.

#### ***Student use of video***

Although students are familiar with video, it cannot be assumed that they can make the switch from video as an entertainment medium, to video as an educational medium. The characteristics

noted in Table 6.2 suggest a number of responses in the viewer, but the activities necessary to take full advantage of video would need to be explained to students beforehand. It was felt that some additional clarification would also be necessary, such as providing upfront an outline of the video's purpose and main components, explaining how it should be used, relating video material to content with which students are already familiar, and providing opportunities for students to collaborate (in pairs or small groups) in discussions related to the video material after viewing it (Adams & Hamm, 2000).

Ideally a video should be used frequently and interactively, but in the knowledge that not all students would have easy and regular access to a video cassette player, the video was designed so that it was possible to watch it in one sitting. However, the introductory part of the video attempted to explain to students that this was not the ideal situation, and that they needed to be actively involved in the process, by stopping, restarting, rewinding, etc.

Since easy access to video cassette players could not be guaranteed for all students it was necessary to create a supplementary video workbook as well. The workbook attempted to explain in writing the reading activities that were discussed by the video presenters. In some cases graphics used in the video could also be reproduced for the workbook, but the two products were essentially different. The video was theoretically easier for students to follow, in that video footage could show movement and direction in a way that was not possible in the written version; the presenters' tone of voice and body language could also add an emphasis that was difficult to capture in a written format.

### ***Lack of facilitation***

In the UNISA context it was unlikely that students would have the benefit of facilitators to help them work through the video. However, the fact that the University of Port Elizabeth had used VSI effectively for similar students, to promote aspects of mathematical thinking and English language proficiency as well as actual content knowledge (Koch & Snyders, 2001), suggested that it was an experiment worth considering for Access Module students, in spite of the limitations inherent in the UNISA situation.

## **6.3 Methodology for Phase III**

This section describes the materials used and the procedures undertaken in the different action research cycles related to Phase III of the reading intervention. It also deals with student

perceptions of this phase. Phase III consisted of a preliminary evaluation of students' reading skills, the production of a video, and the design of reading activities to reinforce the video material. The first action research cycle relating to Phase III involved planning and evaluating the video (Video 1) and the reading activities implemented in 2002. The results of the research led to modifications in the video (resulting in the production of Video 2), and changes in the way reading skills were assessed. The second action research cycle relating to Phase III involved an evaluation of the modified video (Video 2) and the reading activities implemented in 2003.

### **6.3.1 Acquiring background information**

Before implementing a wider intervention programme it was important to consider some way in which the effectiveness of such a programme might be measured. It was thus necessary to determine, in advance of the intervention, whether the group of students who would be exposed to the intervention in 2002 was in any way comparable to the 2001 group, who had not been exposed to the intervention. If the groups could be shown to be comparable, and examination results improved after a year of study in which other aspects of the module were as far as possible unchanged, it would seem that an improvement in results could be attributed to the intervention. This was the particular focus in 2002, when the intervention was first introduced.

For a large group of dispersed students it was not possible to carry out the kind of pre-testing that had been undertaken during Phase II. However, it was nevertheless important to try to obtain information about all students regarding reading speed, comprehension, and different aspects of reading skill, before they were exposed to the intervention. It was also felt that some biographical information might be useful. An attempt made to obtain this information in 2002 proved to be of limited value. This led to a more concerted effort to obtain additional information in 2003. The information reflected the competence of students on entry, and complemented the growing amount of data available regarding the reading skills of Access Module students.

### **6.3.2 Producing video material**

For Phase III a video entitled 'Read to Learn Maths' was produced. The primary purpose of the video was to focus on reading skills situated in a mathematical context. This would have the added advantage of giving students an opportunity of hearing how mathematical language, notation and symbols are verbalised.

### ***Structure of the video***

The video was divided into eight segments, respectively called the Introduction, and Segments 1 to 7. At the end of each segment students were referred to a section in the video workbook containing activities so that they could practise the skills discussed in that segment. The answers for all the segments were grouped together at the end of the video workbook.

Based on the results of the face-to-face intervention programme it was decided that the different segments should incorporate the components that had formed the basis of the content used in the face-to-face sessions. Most of these are described in more detail in the previous chapter.

At the beginning of the video it was explained to students that they should take note of all instructions and use the pause/rewind function when a particular aspect was not clear. To promote interactivity the students were encouraged to stop the video at specific points, find the sections in the study guides that were being referred to, do activities, check answers (given in the back of the workbook) and watch parts of the video again where necessary. It was emphasised that students needed to be active participants in the process, and not merely view the video passively, as one would normally watch a video for entertainment. The video consisted of eight parts, referred to as the Introduction, and Segments 1 to 7, described below.

The ***Introduction*** included the following aspects:

- The *rationale* for the reading intervention programme and the use of video
- The *importance of reading*
- The *BICS/CALP* distinction
- *Vocabulary*: low-frequency words, mathematical words and academic words
- *Kinds of reading*: skimming, scanning, reading for meaning and study reading
- An outline of the *extensive reading activities* that should be undertaken in order to improve reading skills
- An *overview* of the different segments that would follow
- The passage of text used to assess reading speed and comprehension, as well as the comprehension questions, answers and a data sheet on which students could record their performance in the two tests. (Once Video 2 had been produced this was omitted, and similar activities were provided in an assignment.)

***Segment 1***: This segment dealt with *text structure*, particularly the macro structure of text, including text-previewing techniques, and the microstructure of text, namely the form and

function of various statement types, such as statements that ask questions, give instructions, or provide information.

**Segment 2:** *Anaphoric references* were explained and illustrated first using general texts that students would be familiar with, and then using mathematical texts from the Access Module study guides.

**Segment 3:** *Causal relations* (including conditional causal relations) were explained and illustrated, again first in a general way, and then in a mathematical context.

**Segment 4:** In this segment *contrastive relations* were explained. Once again examples were based on everyday text, and on mathematical text.

**Segment 5:** This segment dealt with using and interpreting *tables* and *geometric shapes*.

Video 1 did not include the section on geometric shapes, but by the time production of Video 2 was under way it had become evident that this was a necessary addition.

**Segment 6:** The focus of this segment was on understanding and using *graphs*, in a general sense rather than the specific mathematical graphs which were dealt with in the study guides. The activities given in the workbook to reinforce the video content were based on specific types of graphs that the students would encounter in their studies.

**Segment 7:** This segment was entitled '*Reading and problem solving*' and attempted to consolidate the aspects that had been dealt with in the previous segments, considering specifically the application of the PQ4R technique to two specific contexts, namely learning a new concept, and solving a problem.

### ***Modifications made for Video 2***

Video 2 was about two thirds of the length of the first. The revision of the video necessitated some restructuring of the video workbook. To make it easier to refer to sections in the study guide, in Video 2 students were told at the beginning of each segment what they would need during that segment, so that they could pause the video and fetch relevant study guides, pens and paper, etc., if necessary.

### ***The video workbook***

The reason for the creation of a workbook as well as a video has already been given. The video workbook has the same structure as video. The workbook also contains activities based on all the video segments, in which the reading strategies discussed can be applied to various mathematics texts. The added availability of the video workbook gives students the choice of using only the video (and referring to the workbook for the activities), only the video workbook, or both.



The first edition of the workbook (supplementary to Video 1) contained a diagnostic reading skill test which could be self-assessed. It was intended to help students identify aspects of reading that might need remediation. Once Video 2 had replaced Video 1 it was also no longer necessary to include the reading speed and comprehension test in the video workbook, as this became part of Assignment 1 in 2003.

Giving students with poor reading skills even more to read was somewhat self-defeating, but an alternative option had to be provided in the interests of equity and access. The video workbook, with the same title as the video, was Book 7<sup>2</sup> in the series of study guides for the Mathematics Access Module.

### **6.3.3 Related reading activities**

Students tend not to take activities seriously unless they are assessed in some way. For this reason three of the six assignments set for the Access Module in 2002 included some questions featuring activities similar to those given in the video workbook (related to Video 1). In 2003 only one of the assignments contained reading activities. In order to answer the assignment questions students would probably have needed to watch the video at least once, or to refer to the workbook.

Segment 6 of the video related to concepts that were dealt with in Book 4, and several of the workbook activities in that segment reflected the extent to which reading is an important aspect of interpreting graphs. It was possible for students to make sense of Segment 6 regardless of when they viewed that segment, but it was suggested that they would derive greater benefit if they viewed it while they were studying the relevant topics in Book 4.

## **6.4 Evaluations undertaken in the third and fourth research cycles**

The third cycle in this set related to determining the impact of the video, and was also based to some extent on measuring students' reading skills. Various methods were used to obtain the required information. Phase III of the reading intervention involved the production of two different videos, and thus spans a two-year period: 2002, in which Video 1 was used, and 2003, in which Video 2 was used. It was necessary to gather information about students' perception of the video, and its impact. Analysis of these results led to two consecutive action research cycles, in these two years.

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<sup>2</sup> With the restructuring of the Access Module study material in 2003, from 2004 this became Book 6.

### 6.4.1 Evaluating Video 1 and Video 2

Attempts were made to gather some information on the viewing practices of the students, and feedback regarding the content and its presentation. In 2002 a questionnaire was included in one of the tutorial letters that contained the assignment questions (see Appendix E). Students were asked to complete the questionnaire and return it with the assignment. Student feedback on the content of Video 1, together with the experience of those involved in making the video, was useful in identifying aspects that needed attention. Where possible these comments were taken into account in the production of Video 2.

Students were asked to rate the different segments of the video (from the Introduction through to Segment 7, and the workbook activities) on a scale from 1 to 4, where

1	represents	<i>not at all helpful</i>
2	represents	<i>helped a little</i>
3	represents	<i>helped quite a lot</i>
4	represents	<i>helped very much.</i>

The questionnaire also asked several yes/no questions regarding students' experiences of the video, for example probing whether they had used only the video, both the video and the workbook, or only the workbook; whether they had watched parts of the video more than once; whether they perceived that the video/video workbook had helped them 'read to learn' better. There were also two open-ended questions relating to what they considered to be the best and worst aspects of the video.

In 2003 students were again asked to complete a video questionnaire and return it, either with an assignment or separately.

### 6.4.2 Evaluating reading

Reading skills were determined in different ways over the three cycles (2000 to 2003), for obvious reasons. In 2000, the overall reading scores of *all* respondents (308) was determined towards the end of the year, by means of a questionnaire completed under a variety of conditions (the mean reading score was 63,8%, and no reading speed data was obtained). In 2001, different aspects of the reading skills of students in a volunteer group (33 students) were investigated before they were exposed to the reading intervention (the overall mean reading score in the pretest was 46% and the mean reading speed was 92 words per minute (wpm)). In 2002 and 2003

an attempt was made to assess some of these aspects in a diagnostic test that was voluntarily submitted by students (discussed below), also in advance of their exposure to the intervention.

Clearly the reading speed and comprehension data obtained under such diverse conditions could not be used as a basis of comparison of the different groups of students; neither could the data obtained in 2001 and 2002 be assumed to be an accurate reflection of the student group as a whole. The tests themselves were also not comparable. However, it was thought that the data would provide some insight into student reading skills at entry level.

A further reason for evaluating reading skills, both in the 'pre-test' and in the assessment of reading skills carried out via certain assignments (see 6.3.3), was to provide students with information on possible reading problems, to motivate them to make use of the video.

### ***Investigation of reading skills in 2002***

The third phase of the reading intervention was chiefly based on the results obtained from Phase II. In the face-to-face intervention programme it had been possible to use pre- and posttests to assess the impact of the intervention. Although desirable, it was not feasible to use such a pretest in Phase III. No information regarding reading attitudes and practices was thus obtained in 2002. However, the video workbook contained a data sheet on which students could record some of the required information. The only biographical information obtained related to the last level (Grades 9, 10, 11 or 12) and grade (Higher Grade, Standard Grade) of mathematics studied at school (since not all students had taken mathematics up to Grade 12) and the symbol achieved; as well as the grade on which English was studied and the symbol achieved.

An attempt was also made to assess reading speed and comprehension. In the video workbook, a passage of text was provided, as well as a data sheet on which students could record the required information. The students were instructed to record the time at which they began reading the passage, and the time at which they finished reading. A list of 12 comprehension questions was provided as well. Again, students were asked to record the time they began answering these questions, and the time they completed the questions. The answers to the comprehension questions were provided over the page, and obviously there was no way of determining whether students consulted these answers beforehand. The data sheet could be cut out of the workbook without damaging any other pages. The students were asked to submit the information, but there were no special incentives for doing so.

On the basis of the completed data sheets, for each student the total reading time was calculated (by finding the difference<sup>3</sup> between the starting and finishing times), and hence the reading speed in terms of words per minute (the number of words divided by the number of minutes). The time taken to answer all the questions was calculated in the same way, and the number of correct answers was recorded. So as not to prejudice the results, students were given information regarding acceptable reading speeds and comprehension levels later, in a separate tutorial letter. Students who performed below acceptable levels were strongly advised to take the video (Video 1) seriously.

As noted above, three of the six assignments contained reading questions. These were marked by the lecturer and by external markers<sup>4</sup>, according to the memorandum provided.

### ***Investigation of reading skills in 2003***

In 2003 the passage used to test reading speed, the subsequent comprehension test, and various questions assessing different aspects of reading were all incorporated into the first assignment. These questions were modified from the questions that had been included in the reading questions in the three assignments in 2002. (See Appendix F.) Table 6.3 summarises the components of the test.

**Table 6.3:**  
**Components of the diagnostic test included in the first assignment**

<b>Assignment section</b>	<b>Purpose</b>	<b>Score</b>
A: Part 1	Biographical information	25 credits for completion
A: Part 2	Reading speed Comprehension	No. of words per minute (wpm) 20
A: Part 3	Anaphors Vocabulary Sequencing; main/secondary ideas Causal & contrastive relations	17 12 16 9 } Total: 54
B	Mathematics (Book 2: Number Skills and Simple Algebra)	50 marks (25 credits)

<sup>3</sup>The calculations were checked by the markers, and corrected where necessary: in several cases students *added* the starting and finishing times.

<sup>4</sup> External markers were employed under contract to assist with the marking of Access Module assignments.

Section A of the assignment consisted of three parts. The aim of Part 1 was to obtain some biographical information, such as students' perceptions of their English reading ability, how often they needed to read sections in the study guides before answering assignment questions, specific reading problems, numbers of books in the home, etc. Part 2 assessed reading speed and comprehension. Students were asked to note their reading times, from which reading speed could be calculated, and to answer a comprehension test based on the passage, noting their start and finish times. They were not given the correct answers at that stage, so that a more accurate picture of comprehension scores could be determined. The maximum score for the comprehension was 20. Part 3 assessed different components of reading skill, namely anaphoric referencing, vocabulary (low-frequency words), main/secondary ideas and sequencing, and causal and contrastive relations, for which the maximum totals were 17, 12, 16, and 9, respectively, giving a total score of 54. All answers for Section A could be filled in on the questions, for example by circling an option, filling in missing words, etc. Students were asked to cut out these pages and submit them with Section B of the assignment, which related to the mathematical concepts taught in Book 2.

The majority of the assignments were marked by external markers. They also marked the section of the assignment dealing with reading. It was more streamlined than the reading sections in the 2002 assignments, and hence easier to ensure uniformity and objectivity in the marking. Since this section was part of a credit-bearing assignment, students had greater motivation to submit it. This assignment yielded a large amount of data pertaining to the reading skills of the 2003 students (1 363 students submitted the assignment, out of approximately 1 600 registered students).

## **6.5 Results of the video evaluations**

### **6.5.1 Video 1**

It seemed that students had not fully understood what was required in order for them to obtain optimal benefit from the video. Several responses to the open-ended questions highlighted the fact that some students had misunderstood the nature and purpose of the video. For example, in response to the question asking what the worst aspect of the video/workbook was, one student wrote

*To read things while you are not going to write about in the exams – as it is stated in Tutorial letter 110<sup>5</sup>. It was totally disgusting, maybe for your contributors it was just to read and know all about it. What a waste of time!*

This attitude was not altogether unexpected. Rowntree (1997) points out that in most educational contexts students are pressed for time, and will often only focus on aspects that will be assessed, since ‘as in most areas of life, it’s the squeaky wheel that gets the grease’ (p. 16).

There was no clarity regarding the number of students who used the video, or, for those who did, whether they used it effectively. Tutors had been asked to emphasise the potential benefits of the video. However, since their prime concern (and the students’, as well) was to try to deal with the subject content suggested for each session, it is unlikely that they mentioned the video often, or at all. Discussions with tutors underscored the difficulties they had in finding enough time in the tutorial sessions to deal with the mathematical problems of diverse students, and the fact that they felt pressurised to deal with concepts the students perceived to be relevant, often related to the next assignment.

Student feedback ( $n = 165$ ) from the video evaluation questionnaire provided valuable information, even though the response rate was relatively low (about 11,6%). The results appear in Table 6.4. In the last column the total number of positive responses (either 3 or 4) is converted to a percentage (shown in brackets) of the total number of responses.

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<sup>5</sup> In this tutorial letter students were told that the examination would focus on the mathematical content of their study guides, and that there would be no questions on reading activities.

**Table 6.4:**  
**Evaluation of Video 1**

<b>Video component</b>	<b>Rated 3 (helpful)</b>	<b>Rated 4 (very helpful)</b>	<b>Total number of 3 or 4 responses (approx %)</b>
Introduction	56	36	92 (60)
Segment 1 (text structure)	55	37	92 (60)
Segment 2 (anaphors)	62	62	104 (68)
Segment 3 (causal relations)	59	68	117 (76)
Segment 4 (contrastive rel.)	59	64	123 (80)
Segment 5 (tables)	64	44	108 (71)
Segment 6 (graphs)	59	55	114 (69)
Segment 7 (problems)	65	51	116 (70)
Workbook activities	61	72	133 (81)

In each category 40% or less of the respondents either found the segments relatively or totally unhelpful (responses of 1 or 2), or did not comment on the component. Students were assured of confidentiality, and informed that the video questionnaire was for research purposes only; however, as in the case with all such questionnaires, it is not possible to know whether students were providing ‘acceptable’ answers, particularly since student numbers were included.

Apart from the quantitative data regarding the ranking of the video segments, the yes/no and open-ended questions provided useful information. Not unexpectedly, students felt that the time demands of dealing with reading skills as well as with mathematical issues were excessive. Some comments were positive, for example *‘It is perfect. It has zero defect.’*, and *‘It helped me to pay attention to some of the thing I never took serious.’*

There were also negative remarks, some of which were useful in the video revision process. Some of the negative remarks related to the content (e.g. boring for L1 students, too difficult for L2 students, easy examples but difficult questions in activities); other comments related to the presenters, such as speaking too softly or being boring (one student wrote *‘It is too boarding, try to make it more interesting’*), and others related to structural and technical problems, such as difficulty with the stop/rewind instructions when trying to locate items, too great a focus on the presenters with correspondingly less focus on other aspects, page number references for the study guides or the video workbook were not given, there was occasionally a lack of text and graphic

clarity (font too small or not easy to read), the zoom option was too infrequently used, and the video was too long.

The students who completed the video questionnaire comprised approximately 20,3% of the students who obtained examination admission<sup>6</sup>, and approximately 11,7% of those who had registered. As the number of students who could be considered in terms of all possible variables (namely reading speed and comprehension, video feedback, submission of assignments, and final examination mark) was very low ( $n = 31$ ), statistical analysis of this group seemed unlikely to be helpful and was not undertaken.

### 6.5.2 Video 2

Student response to the questionnaire provided was very low (89 students, about 5,5% of registered students). Of the 89 students who responded, 20 indicated that they had not used either the video or the video workbook. (Of these, five were repeat students.) The results, in respect of the students who actually used the video and/or the workbook, are shown in Table 6.5.

**Table 6.5:**  
**Evaluation of Video 2**

<b>Video component</b>	<b>Rated 3 (helpful)</b>	<b>Rated 4 (very helpful)</b>	<b>Total number of 3 or 4 responses (approx %)</b>
Introduction	21	14	35 (51)
Segment 1 (text structure)	26	17	43 (62)
Segment 2 (anaphors)	26	26	52 (75)
Segment 3 (causal relations)	26	26	52 (75)
Segment 4 (contrastive rel.)	22	24	46 (67)
Segment 5 (tables)	24	20	44 (64)
Segment 6 (graphs)	28	18	46 (67)
Segment 7 (problems)	23	25	48 (70)
Workbook activities	27	24	51 (74)

The segment that was rated lowest was the Introduction (38% of the respondents rated it as either 1 or 2). The workbook activities obtained the least number of 1 or 2 scores: only a quarter of the respondents felt that the workbook activities were relatively or totally unhelpful.

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<sup>6</sup> Examination admission is discussed in Chapter 8.



The quantitative data regarding the ranking of the video segments was again complimented by yes/no and open-ended questions. The data showed that 39% of those who used the material used only the video workbook. The data also showed that 58% of the respondents used the video, and referred to the activities in the workbook; 43% watched parts of the video more than once, and 90% felt that the video/video workbook had helped them 'read to learn' more effectively.

The positive comments included references to specific segments that had been particularly helpful, as well as general comments regarding improved reading speed, improved vocabulary, and greater ability to keep track of a topic being discussed. Students also appreciated the links between the video segments and the topics dealt with in the study guides. On the negative side, there were again comments about the presenters being boring; however, there were fewer comments about technical aspects than in 2002. The increased workload brought about by having to study another book and take time to do additional activities was again seen as a problem. One student commented that students should be expected 'to watch it as an alternative after they finished the 6 prescribed books' (the comment again reflects a lack of understanding regarding the purpose of the video, but highlights the problem of finding additional time).

In spite of attempts in the Introduction to make the purpose of Video 2 even clearer, there were still students who did not understand that the video was not intended to deal with specific mathematical concepts, but with reading skills. Many students rated the material negatively for not providing greater assistance with specific mathematical topics, dealing with assignment questions, examination assistance, etc. There also seemed to be a misconception regarding the need for a video workbook as well as a video: one student felt that the pace of the video should be slower so that it would be possible to read the text in the workbook and simultaneously follow the discussion on the video, which was of course not the intention.

### **6.5.3 Results of the reading evaluations, 2002**

#### ***Reading speed and comprehension***

The number of students who submitted the reading speed and comprehension test was small ( $n = 78$ ), although it is possible that students completed the task but chose not to submit the results. It was not possible to determine whether the feedback students were given motivated them to take the video seriously. It was however abundantly clear that there was a need for them to do so. The mean reading speed was 128 wpm, ranging from as low as 14 wpm (this student obtained 11% in the final examination) to as high as 344 wpm (although this may have been an

inflated figure: this student only submitted two assignments, and obtained 39% in the examination). Of the 78 students who completed the data sheets, 28 (just over one third) took more than 6,5 minutes to read the article (which should not have taken even L2 students more than three to four minutes to read). It should not have taken more than about three minutes to answer the questions based on the passage; students reported times from two to 67 minutes for this activity. Twelve students took longer than 25 minutes. The mean score for the comprehension was approximately 8,5 out of 12 (approximately 71%, but the answers were readily available, in that they appeared in the workbook just after the passage on which the questions were based).

### *Assignment activities*

The three assignments which tested aspects of reading as well as mathematical concepts illustrated other problems associated with reading mathematics, and highlighted some of the findings in the project assignment, in which students demonstrated limited awareness of the need for answers to make sense (discussed later, in Chapter 7). In Chapter 7 the sense making was more related to everyday situations; in this chapter it relates to making sense when ideas are expressed in mathematical notation. In one of the assignment questions students were required to fill in the words that appear in the highlighted sections below:

By the vertical line test  $f$  is a function since **any vertical line** cuts the **graph** of  $f$  in **at most one place**.

Students gave the following responses (highlighted):

Student 2: By the vertical line test  $f$  is a function since  $f(x) > 0$  cuts the  $x$ -axis of  $f$  in **2 parts**.

Student 3: By the vertical line test  $f$  is a function since  $f(x)g(x) > 0$  cuts the  $x$ -axis of  $f$  in  **$-1 \leq x \leq 4$**

Student 5: By the vertical line test  $f$  is a function since **parabola cuts  $x$ -axis at  $-1, 2$  and  $4$**  cuts the **graph** of  $f$  in **three times**.

Student 6: By the vertical line test  $f$  is a function since  $g(x)$  cuts the centre of  $f$  in  $f(x)$ .

Student 7: By the vertical line test  $f$  is a function since **we have  $x > 0$  and  $x < 0$**  cuts the **value** of  $f$  in **two points**.

Student 8: By the vertical line test  $f$  is a function since **it intersects the graph twice** cuts the **graph** of  $f$  in **two places**.

Student 10: By the vertical line test  $f$  is a function since **it touches the graph** cuts the  $x$ -axis of  $f$  in **1 place**.

It is clear that Students 8 and 10 did not realise that the word ‘it’ was used ambiguously; Student 5 did not realise that ‘in’ made no sense in this context; Students 2 and 3 were not able (or did not attempt) to ‘read’ or ‘translate’ what they had written and hence did not realise that what they had written did not make sense (e.g. Student 2: ‘... the value of the function at  $x$  is greater than zero cuts the  $x$ -axis ...’); Student 6 seemed to have a problem with orientation: it was not clear what was meant by ‘centre’.

If the students had read in words what these statements really say, they would possibly have realised that most of them are illogical, meaningless or ambiguous. Should we assume that they *could not* translate from symbols to words, *did not try* to do so, *did not recognise* the lack of meaning if they did translate? Or did they not expect mathematics to make sense?

#### **6.5.4 Results of the reading evaluations, 2003**

##### ***Reading speed and comprehension***

The number of students who completed both the reading skill assessment and the comprehension test was much larger than in 2002 ( $n = 1\,371$ ). The marked assignments showed students how they had scored in the various reading components that were tested. The completed data sheets showed the reading time for each student, from which their individual reading speeds were calculated. The information regarding acceptable time frames within which to read the set passage and answer the questions, and explanations of answers to reading questions were sent to all students in a follow-up letter. Students were encouraged to take the video seriously if their performance was below acceptable levels.

Reading speed data is included with other relevant information in Table 6.7.

##### ***Biographical information***

Not all the biographical questions were analysed, for several reasons. There was insufficient time to analyse all the questions. It also appeared that students had misunderstood several questions. For example, the first five questions related to levels and grades of secondary mathematics and English, and superficial scanning of the questionnaires confirmed that in many cases students misread the first question, which related to the last grade of mathematics studied at school, and answered either Higher Grade or Standard Grade, instead of Grade 9, 10, etc. Question 6 (other languages studied at school) was interesting but not particularly informative in this context (and here too students misunderstood and listed many *subjects* other than languages). Question 7

related to previous qualifications, and students misinterpreted this to mean any course or subject they had ever attempted, formal or informal, whether they had passed or not. Question 9 suggested that most students did most of their reading in English, as a result of which Question 13 (dealing with students' perceptions of their reading skills in a language other than English) was largely irrelevant. Questions 14 and 15 related to dictionary usage, which had been important in Phase II, where it was possible to follow up students who were not assiduously compiling mini-dictionaries of their own. Question 19 (attitude to reading) was technically incorrect. One of the options involved two different aspects, which resulted in ambiguity: 'I really enjoy reading and I read a lot.'

Table 6.6 summarises the biographical information obtained from four specific questions (12, 16, 17 and 18). For each question the total number of students selecting options 1, 2, etc. is given, first as a number and then as a percentage of the total number of responses. Not all students answered all questions, and in Question 17 more than one response was permissible. The selected questions and the possible responses are given below.

Question 12: Students described their perceptions of their own reading ability by selecting one of the following five options:

1. I am a fast, highly-skilled reader and I seldom have problems understanding what I read.
2. I regard myself as an average reader – I understand most of what I read.
3. I read quite slowly but I usually understand most of what I read.
4. I read quite slowly and I often have problems understanding what I read.
5. I struggle to read in English. I read slowly and most of the time I do not really understand what I have read.

Question 16: Students were asked: When preparing for an assignment, how often do you read through the relevant sections of your study guides? The possible options were:

1. Once
2. 2 times
3. 3 – 4 times
4. 5 times or more

Question 17: The question asked students to select as many options as were applicable out of seven statements describing problems they experienced when they read their mathematics study guides and tutorial letters:

1. There are lots of words whose meaning I do not know.
2. There are several grammatical structures I have problems understanding.
3. It is not easy keeping track of the main idea or argument in a paragraph.
4. I forget what I have read by the time I get to the bottom of the page/end of a section.
5. I have problems understanding diagrams, tables and graphs.
6. I am a slow reader.
7. I do not really have any problems with my reading.

Question 18 probed the number of books in the home. Students could select one option from the following five:

1. None
2. About 10
3. More than 20 but less than 50
4. More than 50 but less than 100
5. More than 100

**Table 6.6:**  
**Responses to four biographical questions**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>Total</b>
<b>Q 12: n</b>	192	791	275	64	3	-	-	1 325
<b>%</b>	14,5	59,7	20,8	4,8	0,0			
<b>Q 16: n</b>	123	676	438	69	-	-	-	1 306
<b>%</b>	9,5	51,8	33,5	5,3				
<b>Q 17: n</b>	120	373	181	100	391	130	545	1 310*
<b>%</b>	9,2	28,5	13,8	7,6	29,8	9,9	41,6	
<b>Q 18: n</b>	48	341	417	220	273	-	-	1 299
<b>%</b>	3,7	26,3	32,1	16,9	21,0			

\* Multiple responses were permissible for Question 7, and the total is hence an estimate, being the average of the total number of responses for the other three questions.

Students often gave contradictory responses. For example, in Question 12 many students selected the first option, namely 'I am a fast, highly-skilled reader and I seldom have problems

understanding what I read' and yet reflected several contradictory characteristics. For example, two students (S1, S2<sup>7</sup>) who also selected 'I do not really have problems with my reading' in Question 17, took 17 minutes and 60 minutes, respectively, to read the passage. The first student obtained 34% in the examination and did not write the supplementary examination; the second did not write the examination, and claimed that s/he needed to read through the study material five times or more when preparing for an assignment. A student (S3) who claimed, in Question 17, that 'there are lots of words whose meaning I do not know', took 20 minutes to read the passage, obtained an assignment average of 33% out of seven assignments, and although he obtained examination admission<sup>8</sup> he did not write the examination. Another student who obtained 78% for English on Higher Grade in Grade 12, selected the option 'I forget what I have read by the time I get to the bottom of the page/end of a section' for Question 17. In the examination this student (S4) got 41%, and 43% in the supplementary examination. A student (S5) claimed to have taken 90 minutes to read the passage, and she obtained 14% in the examination. None of these responses answers warrant the selection of the first option for Question 12.

The following example possibly reflects a more realistic response. Student S6 selected options 3 for Questions 12 and 16, all options except option 7 for Question 17, took 15 minutes to read the passage and claimed to have no books in the home. This student did not write the examination.

The data highlight a number of issues. The study material for the Mathematics Access Module consisted of 7 study guides (including the Video Workbook). For students who read slowly, this constitutes an enormous workload: 38,8% of the students (those who selected options 3 or 4 in Question 16) needed to read the material three times or more in order to prepare for their assignments. The number of students who have fewer than 10 books in the home (29,9%) illustrates the limited opportunity for intellectual stimulation afforded by many home environments. On the whole the majority of the students regarded themselves as average readers (59,7% of the students selected option 2 for Question 12), and felt that they did not have any problems with their reading (41,6% of the students selected option 7 for Question 17). This does not agree with the reading speed data: the mean reading speed was approximately 115 wpm<sup>9</sup>, less than the accepted minimum of 160 wpm (see Table 6.7).

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<sup>7</sup> The labels S1, S2, etc., are used in place of the student numbers.

<sup>8</sup> Examination admission is discussed in Chapter 8.

<sup>9</sup> This figure would have been inflated by students who reported very high figures, such as 470 wpm and 300 wpm, which seemed unlikely. Experience with students suggests that figures at the lower end of the range are more credible.

### *Assignment activities*

The data pertaining to the reading section in Assignment 1 were recorded on data sheets, and later captured. The results in Phase II (see Chapter 5) suggested that students seemed to have particular difficulty with anaphors, vocabulary and logical relations. There was some doubt as to the value of the questions in the vocabulary section of Part 3 in Assignment 1 (it only contained 12 items, attempting to assess knowledge of both academic and technical words) and in the sequencing items (it seemed that students generally either scored full marks or no marks). It was thus decided to take into account only one of the individual reading components, namely anaphoric reference, and the overall reading score (i.e. the total for Part 3) for further analysis.

### *Analysis of results*

Table 6.7 gives the mean scores for anaphoric reference, overall reading ability, reading speed and comprehension, and for two mathematical variables, namely the assignment mark and examination mark, all given as percentages. A comparison of the numbers of students shows that not all students had scores in all categories.

**Table 6.7:**  
**Mean scores in reading and mathematical variables**

<b>Variable</b>	<b>Number</b>	<b>Mean (to one decimal)</b>
Overall reading score (%)	1 276	59,9
Reading speed (wpm)	1 371	114,7
Comprehension (%)	1 371	66,5
Anaphoric reference (%)	1 371	66,7
Assignment mean (%)	1 543	44,0
Final examination mark (%)	577	34,4

A picture emerges of students with reading scores below optimal levels, who were reading very slowly, and who performed poorly in their assignments and in their examinations.

Table 6.8 shows the relationships between different components of reading, the assignment mean and the final examination mark. Table 6.9 shows, in addition, the relationships between the different reading components.

**Table 6.8:**  
**Pearson correlations between components of reading skill,**  
**and performance in mathematics assignments and examination**

		Assignment mean	Examination mark
<b>Assignment mean</b>	Pearson corr Sig. (2-tailed) <i>n</i>	- . 1 543	0,525 0,000 577
<b>Exam mark</b>	Pearson corr Sig. (2-tailed) <i>n</i>	0,525 0,000 577	- . 577
<b>Comprehension</b>	Pearson corr Sig. (2-tailed) <i>n</i>	0,283 0,000 1 345	0,305** 0,000 551
<b>Anaphoric reference</b>	Pearson corr Sig. (2-tailed) <i>n</i>	0,293 0,000 1 345	0,383** 0,000 551
<b>Overall reading score</b>	Pearson corr Sig. (2-tailed) <i>n</i>	0,382 0,000 1 345	0,455** 0,000 551
<b>Reading speed</b>	Pearson corr Sig. (2-tailed) <i>n</i>	0,160 0,000 1 254	0,254** 0,000 520

**Table 6.9:**  
**Pearson correlations between reading skill components and mathematics performance**

		Assignment mean	Exam mark	Compre-hension	Anaphoric reference	Overall reading score	Reading speed
<b>Assign-ment mean</b>	Pearson corr Sig. (2-tailed) <i>n</i>	- . 1 543	0,525 0,000 577	0,283 0,000 1 345	0,293 0,000 1 345	0,382 0,000 1 345	0,160 0,000 1 254
<b>Exam mark</b>	Pearson corr Sig. (2-tailed) <i>n</i>	0,525 0,000 577	- . 577	0,305** 0,000 551	0,383** 0,000 551	0,455** 0,000 551	0,254** 0,000 520
<b>Compre-hension</b>	Pearson corr Sig. (2-tailed) <i>n</i>	0,283 0,000 1 345	0,305** 0,000 551	- . 1 371	0,427** 0,000 1 371	0,581** 0,000 1 371	0,277** 0,000 1 276
<b>Anaphor-ic ref.</b>	Pearson corr Sig. (2-tailed) <i>n</i>	0,293 0,000 1 345	0,383** 0,000 551	0,427** 0,000 1 371	- . 1 371	0,830** 0,000 1 371	0,229** 0,000 1 276
<b>Overall reading score</b>	Pearson corr Sig. (2-tailed) <i>n</i>	0,382 0,000 1 345	0,455** 0,000 551	0,581** 0,000 1 371	0,830** 0,000 1 371	- . 1 371	0,371** 0,000 1 276
<b>Reading speed</b>	Pearson corr Sig. (2-tailed) <i>n</i>	0,160 0,000 1 254	0,254** 0,000 520	0,277** 0,000 1 276	0,229** 0,000 1 276	0,371** 0,000 1 276	- . 1 276

\*\* Correlations highly significant at the 0,01 level



Since the section on anaphoric reference comprised almost one third of the total it could have been predicted that the correlation between anaphoric reference and overall reading score would be high, which it was (0,830). The other correlations greater than 0,5 are between the examination mark and the assignment mean (0,525), and between the overall reading score and comprehension (0,581). There was a moderate correlation between comprehension and anaphoric reference (0,427), and between the final examination mark and the overall reading score (0,455).

Once again it is important to note that the students who were exposed to Video 1 (2002) and Video 2 (2003) were also exposed to the project assignment as it was implemented in these two years. No attempt was made to try to consider separately the impact of the two distinct interventions on the pass rate.

The video and video workbook emphasise the fact that poor reading skills are likely to undermine mathematical performance. This may have persuaded students in 2003 to take the video more seriously, since the examination results improved<sup>10</sup>.

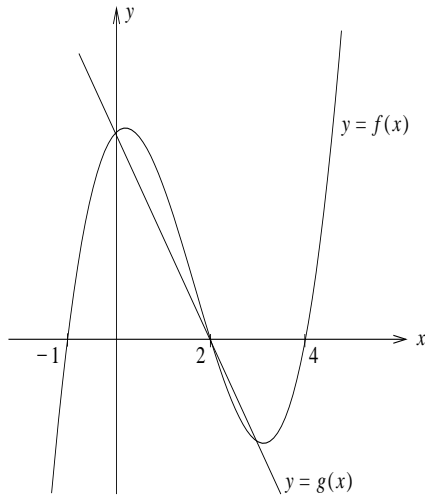
#### **6.5.5 Reading mathematical symbols**

In the video evaluation questionnaires in 2001 and 2002 many students commented that they found the section on graphs especially difficult. In the biographical section of the first assignment in 2003 many students (391) selected option 5 for Question 17 ('I have problems understanding diagrams, tables and graphs.').

During Phase II it had become evident that students have difficulty with prepositions, and this difficulty is possibly one of the factors contributing to the problems they have regarding the interpretation of graphs. In 2002 one of the questions in Assignment 4 dealt with the concepts of greater than, less than, above, below, etc. in relation to a generic graph, called the graph of some function  $f$ , shown on the next page.

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<sup>10</sup> Examination results are discussed in Chapter 8 (see Table 8.9).



The students needed to complete several statements by filling in the blank spaces below:

$$f(x)g(x) > 0 \quad \Leftrightarrow \quad \underline{\hspace{2cm}} \text{ and } \underline{\hspace{2cm}}$$

or

$$\underline{\hspace{2cm}} \text{ and } \underline{\hspace{2cm}}$$

$\Leftrightarrow$  the graph of  $f$  lies  $\underline{\hspace{2cm}}$  the  $x$ -axis  
and  
the graph of  $g$  lies  $\underline{\hspace{2cm}}$  the  $x$ -axis  
OR  
the graph of  $f$  lies  $\underline{\hspace{2cm}}$  the  $x$ -axis  
and  
the graph of  $g$  lies  $\underline{\hspace{2cm}}$  the  $x$ -axis

$$\Leftrightarrow \quad \underline{\hspace{1cm}} x \underline{\hspace{1cm}} \text{ or } \underline{\hspace{1cm}} x \underline{\hspace{1cm}}$$

The correct answers are highlighted below. Line numbers are given in parentheses at the end of each line, for reference purposes in the discussion that follows.

$$f(x)g(x) > 0 \Leftrightarrow f(x) > 0 \text{ and } g(x) > 0 \quad (1)$$

or

$$f(x) < 0 \text{ and } g(x) < 0 \quad (2)$$

$\Leftrightarrow$  the graph of  $f$  lies above the  $x$ -axis (3)

and

the graph of  $g$  lies above the  $x$ -axis (4)

OR

the graph of  $f$  lies below the  $x$ -axis (5)

and

the graph of  $g$  lies below the  $x$ -axis (6)

$\Leftrightarrow -1 < x < 2$  or  $2 < x < 4$ . (7)

The following examples reflect a sample of student responses. In each case the given answer appeared in the place of the highlighted sections shown above.

Student 1: In line 1:  $f(x)$  and  $g(x)$   
In line 2:  $g(x)$  and  $f(x)$   
In line 7: below  $x$  above or above  $x$  below

(In the first two lines the 'statements' are incomplete and meaningless; the third line has no meaning at all.)

Student 2: In line 7:  $0 < x < 0$  or  $0 > x > 0$   
(It is impossible for  $x$  to be simultaneously less than and greater than 0.)

Student 3: In line 3: below  
In line 4: on  
In line 5: above  
In line 6: on  
(In both cases this would imply that  $f(x)g(x) = 0$ .)

Student 4: In line 7:  $\geq x \leq$  or  $\leq x \geq$   
(This has no meaning.)

Student 5: In line 1:  $-1 < 0$  and  $2 > 0$   
In line 2:  $2 > 0$  and  $-1 < 0$   
In line 7:  $2 > 0 x > -1$  or  $x < 2 x > -1$

(While the statements in lines 1 and 2 are correct they bear no relation to the question. In line 7 two pairs of inequalities are provided, with no indication of the relationship between them, or their relationship to the given graphs.)

Student 6: In line 7:  $f(x) < x < g(x)$  or  $f(x) > x > g(x)$   
(Since  $f(x)$  represents a  $y$ -value this is clearly meaningless.)

Student 7: In line 1:  $f(x)$  and  $g(x)$   
In line 2: 6 and  $-1$   
In line 7:  $0 > x < 6$  or  $6 \geq x \geq -2$

(The 'statement' in line 1 is incomplete. Regarding line 2, the number 6 is not indicated anywhere on the graph, and it is not clear why the student has included this number. The first inequality in line 7 is again meaningless.)

The notation denoting inequality (i.e.  $>$ ,  $<$ ,  $\geq$  and  $\leq$ ), what it means, how it is read, and how it should be used, are clearly explained and illustrated both in the video and in Book 4, which deals with functions and graphs. The relationship between a graph lying above, on, or below the  $x$ -axis, and the corresponding values of  $x$ , was also clearly explained in the video and in the study material. Students wrote meaningless 'statements' such as these in spite of the provision of similar activities (with answers) in the video workbook and study guides.

In Chapter 5 it was pointed out that one of the problems with mathematics discourse is its symbolic nature. Students need to read the symbol (in the sense of decoding: for example they need to know that ' $>$ ' represents 'is greater than'); at the same time they need to interpret the symbol (i.e. they need to understand what 'is greater than' means). Interaction with students confirms that little attention is paid to this aspect of mathematics discourse at secondary level. Students have no qualms writing

$$\text{John} = a$$

when they are calculating John's age, or John's weight, for example. The results from the reading activities in the assignments further demonstrate that students will easily ignore the need to associate the symbol with what is signified.

## **6.6 The impact of the video on mathematics performance**

### **6.6.1 Methods used to compare results in 2001 (without video) and 2002 (with video)**

In order to determine whether the reading strategies (as taught by means of Video 1) had any impact on mathematics performance, it was planned that the third phase of the reading intervention project would involve a comparison of the examination results of the Access Module students in 2001, and in 2002. To find out whether such a comparison was at all meaningful, performance in Assignment 1 in 2001 and in 2002 was compared (with the two assignments kept as similar as possible). In this context 'similar' meant that the proportion of recall, procedural skill, application, higher order thinking skills, etc., was maintained in both assignments. In the previous chapter it was pointed out that in the group of students in the intervention programme, matriculation performance did not correlate in any significant way with the final examination result. For this reason it was decided not to take school-leaving results into account for the comparison: students have extremely diverse school backgrounds; furthermore, the impact of school results is affected by the number of years out of school and the influence of post-school experience.

The hypothesis was that if the student groups in 2001 and 2002 were comparable, then an improvement in examination performance could be attributed to an improvement in reading skills (provided all other parameters were unchanged as far as possible). To ensure that students in 2002 did not use the video before submitting Assignment 1 (thereby giving them a potential advantage over the 2001 students), the video was only distributed from the beginning of April, by which time students were expected to have posted the first assignment (due towards the end of April).

An additional factor that could have been taken into account was the number of repeat students. The *presence* of repeat students should, theoretically, have inflated the first assignment mean in both cases. The *proportion* of repeat students in 2001 and in 2002 may have been different, and this could have affected the conclusions. Initially this aspect was not taken into account.

A further factor which may have played a role was the exposure of the students to the project assignment (discussed in Chapter 7). However, students were exposed to this project in 2001 and in 2002. The two tasks involved in the project were the same in both years, apart from minor modifications; however students could choose to do only one of the tasks in 2001, whereas they were expected to do both in 2002. As is always the case, assignment submission is voluntary, and each year there were thus some students who chose not to undertake the project. The possible

influence of this project on the assessment of the impact of the video has not been considered. The comparability of the students (described below) would not have been specifically influenced by the project.

### 6.6.2 Comparability of 2001 and 2002 students

Table 6.10 summarises the relevant information.

**Table 6.10:**  
**Comparability of students in 2001 and 2002**

Year	Number registered	Assignment 1 mean	Number wrote	Number passed	Examination pass rate <sup>11</sup> (pass/wrote)
2001	1 279	57,2%	726	179	24,7%
2002	1 457	63,7%	700	104	14,9%

In 2002 there were 1 457 students who registered for the Access Module. After initial cancellations the number dropped to 1 425. The total number of students who passed (either in the year-end or supplementary examination) was 104. The actual pass rate (those who passed relative to those who wrote) was 14,9%.

In contrast, in 2001 there were 179 students who passed (either in the October or in the January examination), out of 1 279 registered students, giving a pass rate of almost 14%, roughly double that of 2002. In Chapter 5 it was pointed out that 11 of the 33 students in the face-to-face reading intervention passed. To what extent did the results of these students have an impact on the overall results of the group? If the results of these students are excluded, the pass rate becomes marginally lower (23,1%) but still considerably higher than the 2002 figure. Far from an improvement in results, there was a considerable decline in the pass rate. The main purpose of the video was to help students read better in order to learn mathematics more effectively. The examination results in 2002 suggest that this did not take place.

The mean mark for the first assignment in 2002 (out of 1 186 assignments marked) was 63,7% (with a standard deviation of 20,9); in 2001 the mean (out of 1 074 assignments marked) was 57,2% (with a standard deviation of 20,4). The difference between the two assignment means was

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<sup>11</sup> Discussed in Chapter 8.

6,5%, suggesting that the 2002 group may have actually been slightly ‘better’ than the 2001 group. All other parameters during 2002, other than a greater focus on reading skill in three of the seven assignments, were unchanged.

These results relate to the student group as a whole. What is the situation if we consider separately the results of the students who submitted or did not submit the video evaluation questionnaire? The only reason for doing so would be an assumption that those who submitted the questionnaire actually used the video, while those who did not submit the questionnaire possibly did not use it. Table 6.11 summarises this information.

**Table 6.11:**  
**Comparison of results of students who submitted/did not submit**  
**the video evaluation questionnaire**

	<b>Wrote exam</b> <i>(n = 700)</i>	<b>Number who</b> <b>passed</b> <i>(n = 104)</i>	<b>% passed/wrote</b>
<b>Questionnaire submitted</b> <i>(n = 165)</i>	132	23	17,4
<b>Questionnaire not submitted</b> <i>(n = 568)</i>	568	81	14,3

Of the 165 students who completed video questionnaires, 23 passed out of the 132 who wrote the examination, giving a pass rate of approximately 17,4%. The total number of passes was 104, and hence 81 of the students who passed did not use the video. Of the 700 who wrote the examination, 132 had submitted the video questionnaire, and hence 568 of the students who wrote the examination did not submit the questionnaire. A higher percentage of those who submitted the questionnaire passed, however, analysis of the data shows that this difference in performance is not statistically significant.

## **6.7 Discussion of the results**

### **6.7.1 Video**

In 2002 there were 166 students who submitted video evaluation questionnaires, equivalent to 20,4% of the students who obtained examination admission and 23,7% of the students who wrote the examination. In 2003, 89 students completed the video questionnaire, comprising approximately 13,7% of the students who obtained examination admission, and 15,6% of those who wrote. In 2003, since the video content was not directly assessed in any of the assignments, it was possible for students who did not recognise their need for remediation, or who misunderstood

the purpose of the video, to simply watch it early in the year and then ignore it for the rest of the year. If that was the case, it is unlikely that they would have taken the trouble to respond to the questionnaire. It is also possible that repeat students ignored the video.

In spite of poor examination results, it is probably not a good idea to conclude, after two years of using the video, that it is ineffective. It must be remembered that although in theory UNISA caters for adult distance learners, many of the students taking access modules are not academically mature, and have not yet developed the learning skills that enable them to function effectively in a distance-learning environment. Even in the best-case scenarios some contact support is seen as an essential element of distance learning. For example, particularly for foundation courses at the United Kingdom Open University (UKOU), some courses included compulsory attendance at summer schools held on the campuses of a variety of different universities (Harry, 1990). Other studies showed similar practices. In Pakistan, at the Allama Iqbal Open University, students were regularly in touch with trained tutors (one tutor to a group of about 30 students) (Satyanarayana & Koul, 1990). At Deakin University in Australia student advisors contacted students regularly (Moran, 1990). Contact is even more essential in the context of educational disadvantage.

Video 1 was used in 2002; in that year several assignments focused on aspects of the video and the results were extremely poor: the pass rate was 14,9%, and the attrition rate was approximately 50%. The video was revised, and Video 2 was used in 2003. In that year only one assignment dealt with reading issues; it was an attempt to gauge initial reading skills, and to encourage students with identified reading problems to take the video seriously. The pass rate was considerably higher: 27%, but the attrition rate was worse: about 65%. It is difficult to gauge to what extent either of these figures could have been influenced by student use of the video.

### **6.7.2 Additional reading activities**

'Reading' mathematics requires the integration of decoding and comprehension skills with respect to English words as well as mathematical symbols, aspects of visual literacy, and a level of meta-cognitive awareness where students will recognise the necessity of ensuring that they actively make sense of what they read. It did not appear that students were able to grasp the possible potential of the video to enhance these skills.



There could be many reasons for the apparent lack of enthusiasm for additional video material dealing with reading. None of the video components were specifically assessed in the examination, and discussions with students suggested that many simply ignored the material. The sheer volume of work was possibly greater than students could manage, and the video the easiest component to leave out.

In 2002 there was little evidence that the assignment questions, which were designed to reinforce the activities given after each video segment, and persuade students to take the workbook activities seriously, had the desired effect. There were large numbers of students, resulting in 941, 733 and 682 submissions for Assignments 2, 4 and 5, respectively<sup>12</sup>. It was thus necessary to involve external markers who had not been involved in the face-to-face intervention programme. It was also clear from the first round of marking (i.e. after the first assignment containing reading activities) that the markers would have benefited from additional training in order to understand better the nature of the reading difficulties exhibited by students. As a result of a limited grasp of the aspects of reading being investigated, mark allocation was very variable, dependent also on markers' time constraints and motivation. Marking questions such as these was extremely time-consuming. It was difficult to ensure a high standard of marking, and it is thus doubtful whether these sections of the assignments played a meaningful role. There thus seemed little point in keeping records of specific occurrences of reading problems, or trying to relate performance in the reading skill sections with performance in the mathematics sections.

In 2003 the moderate correlation between comprehension and anaphoric reference possibly suggests that competent anaphoric resolution may make it easier for students to keep track of what they read, and hence understand more clearly what they have read. The moderate correlation between the final examination mark and the overall reading score is nevertheless important in that it does reinforce the notion of a relationship between academic performance in mathematics and the ability to read efficiently. What the results cannot show is the extent to which weak reading skills may or may not have had an impact for students who dropped out during the course of the year.

In trying to gauge the impact of the video on mathematical performance, there is no guarantee that the two groups of students were comparable, even though performance in the first assignment in the two years suggests that they may have been. However, if they were in any way comparable,

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<sup>12</sup> These were the assignments that contained reading activities.

it would seem that the video intervention in 2002 (Video 1) did not have a marked effect on the pass rate. There is also no evidence to relate the improved pass rate in 2003 to Video 2.

## **6.8 Conclusion**

### **6.8.1 Potential use of video**

Phase I of the reading intervention identified aspects of reading that relate to constructing meaning in mathematics, and showed that students whose reading levels are below 60% appear to be academically at risk (thereby answering the first research question). Phase II suggested that an intervention programme has potential, but unless students can improve beyond the 60% threshold they are unlikely to be successful in studying mathematics in a distance-learning environment. The results of Phase III suggest that an intervention programme for distance learners may require facilitation for it to be effective. The third research question posed in the reading project was the following: Does explicit attention given to reading improve the reading ability and academic performance of mathematics students? In Phase II the answer to this question seemed to be related to the degree of support needed to raise the 'reading threshold' to at least a 60% level. In Phase III it is suggested that facilitation may be able to play a role. The qualified answer to the third research question thus forms a basis for further research.

It was clear from students' comments (in informal discussions, and from the video evaluation questionnaires) that those who were strongly in need of reading remediation were often unlikely to have the time to attend to reading problems while simultaneously coping with the mathematical content. The video was specifically designed to focus on the reading skills that are needed to make sense of the complex language of mathematics, but it was being used *while* students were studying the mathematics. It seems possible that the use of video per se may be beneficial, but using it in conjunction with, rather than prior to, learning the mathematical content of the module may have undermined its potential.

### **6.8.2 Pre-registration diagnostic assessment of reading skills**

From Chapter 5 it appears that many potential Access Module students need to upgrade their academic reading skills *before* studying mathematics. The data discussed in this chapter reinforces the view that students with impaired reading ability should first be assisted to upgrade their reading skills before embarking their studies. The results obtained suggest that students with reading difficulties are unlikely to be able to upgrade their reading skills and *simultaneously* cope with their studies. They may be more successful if problems are diagnosed and remedial activities

undertaken *before* they begin studying the mathematical content of the module. Fundamental to any intervention is that students need to have reached an academic ‘threshold’ (in terms of academic skills, meta-cognitive skills, reading ability, language proficiency, and general knowledge) from which further learning can take place.

## **6.9 Summary**

This chapter has focused on the design, production and use of video to address the problem of limited reading skills of Mathematics Access Module students on a large scale. The process was carried out twice, and resulted in the production of two videos. Associated activities involved the design and production of a supplementary workbook, and the provision of a number of reading activities, used to evaluate reading skills, and to reinforce the reading skills taught in the video. Research into the different activities that were involved led to modifications and improvements, with respect to both the video and the related reading activities. Phase III of the reading intervention incorporated two action research cycles. Analysis of the impact of Video 1 and the related reading activities led to adaptations and modifications which resulted in the second cycle, which involved Video 2 and other reading activities. Furthermore, the chapter describes an attempt that was made to measure the impact of the video, by investigating possible comparability of two student cohorts (pre and post video) and considering the examination performance of the two cohorts.

The data obtained during the implementation and evaluation of the video and related reading activities, as well as the data obtained over the three years of the alternative assessment project (which will be described in the next chapter), together culminated in the final cycle in the action research process, which will be described in Chapter 8.