Chapter 4 Results and Discussion

Chapter guide

4. Results and Discussion

In this chapter, the data collection methods are grouped together rather than the research questions. This style was followed as many interesting observations and annotations would be lost if the question and answer format was strictly adhered to. These observations and annotations, which are scattered throughout the chapter, are important in building a profile of the students on the SCI 152 course.

In order to guide the reader as to which sections were primarily used to formulate answers to the research questions, the data collection matrix given in table 1.8.2 is repeated below, with the relevant sections in this chapter included in the table.

Table 4.1 *Data collection matrix for the research questions posed in Table 1.5.1, showing the sections in this chapter in which the questions are answered.*

	Course results	Questionnaire	Web-server logs	Assignment hand-in date	Observation & discussion
1. How did the students cope with the Web as a medium for lesson presentation?	4.1 4.3	4.3 4.4	4.2	4.4	4.1 4.2 4.4 4.5 4.6
• face-to-face contact	4.1.D 4.3.B	4.3.B 4.3.C			4.1.B 4.1.D
• sufficient information in Web pages	4.1	4.3.D			4.6
• successful time management strategies	4.1.A 4.1.B 4.1.C	4.3.E 4.4		4.4	4.1 4.4 4.5
• use of study-aid pages		4.3.D 4.3.E	4.2		4.2.B 4.2.E
2. What were students' attitudes towards Web-delivery of course material?	4.1	4.3		4.4	4.1 4.3
3. How did the digital divide affect the students' performance?	4.1 4.3 4.5	4.3		4.4 4.5	4.3 4.5
• prior exposure to computers	4.3.A	4.3.A			4.3.A 4.5
• successful completion of a solo computer-based project	4.1.C			4.4	4.1.C 4.5
• open internet access	4.5			4.5	4.5
4. Was there any difference in the ability of Ra and Rd students to complete the course successfully?	4.1	4.3 4.4			4.1 4.3 4.4

It can be seen from the table that there is much duplication in the methods which answer the different questions. The links between the various methods and answers will be discussed in chapter 5.

In this chapter, the distinction between Resource advantaged (Ra) and Resource disadvantaged (Rd) students set out in table 1.4.2 is used in discussing the results of the students on the SCI 152 course. This difference is examined to determine the effect of the different school systems in South Africa on a student's ability to deal with information presented via an electronic medium rather than in a classroom.

4.1 Comparison of assessment results

4.1.A Examinations

As the SCI 152 course is a credit-bearing course at the University of Pretoria, students have to be assessed by means of a moderated examination. The results of the examinations since 1997 can be compared because the course content has remained fairly constant since then.

Table 4.1.a.1 *The major differences between the Web-based course and the paper-based course.*

Paper based (1997-1999)	Web based (2000 & 2001)
Year course, with the June examination acting as a semester test.	Semester course, with the June examination finalising the course.
An "Academic Proficiency" component was included as part of the course and in the examination.	The "Computer Literacy and Problem Solving" course became a module on its own, separate from "Academic Proficiency".
Classroom based with assignments given weekly as paper handouts.	Web-based information delivery for the "Problem Solving" component of the course.
The course project could be completed within the first week of the second semester (after the June examination).	The course project had to be completed **before** the June examination.

In the data presented below, the results of the Academic Proficiency questions, from the June examination of the paper-based course, have been removed to make a more meaningful comparison. The numerical values used in drawing up these graphs are given in Appendix 1.

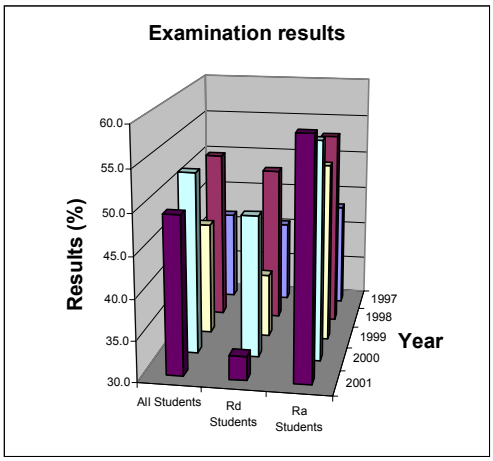


Figure 4.1.a.1 *The class averages for the examinations from 1997 to 2001.*

The apparent skewing of the data shown in Figure 4.1.a.1 towards better results for the Ra students from 1998 is due to the course becoming compulsory for BSecEd(Sci) students (secondary school science student teachers). These students were often in their second academic year, all in the Ra grouping and often had better University entrance prerequisites than the students for whom the course had originally been developed. The huge skewing seen towards the Ra students in 2001 is due to the presence of six Financial Mathematics students[1] in addition to the BSecEd(Sci) students. Five of these Financial Mathematics students achieved 80% or more for their SCI 152 examination. Their effect on the average mark of the class can be seen in the frequency distribution graph (Figure 4.1.a.2).

[1] The Financial Mathematics students took the course as the management of the University of Pretoria had decided that, from the 2001 academic year, all students would have to complete a computer literacy course. The SCI 152 module fulfils the requirements for the generic computer literacy modules CIL 171 and CIL 172. The Financial Mathematics students who took the SCI 152 course felt that it would pose more of a challenge than the generic courses.

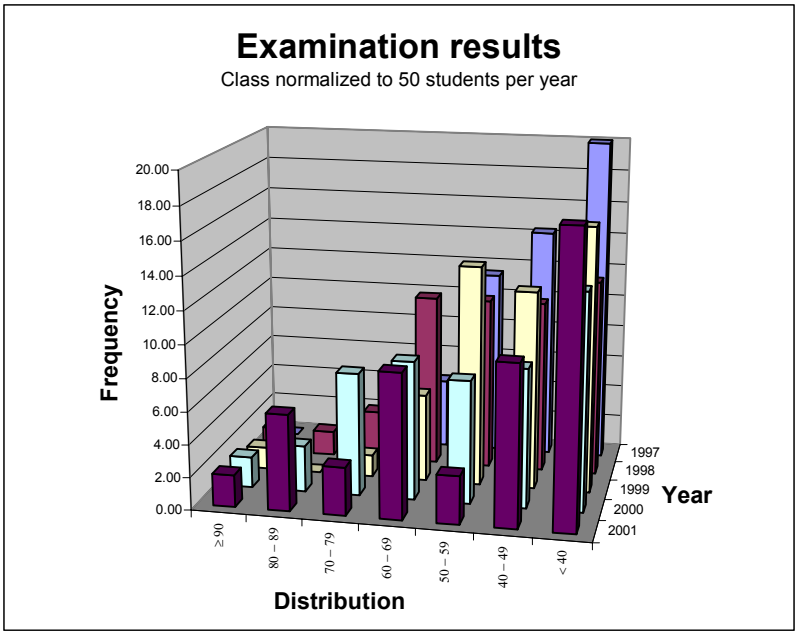


Figure 4.1.a.2 *The frequency-distribution of the students' examination marks. The class size for each year has been normalized to 50 students.*

Figure 4.1.a.2 shows a higher number of students in the grouping with more than 70% for the Web-based course (2000 and 2001) than the paper-based course (1997 to 1999). The number of students failing appears to have remained constant for both the Web- and paper-based courses (except for 1997, which was higher). One very pleasing point was that in 2000 a Rd student achieved more than 90% in the examination for the first time. In 2001, two Financial Mathematics students achieved more than 90% for the examination.

To obtain a better idea of how the Web-based course results compare with the paper-based course, the results shown in Figure 4.1.a.1 were averaged across the years 1997-1999 for the paper-based course and across 2000 and 2001 for the Web-based course. Although statistical significance cannot be claimed, the results provide good support for the trends shown. These results are shown in Table 4.1.a.2.

Table 4.1.a.2 *The difference in examination results for the Web-based and the paper-based courses.*

	Paper-based (number of students)	**Web-based (number of students)**	**Move**
All students	45.5% (105)	51.0% (104)	→ 5.5%
Rd students	42.6% (64)	41.3% (44)	← 1.3%
Ra students	50.0% (41)	58.1% (60)	→ 8.1%

This table shows that, overall, the results of the students doing the Web-based course were better than those doing the paper-based course. In the 2000 and 2001 examinations the Rd students fared marginally more poorly, while the Ra students fared appreciably better than the students who had done the paper-based course.

By doing a similar analysis on the data making up the frequency distribution graph in Figure 4.1.a.2, one can assess the effect of the Web-based course on the pass rate.

Table 4.1.a.3 *The difference in pass rate for the Web-based and the paper-based courses.*

	Paper-based %pass (%fail)	**Web-based %pass (%fail)**	**Move**
All students	42.9% (57.1%)	51.0% (49.0%)	→ 8.1%
Rd students	35.9% (64.1%)	31.8% (68.2%)	← 4.1%
Ra students	53.7% (46.3%)	65.0% (35.0%)	→ 11.3%

From Table 4.1.a.3 it can be seen that the Web-based course showed an overall improvement of 8.1% in the number of students passing their examination. However, 4.1% fewer Rd students passed the Web-based course than the paper-based course, whereas 11.3% more Ra students passed the Web-based course. This suggests that the Ra students were more at ease with the method of lesson delivery in the Web-based course than their Rd counterparts. However, as mentioned earlier, the skewing of results of the Ra students is more than likely due to the presence of the mathematically more capable Financial Mathematics students on the course in 2001.

To show the effect of the six Financial Mathematics students on the course averages, the data making up Table 4.1.a.3 has been recalculated without taking these students' results into account.

Table 4.1.a.4 *The difference in pass rate for the Web-based and the paper-based courses without the results of the Financial Mathematics students.*

	Paper-based %pass (%fail)	**Web-based %pass (%fail)**	**Move**
All students	42.9% (57.1%)	48.0% (52.0%)	→ 5.1%
Rd students	35.9% (64.1%)	31.8% (68.2%)	← 4.1%
Ra students	53.7% (46.3%)	61.1% (38.9%)	→ 7.4%

Although the table shows that the Ra students on the Web-based course still did better than their counterparts on the paper-based course, the difference is not nearly as dramatic after the exclusion of the Financial Mathematics students.

From the "no significant difference" phenomenon (Russell, 2002), one may have expected the results between the paper-based and Web-based courses to have been closer. However, the question should be asked as to **why** should there be no significant difference between assessment results of technology-based teaching and classroom-based teaching. The author feels, that regardless of how the information is presented, students have preconceived notions as to

- which information is relevant, and
- how to interpret this information.

These preconceived notions are based on their expectations as to what will be required in the assessment phase of the subject matter (see also Laurillard, 1993:211). [Draper (2001b) discusses similar matters under the headings "shallow learning" and "the hidden curriculum".] These expectations are a direct result of the coaching techniques used by teachers in preparing students for the assessment phase. As the assessment methods have not changed, one can hardly expect a change in results between classroom-based teaching and technology-based teaching.

4.1.B Assignments

From the preceding section, it appears that the students had gained sufficient knowledge from the information presented in the Web pages to fare better than the equivalent classroom/paper-based courses in their examinations. In order to assess more fully the students' interaction with the information on the Web pages, a comparison was made between the marks that had been allocated for the assignments over the years in which the study has run. With the paper-based course, the assignments were handed out after each lecture and these had to be completed within two days after the lecture. In the case of the Web-based course, the students had access to all the assignments and lecture notes from the beginning of the course. However, a weekly deadline for completing the assignments was still maintained.

Although the content of the assignments falls outside the scope of this document, it is nevertheless useful to be aware of this content in analysing the results of the assignments. In the following table (a shortened form of table 3.2.c.1), assignment numbers and the corresponding assignment titles are given. These titles will give the reader a quick review of the content of the assignments (the complete content is given on the enclosed CD under the directory "SCI152 Web pages").

Table 4.1.b.1 *SCI 152 assignments*

Assignment no.	Assignment title
1	Introduction to Logo
2	Using colour & Regular polygons
3	Using REPEAT & Rotating regular figures
4	"Circles"
5	Procedures
6	Procedures and variables

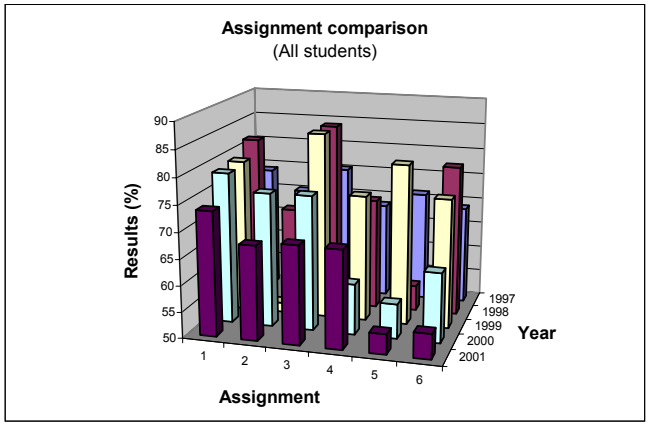


Figure 4.1.b.1 *Class averages for each of the assignments.*

Figure 4.1.b.1 shows little difference in the results over the years for the first three assignments (apart from assignment 2 in 1999). However, on the Web-based course, the results obtained for the fourth, fifth and sixth assignments were markedly worse than in preceding years. Another point of interest is that, in spite of faring extremely badly in their examinations, the 1997 group did not fare too differently to subsequent groups as far as their assignment results were concerned. Figures 4.1.b.2 and 4.1.b.3, depict a comparison of the assignment results for the Rd and Ra groups.

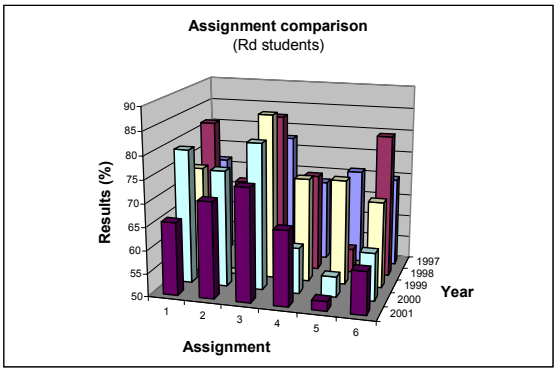


Figure 4.1.b.2 *Class averages for Rd students.*

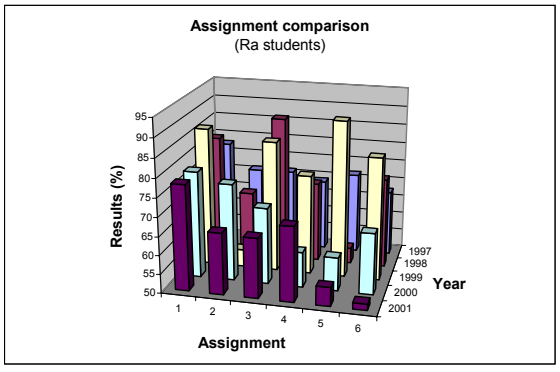


Figure 4.1.b.3 *Class averages for Ra students.*

From Figures 4.1.b.2 and 4.1.b.3, it can be seen that there appears to be very little difference in the results obtained by Rd and Ra students in most of the assignments across the years. In the Web-based course, Rd students did better in assignments 2, 3 and 6 than their Ra counterparts, whereas these students did better in the rest of the assignments. In the opinion of the author, the concepts addressed in assignments 4 to 6 were the most difficult to understand and master. In the following table, the assignment results for the paper-based and the Web-based courses are compared.

Table 4.1.b.2 *Average assignment results for the paper- and Web-based courses.*

Assignment	Paper-based (hand-ins)	Web-based (hand-ins)	Move
1	78.3% (107)	76.3% (103)	← 2.0%
2	63.2% (106)	72.0% (102)	→ 8.8%
3	81.9% (106)	72.4% (104)	← 9.5%
4	71.2% (106)	64.1% (102)	← 7.1%
5	69.3% (105)	55.2% (98)	← 14.1%
6	73.9% (104)	59.4% (92)	← 14.5%
Average	73.0%	66.6%	← 6.4%

From the above table it can be seen that, apart from assignment 2, the students on the paper-based course achieved better results for their assignments. This is a rather curious finding in the light of the examination results discussed in the previous section, where the students on the Web-based course had achieved higher results. The poorer results of the students on the Web-based course (especially in assignments 5 and 6) probably means that the information in the Web pages was insufficient to meet these students' requirements. Another possibility for the poorer assignment results is that student activity was not mainly confined to the practical period as had been the case with the paper-based course. Students had the freedom to work if and when they chose. This removed an important source of information from the group as a whole: communal activity. It became more difficult for students to rely on their peers for information and solutions to the problems. A phrase for this was coined by a tutor on the course from 1995-1998, namely, the "communal brain" (Horak, 1996). This communal brain frustrated the tutors as it led to widespread duplication of solutions. This is one of the reasons why the author is against groupwork. One is never sure of the origins of the insights presented. (According to Tam (2000), collaboration by students in solving problems is one of the tenets of constructivism.) It is also one of the reasons why the author is against examination exemption for students with high semester marks - one can never be certain whether their own work led to the results

achieved. However, the independent activity of the students on the Web-based course was more than likely the main reason for their ability to solve the problems set in the examination, thereby accounting for their better results than those of students on the paper-based course.

Another point evident from the Table 4.1.b.2 is that the students on the paper-based course consistently handed in their assignments, whereas those on the Web-based course became more lax (recall that 105 students on the paper-based course and 104 students on the Web-based course wrote the examinations). One must assume that this laxity may be attributed to poor time management practises by the students. (See Section 4.4 *Time management*.)

4.1.C Church project

In order to show the students' ability to work independently, they were each required to produce a project program which drew a church. This project was worth 15% of the final grade for the SCI 152 course (whereas the examination was worth 40% of the final grade). As mentioned in Table 4.1.a.1, one major difference between the paper-based and Web-based courses was in this project: with the paper-based course, the students were allowed one week in the second semester to complete their project (*i.e.* after the examination), whereas the students on the Web-based course had to complete their projects within the first semester (*i.e.* before the examination).

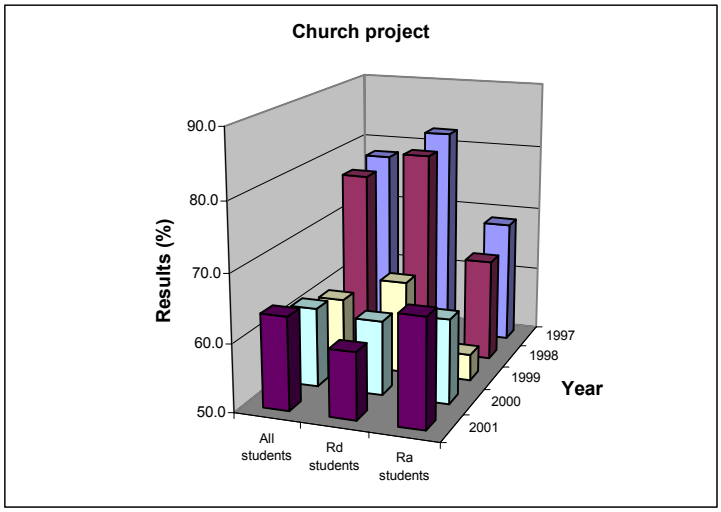


Figure 4.1.c.1 *Class averages for the church project.*

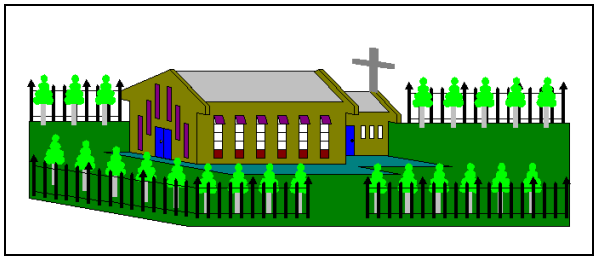
The figure shows that the Rd students in 1997 and 1998 put an exceptional effort into their projects.

Table 4.1.c.1 *Average results for the church project for the paper- and Web-based courses.*

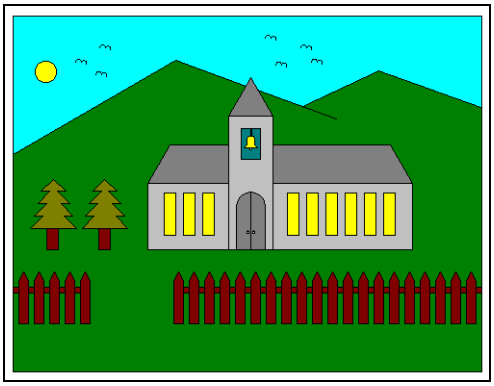
	Paper-based (hand-ins)	**Web-based (hand-ins)**	**Move**
All students	71.5% (92)	62.7% (104)	← 8.8%
Rd students	76.0% (63)	60.5% (44)	← 15.5%
Ra students	61.7% (29)	64.4% (60)	→ 2.6%

As can be seen from table 4.1.c.1, there was an extraordinary downward move in the results of the Rd students from the paper-based course to the Web-based course. The author feels that this difference is attributable to an attitude change on the part of the Rd students rather than to the extra time allowed to complete the project on the paper-based course (see table 4.1.a.1). This is evident from the fairly consistent results obtained by the Ra group over both the paper-based and the Web-based courses for their projects. The Rd students' results on the Web-based course fell more into line with that of the Ra students whose attitude was to complete the project with a minimum of effort.

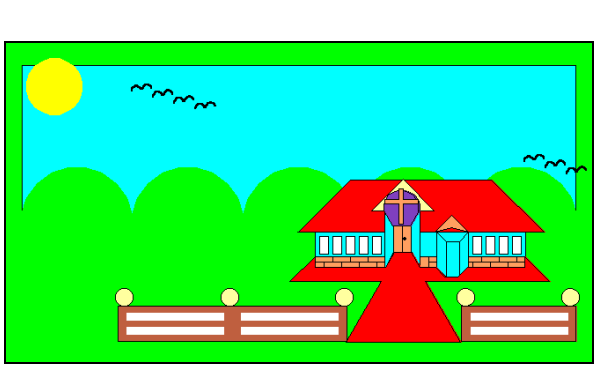
A further interesting point from the table is that all the students on the Web-based course who wrote the examination completed their church project. This is in stark contrast with the assignment completions shown in Table 4.1.b.2. These students evidently felt that completing the church project was more important than completing their assignments. The opposite is true for the students on the paper-based course. Although these students completed all the assignments, many (most in the Ra grouping) decided that the church project was irrelevant. In spite of this, many excellent programs were produced. Some of the best churches are shown in the following figures.



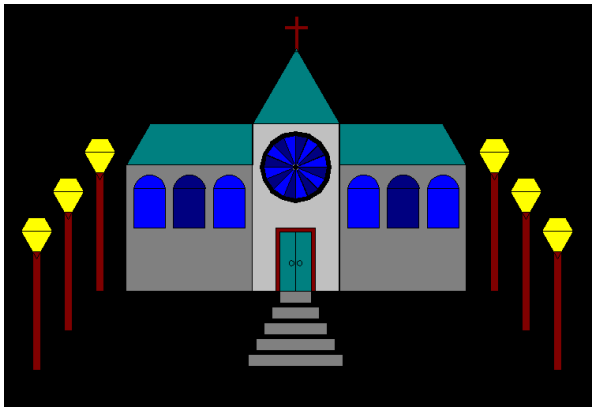
1997



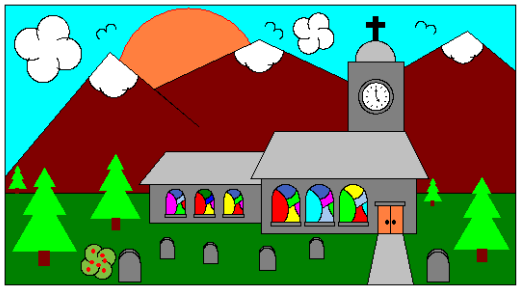
1998



1999



2000



2001

Figure 4.1.c.2. *A sample of churches produced by students on the paper-based and Web-based courses.*

4.1.D Supplementary examinations

The regulations of the University of Pretoria allow students who have done well during the semester, and who have nevertheless failed their examination, a chance to write a supplementary examination to boost their marks to 50%. In 2001, eleven students were given the opportunity to write the supplementary examination (nine Rd and two Ra students). Of these students, five (four Rd and one Ra) approached the author for assistance prior to the supplementary examination. The author was shocked to find, that these students had only a vague idea as to what a Logo procedure was, and no idea whatsoever about manipulating variables within a procedure. These concepts should have been mastered in the last two assignments (see Table 4.1.b.1). To deal with this shortcoming, the author discussed, in detail, an approach to solving the examination problem (which they had failed) as well as a similar problem taken from assignment 5. On seeing the logic behind this approach, the Rd students, of their own accord, tried several variations to these problems. The Ra student only made a half-hearted attempt at doing the examination problem. In the supplementary examination, three of the four Rd students achieved full marks, the third obtained almost 90% while the Ra student got 56%. The rest

of the students again failed dismally. The author feels that it goes without saying that the students who failed, both the examination and the supplementary examination, had the same lack of knowledge as did the students discussed earlier.

The author learned a valuable lesson from his interaction with these students. For a student to learn problem solving skills he or she needs to **see** the process in action in order to be able to **emulate** it. By talking and asking questions while simultaneously doing the problem the teacher definitely gives the student more insight into the problem solving process than the student would derive from a static medium, such as a book or a Web page (see also Tam, 2000). Of course, a major advantage of working with individuals or small groups is that the students feel more at ease and less afraid to ask questions of the teacher. Unfortunately, with the asynchronous nature of Web-based learning, the student is not always able to ask a question at the right moment. Also, he or she has no way of learning what is the **right question** to ask, without observing a role model. The author feels that regardless of how sophisticated computer software may be, it can never be a role model.

4.2 Analysis of student activity on the Web pages

The Web server software used, Apache, generates a detailed log file of all files downloaded as each page is accessed. The data includes

- the IP address of the computer requesting the file,
- the date and the time of the request, and
- the name of the file being downloaded.

There are, however, two unfortunate omissions to the data in the log files:

- although an IP address signifies a specific computer, there is no way of knowing who is at the computer and
- if the browser's back button is used, the browser uses information retained in its own cache and does not request that page from the Web server, which means that no record is kept of that particular request.

From July 2000, the Web server was also used to host the pages of the Gold Fields Computer Centre, the personal pages of several staff members as well as test pages for external work done by staff members. This had the unfortunate side effect of generating a great deal of extra information in the log files, both from hits on these pages and from Web spiders tracking hits on Web servers. This made it much more difficult to extract the data for hits on the SCI 152 pages from the log file in 2001 as more than 65000 requests were registered on the Web server. In analysing this data, hits from Web spiders, ISPs outside South Africa and the author's computer have been excluded.

Table 4.2.1 *Requests on http://goldilux.up.ac.za/sci152*

Course dates	Home page requests	Average home page requests per student (no. of students)
22 March 2000 - 29 May 2000	1236	23.3 (53)
16 March 2001 - 1 June 2001	1226	24.0 (51)

(The numbers of students given in the above table are those who wrote the respective examinations.)

4.2.A Objectives

As the Objectives page was linked from the Index page, using a browser's back button from the Objectives page would result in the user returning to the Index page, without a record being made in the Web log files. To access another page, the user would have to click on a new link on the Index page. This new link would then be registered in the Web log file. So, providing that the user remained on the course pages, an estimate of the time spent on the Objectives page could be obtained by considering the time the Objectives page was opened to the time the next page was opened.

In the tables below, the total number of hits with the average time spent on the Objectives page is given in the first data column. In the following data columns this figure is broken down to those students who spent 60 or more seconds on the page; those who spent between 30 and 60 seconds on the page; and finally, those who spent less than 30 seconds on the page.

Table 4.2.a.1 *Time (in seconds) spent on the Objectives page in 2000.*

	Total	$t \geq 60$	$30 \leq t < 60$	$t < 30$
Number of hits	25	6	12	7
Average time spent on page	49.60	102.00	45.00	12.57

Table 4.2.a.2 *Time (in seconds) spent on the* Objectives *page in 2001.*

	Total	$t \geq 60$	$30 \leq t < 60$	$t < 30$
Number of hits	24	6	6	12
Average time spent on page	44.67	106.83	47.67	12.08

What is interesting to note is that the number of hits on the Objectives page was very similar in both years. However, in 2000 more students[1] spent more than 30s on the page than in 2001 (18 as opposed to 12) from which one could deduce that the 2000 students tried harder to make sense of the course than in 2001. This is further borne out by the fact that of the 12 students in 2001 who had spent fewer than 30s on the page, 11 spent less than 20s there!

In trying to set a time standard for reading this page, the author had an English-speaking person read the complete page aloud while timing her with a stopwatch. It took her 52s to read the complete page. One would thus assume, given that the majority of students on the course were **not** first language English speakers, and that they should have been trying to extract meaningful information from the Objectives page, they should have taken more than 52s to read **and** understand the page. This means that only those students who spent more than 60s on the page made an effort to understand where the course was heading. In 2000, 53 and in 2001, 51 students wrote the final examination, which means in both years, fewer than 12% of the students read the page meticulously.

This supports the author's view that course objectives are irrelevant to most students. These students see the objective of most courses as completing the assignments as quickly as possible (Carr, 2001a).

The issue of objectives in instructional design was hotly debated on ITForum[2] in February 2001[3]. The discussion was started by Jones (2001) wanting to know where, in a CBT lesson, one should place the objectives of a lesson. The debate centred around whether they should be included (JRI, 2001; Morrison, 2001), whether they should be hidden (for the instructor's use only) (Draper, 2001a), or whether they should be set out in a watered-down form in a language that students could understand (Buckner, 2001; Clark, 2001; Draper, 2001a). Flanagan (2001) raised a novel concept in having the students formulate the objectives themselves, after completing the lesson. Cronjé (2001) feels that the title "Objectives" should be avoided. In his view a phrase such as "possible examination questions" should be used to attract the student's attention to this section of the lesson.

[1] In using this data, the author makes the [unverifiable] assumption that no student visited the page more than once. This assumption is used throughout this section.

[2] ITForum is a discussion group devoted to matters relating to instructional technology. More information can be found at http://itech1.coe.uga.edu/itforum/home.html

[3] The discussion can accessed in the searchable archives of the ITForum listserver at http://www.listserv.uga.edu/archives/itforum.html

4.2.B Naming of parts

To try to familiarise the students with the PC Logo environment, a page showing the major windows used by the software was linked to the first assignment page. As this page also included a discussion of the Logo co-ordinate system, it was important that the students should have accessed this information before attempting the assignments. Unfortunately, as this page was linked to the Assignment 1 page, most students used the back button of the browser to exit from it. This meant that it is not possible to estimate the time students spent on the page.

Table 4.2.b.1 *Hits on the page which discussed the PC Logo environment.*

Year	Number of hits	Percentage of students who submitted Assignment 1 (no. of students)
2000	34	65% (52)
2001	44	86% (51)

As can be seen from Table 4.2.b.1, many students submitted Assignment 1 without looking at the layout of the PC Logo windows. This could mean the that

- students were capable of exploring the PC Logo environment without outside assistance;
- students relied on their colleagues and tutors to explain the PC Logo environment;
- students submitted copies of their peers' work.

Ideally, the hope would be that the first point is the correct assumption, but the author feels that the second and third points were more likely to be correct.

It should be noted that very few further hits were made on this page after the due date for assignment 1, in 2000 as well as 2001.

4.2.C Solutions

One of the most important aspects of a Web-based course (or distance-based course) is the need for self reflection by the student. After an assignment is completed, it is necessary for the student to compare and evaluate his or her submission with a model answer delivered by the course presenter. In the present course, a set of model answers for each assignment was posted to the Web site on the due date for the submission of the particular assignment.

In preparing the following table, hits on the day of the examination have been excluded. These will be discussed separately in Section 4.2.F *The search for inspiration.*

Table 4.2.c.1 *Hits on the solution pages.*

Year	A1	A2	A3	A4	A5	A6
2000	47	53	51	17	15	26
2001	40	42	40	56	49	28

In 2000, the solution pages could only be accessed from the assignment pages. In 2001, to make it easier for the students to access these pages, a link was included on the home page. As can be seen from the above table, the students in 2001 appeared to show even less interest in these pages than in 2000 (apart from the solutions to assignments 4 and 5).

One very interesting conclusion that can be drawn from this table is that, in spite of the poor results achieved for assignments 4 and 5 in 2000 (see Figure 4.1.b.1), the students had largely disregarded the solution pages for these assignments. As mentioned previously, the students from 2001 appeared to see more value in these particular pages.

4.2.D Additional assignments

This page was created to offer the students stimulating challenges over and above the exercises given in the weekly assignments.

In many cases, students ended their browsing of the SCI 152 site on this page, so no time measurement (as in paragraph 4.2.A. *Objectives*) could be made. In the table below, hits on the examination day have been excluded. These will be discussed in Section 4.2.F. *The search for inspiration*.

Table 4.2.d.1 *Hits on the* Additional assignments *page.*

Year	Page requests	Average page requests per student (no. of students)
2000	115	2.17 (53)
2001	74	1.45 (51)

Table 4.2.d.1 shows that students exhibited very little interest in these pages. The students of 2000 appear to have been more conscientious than those in 2001, in spite of the tutors in 2001 warning students that an examination question from 2000 had come from these pages.

In neither 2000 nor 2001 did students approach the author for assistance in solving the problems on this page, so the assumption must be made that, although many students looked at the page, none tried the exercises. The following figure shows one of the exercises, which the author had used in the final assignment prior to 1997. This exercise was

removed, as even the most competent of students could not solve it without a great deal of coaching. The author feels that this problem, at least, should have generated questions from the students had it been attempted.

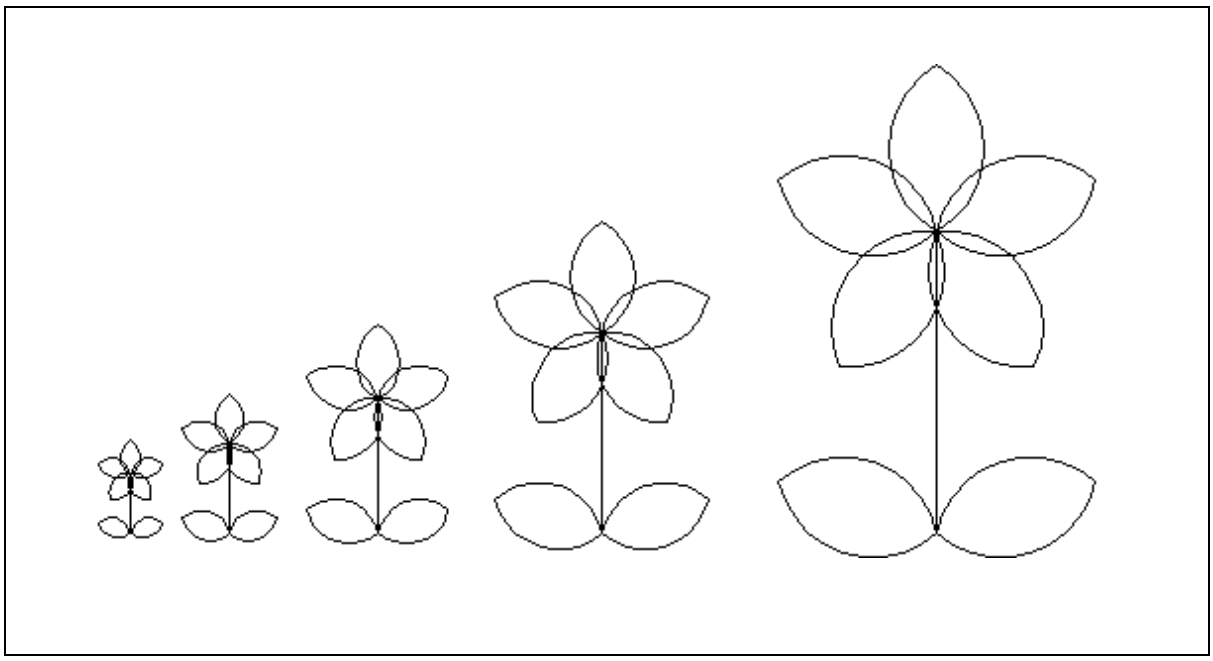


Figure 4.2.d.1 *One of the exercises from the* Additional assignments *page*

In the paper-based course, the additional assignments were included in the SCI 101 course workbook (SCI 101 was the precursor to the Science Orientation course). Only one student discussed those exercises with the author. In discussions with other students, none realised that additional exercises had been included in the workbook. So, in defence of the students taking the Web-based course, the students on the paper-based course were no more conscientious than their counterparts on the Web-based course.

4.2.E Useful information

The author had hoped that the *Useful information* page could be used to give the students hints on how to schedule their time in the absence of lectures.

Table 4.2.e.1 *Hits on the* Useful Information *page*

Year	Page requests	Average page requests per student (no. of students)
2000	141	2.66 (53)
2001	92	1.80 (51)

Although more interest was shown in this page than in the *Additional assignments* page, it was still lower than the author had expected. Again, as with the *Additional assignments* page, the 2000 students showed more interest in this page than the 2001 students.

One of the objectives of the *Useful information* page was to inform students of important dates in their course calendar. To have achieved this aim, one would have expected at least one visit per week per student. However, the students seemed to prefer receiving such information by word of mouth from the author, the tutors or other students.

4.2.F The search for inspiration

During the examination, the students had full access to the Internet, including the course Web pages and solutions. In this section an attempt is made to track the students in their search for inspiration while trying to solve the examination problem. Although it is not possible to identify particular students, it is possible to track their activities through the IP address of each computer which was used to access the course Web pages. Students sat at the same computers throughout the examination.

Table 4.2.f.1 *Number of students accessing the SCI 152 pages during the course of the examinations (The second number is the number of students who wrote the examination.)*

	No. of students
2000	49/51
2001	27/53

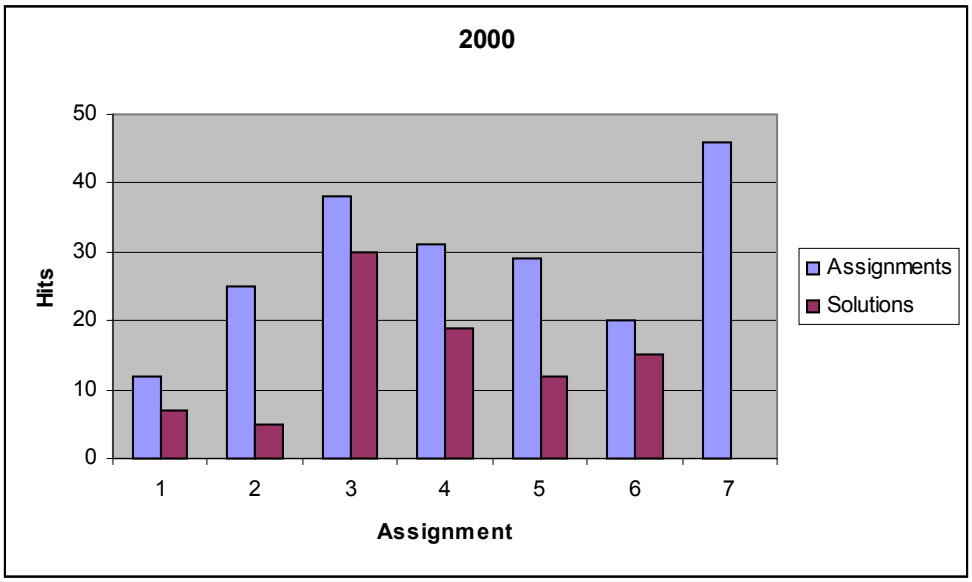


Figure 4.2.f.1 *Hits on the SCI 152 pages during the course of the 2000 examination*

In Figure 4.2.f.1 (and Figure 4.2.f.3) Assignment 7 is the *Additional assignments* page.

In 2000, the high number of hits on the *Additional assignments* page was due to the author mentioning, during the course of the examination, that an examination question had been taken from that page. Many students would thus have looked at this page in search of a solution (or inspiration!). Of the 49 students who accessed the SCI 152 site during the examination, eight only looked at the *Additional assignments* page, and one student only looked at the *Index* page. Pages which may have been useful in assisting the students in answering the examination question were:

- the solution page to Assignment 3;
- the solution page to Assignment 6; and
- Assignment 2 or its solution page (the examination question required the use of colour).

As can be seen from Figure 4.2.f.1, the highest number of hits (apart from the *Additional assignments* page) was on the Assignment 3 page followed by the Assignment 4 page. Apart from the solutions to Assignment 3, the students appeared to regard the solution pages as being of negligible value. Figure 4.2.f.2 shows the paths followed by four students in moving through the SCI 152 Web pages during the 2000 examination.

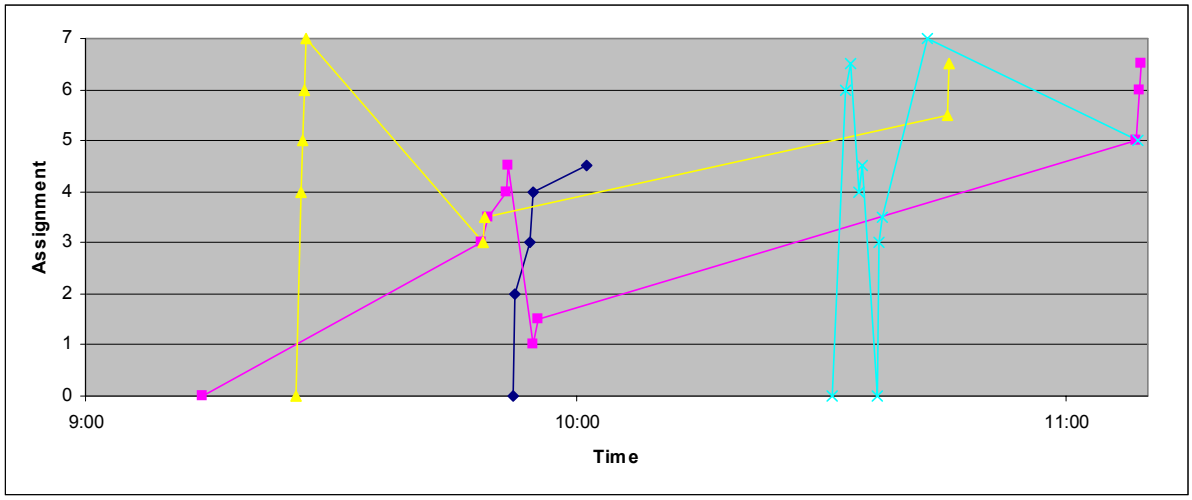


Figure 4.2.f.2 *Paths followed by four students in moving through the SCI 152 Web pages during the 2000 examination*

In the above figure (and Figure 4.2.f.4), Assignment 0 is the home page and Assignment 7 the *Additional assignments* page. The half values indicate the respective solution pages (*i.e.* 1.5 would signify the solution page to Assignment 1).

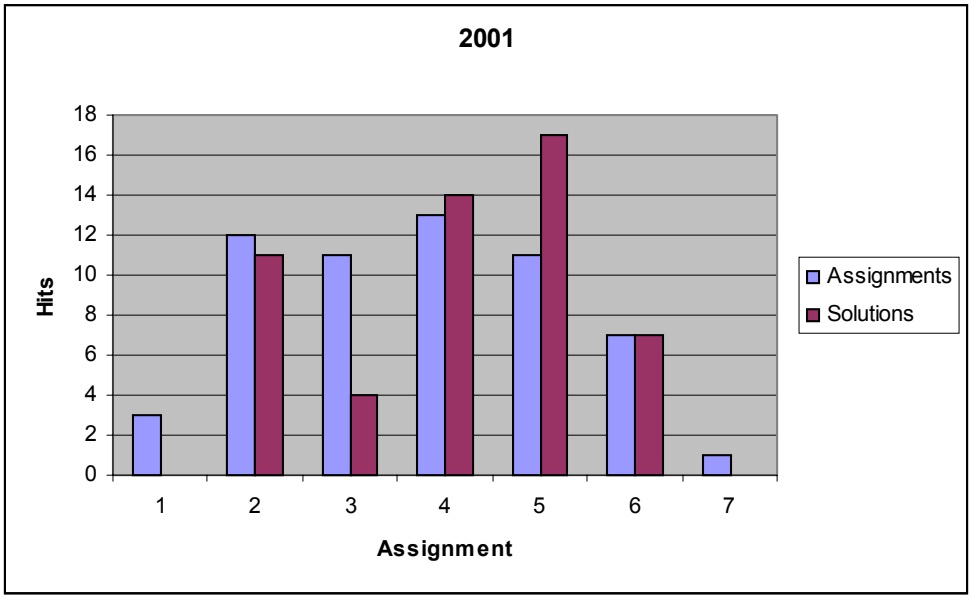


Figure 4.2.f.3 *Hits on the SCI 152 pages during the course of the 2001 examination*

In 2001, of the 27 students who used the SCI 152 pages during the examination, one visited only the solutions to Assignment 2, one only the solutions to Assignment 4 and two only the solutions to Assignment 5. Pages which may have been useful in answering the examination question were:

- the solution page to Assignment 5;
- the solution page to Assignment 4; and
- the solution page to Assignment 6 (if a student did not understand how to use variables).

Figure 4.2.f.3 clearly shows that the highest number of hits were on the solution pages to Assignments 4 and 5. The author can think of no valid reason why the number of hits on Assignment 2 and its solutions was so high. What is also of interest from Table 4.2.f.1 is that, apparently, almost half the class had decided that nothing could be gained from looking at the course Web pages during the examination.

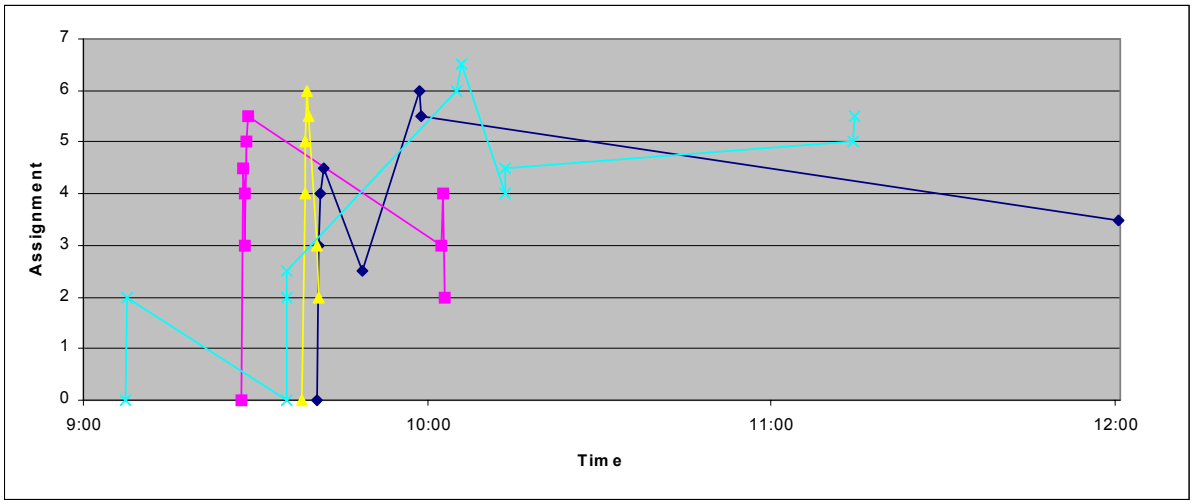


Figure 4.2.f.4 *Paths followed by four students in moving through the SCI 152 Web pages during the 2001 examination*

The light blue path is the really interesting one in Figure 4.2.f.4. This student seemed to think there was something in Assignment 2 which could help him or her, then gave up and did something else. Around 09:30 this student returned to Assignment 2 and its solutions, thought about it for 30 minutes then went to Assignment 6 and its solutions, thought about that for five minutes and went on to Assignment 4 and its solutions. After an hour of trying, the student then proceeded to Assignment 5 and its solutions. While it is unclear whether this student found the information he or she needed, he or she did eventually follow a path that would have offered the most assistance in his or her search for a solution.

4.3 Student assessment of the Web-based course

Students in 2000 completed a questionnaire covering aspects of the Web-based course. Selected questions from the questionnaire, given in Appendix 2, have been analysed to show the students' opinion, as well as to test the validity of their answers by correlating these with results given in previous sections.

4.3.A Computer literacy

A series of questions required students to rate their computer literacy. The responses to four of these questions have been used to generate a computer literacy profile of the students[1].

[1] The ratings used in generating the computer literacy profiles are based on the author's experiences in teaching computer literacy to students for more than 10 years.

In Question 1, students were asked to rate their computer expertise before enrolling at the University of Pretoria.

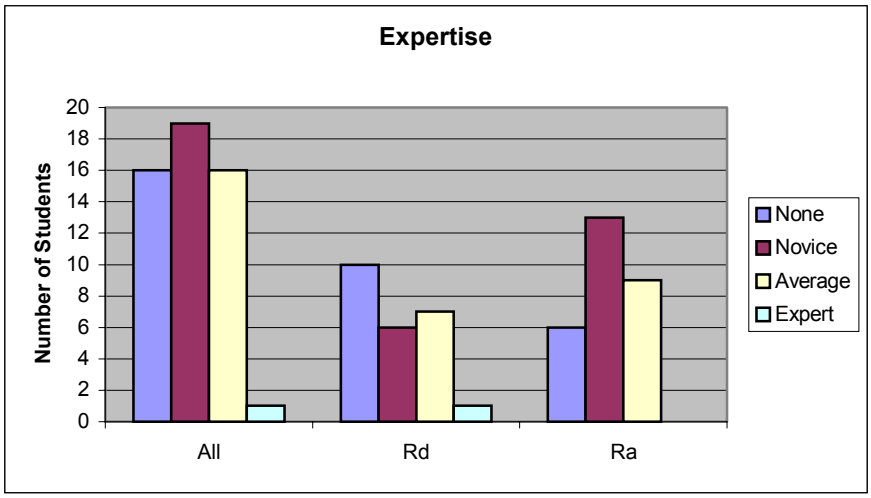


Figure 4.3.a.1 *Students' own rating of their computer expertise*

The author feels that the student who rated himself as being an expert was being facetious. This student had not used the Internet before; nor had he completed the game King's Quest (Question 6). Often, young people regard themselves as computer experts if they have played computer games, which was not the case with this student. A student who had both the "Microsoft Driver's License" and the "A+" certification viewed her expertise as Average. From Figure 4.3.1.a it can be seen that just over 60% of the class regarded themselves as having little or no computer skills.

In Question 2, students were asked whether they had access to a computer at home.

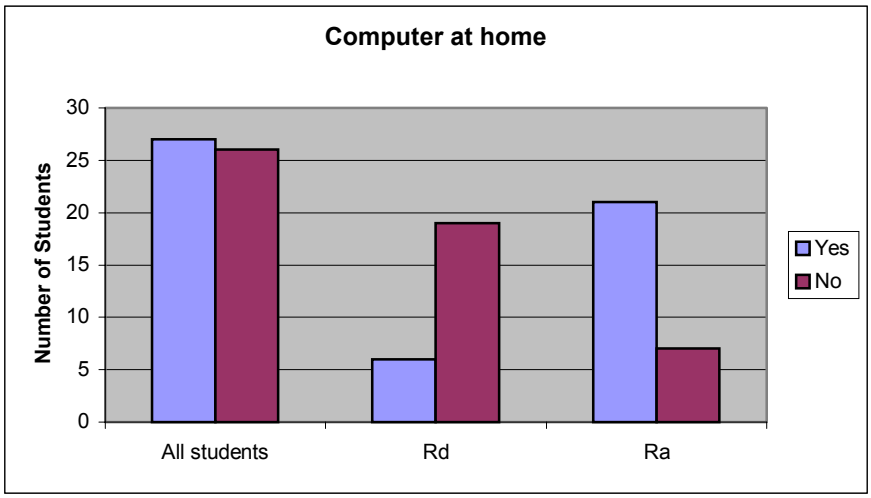


Figure 4.3.a.2 *Students' access to a home computer*

Quite a high premium can be put on access to a home computer on the level of expertise of a user. These students are often not scared to experiment with the technology. As can be seen from the graph, there was little difference in the numbers of students who had and who did not have access to a home computer. However, an expected difference between

access and non-access by the privileged and non-privileged groupings is shown in the graph.

In Question 4, students were asked whether they had used a word processor before. Word processing can be regarded as a high-level computer skill.

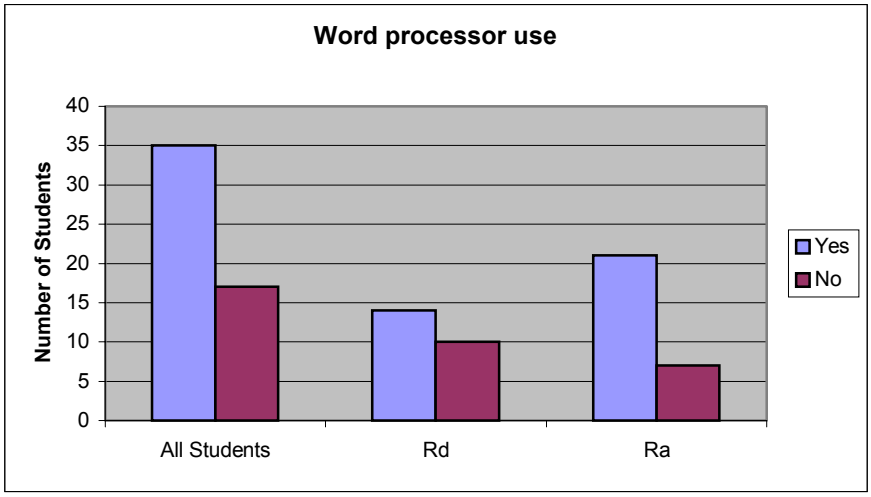


Figure 4.3.a.3 *Word processor usage by the students*

The non-use of a word processor shows a strong correlation with the students' own ratings of themselves as first-time computer users (see Figure 4.3.a.1).

In Question 7, students were asked whether they had used the Internet before. Internet usage can be regarded as a very high-level computer skill.

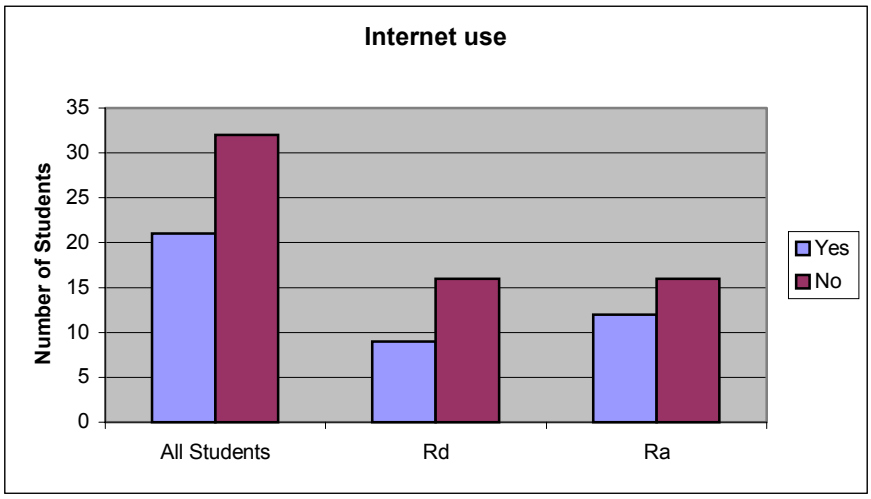


Figure 4.3.a.4 *Internet usage by the students*

The above graph is interesting, showing that more than 60% of the class had not used the Internet before, with slightly more of the privileged group having had access than the non-privileged group.

Figure 4.3.a.5 was generated from the data comprising Figures 4.3.a.1 to 4.3.a.4 by adding weighting factors to the students' responses to those questions. The weighting factors and the responses used are given in the following table.

Table 4.3.a.1 *Weighting factors used in generating Figure 4.3.a.5*

Question	Response	Weight
1. Own expertise rating	Novice	1
	Average	2
	Expert	1
2. Access to a home computer	Yes	2
4. Used a word processor	Yes	3
7. Used the Internet	Yes	4

From Table 4.3.a.1, it can be seen that the student who rated himself as an expert was viewed as novice[1] in compiling the scores used to draw up Figure 4.3.a.5:

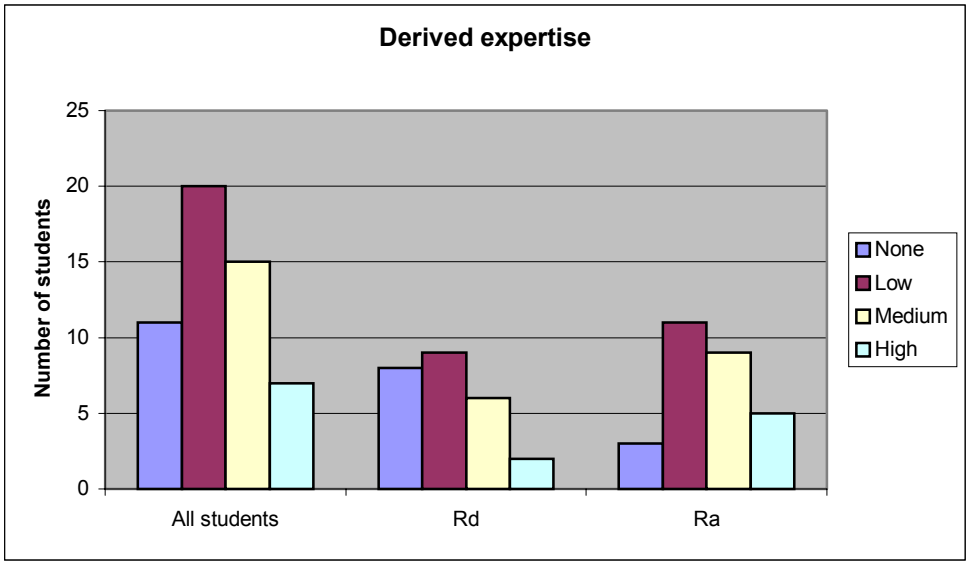


Figure 4.3.a.5 *Derived computer literacy levels*

What is interesting when comparing the above graph to Figure 4.3.a.1, is that some students who regarded themselves as having no expertise, had in fact used computers before.

The overall shapes of the clusters in this graph are very similar, apart from the first time users, where more are in the non-privileged group. It should again be noted that this graph shows that almost 60% of the class had little or no computer skills at the beginning of the course. This is important in analysing their responses to other questions in the questionnaire.

[1] This was discussed earlier, below figure 4.3.a.1.

Figure 4.3.a.5 can be extended to see if the students' computer literacy levels influenced their examination marks. In Figure 4.3.a.6, the marks of the students whose responses made up the categories in Figure 4.3.a.5, have been averaged.

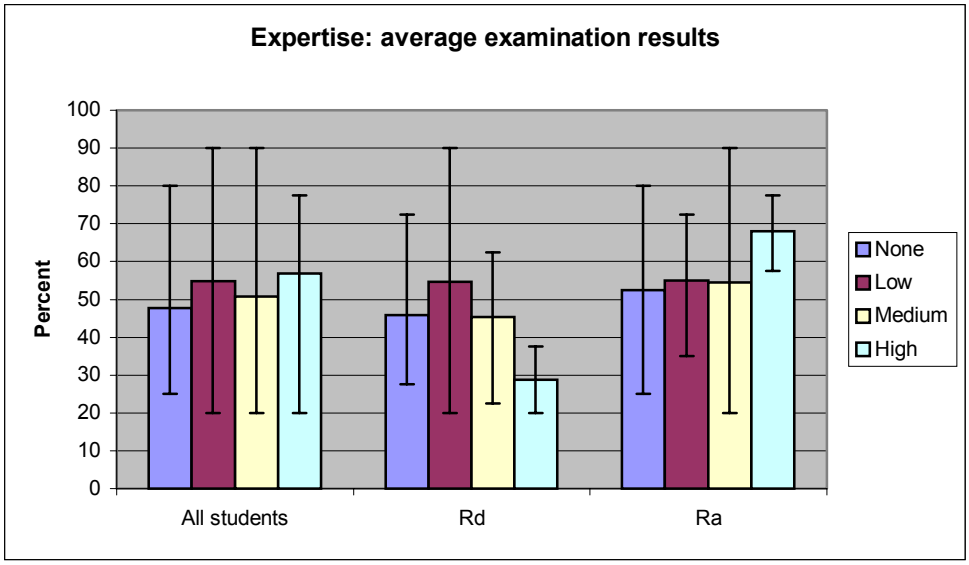


Figure 4.3.a.6 *Average examination marks achieved by students who responded as shown in the different categories in Figure 4.3.a.5.*

In Figure 4.3.a.6, error bars have been used to show the maximum and minimum examination marks achieved by the students in the different categories. The scatter in the average marks of the group "All students" shows that computer literacy played an insignificant role in the students' examination performance. However, in considering the groupings, it is evident that Rd students with high computer literacy levels performed very poorly, whereas those in the Ra group performed much better than the other categories in the group. What is also of interest is that the best-performing Rd students were in the lower categories of computer literacy, whereas with the Ra group, the top-performing students were spread through all the categories.

4.3.B Using the Web pages of the SCI 152 course

The questions discussed in this section were intended to test the students' opinions on a course without formal lectures.

Question 32 asks whether the students had coped with the course without lectures.

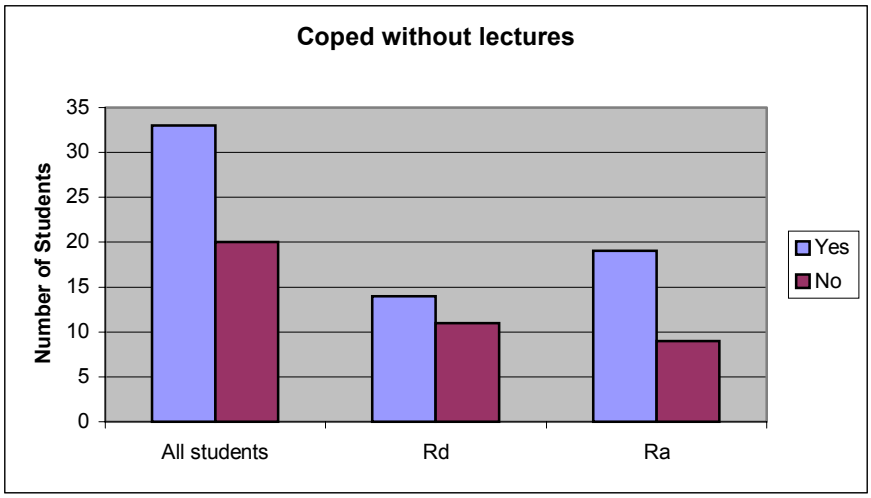


Figure 4.3.b.1 *Did students cope with the course without lectures?*

62% of the students felt that they had coped with the course well enough not to warrant lectures. However, a rather high percentage (38%) of the students felt that they had not coped with the Web presentation. This is to be expected when students are faced with a new method of learning (Åkerlind & Trevitt 1995).

Question 35 asks whether the students found sufficient information in the Web pages to complete the assignments.

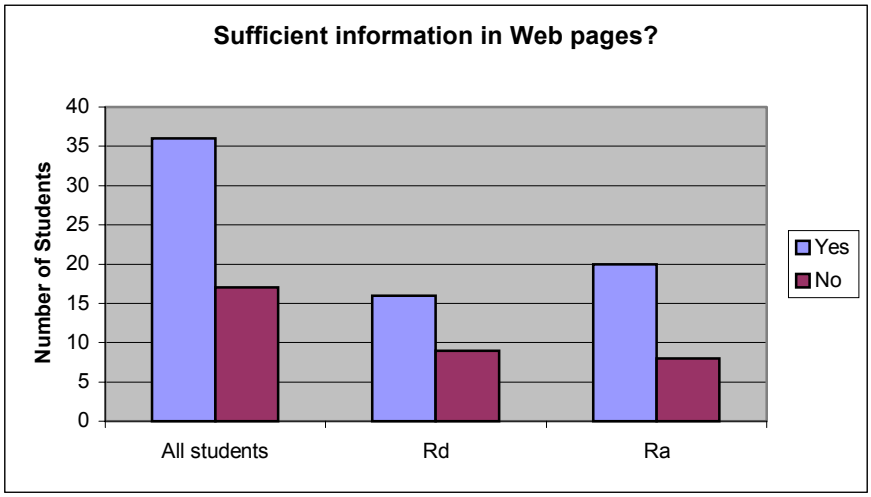


Figure 4.3.b.2 *Was there sufficient information in the Web pages to complete the assignments?*

68% of the students felt that the Web pages had provided them with sufficient information to complete the assignments. However, a high percentage felt that they needed more information. If one looks back at Figure 4.1.b.1, it is evident that students did not fare too well in Assignments 4 to 6. An explanation may be that, in spite of the positive feeling amongst these students, insufficient information had been available. This is further borne out by the data shown in Table 4.1.b.2, where the students on the paper-based course fared consistently better in their assignments than those on the Web-based course.

In Question 33, students were asked whether they would have liked to have had some lectures.

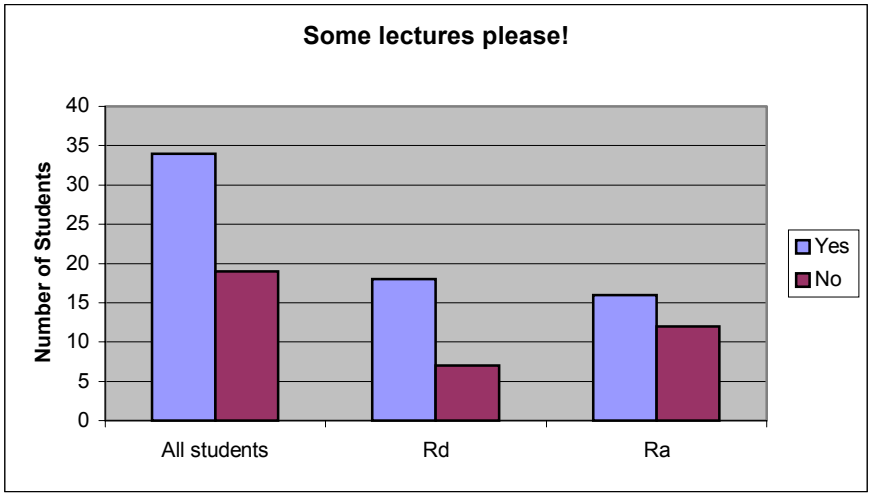


Figure 4.3.b.3 *Would the students have liked to have had some lectures?*

In spite of Figure 4.3.b.1 showing that the majority of students were satisfied with their ability to cope without lectures, 64% indicated that they would have liked to have had some lectures. This means that 26% of those who felt that they had indeed coped would still have appreciated some lectures.

Question 34 queries whether the students could have completed the assignments without the presence of the lecturer and the tutors.

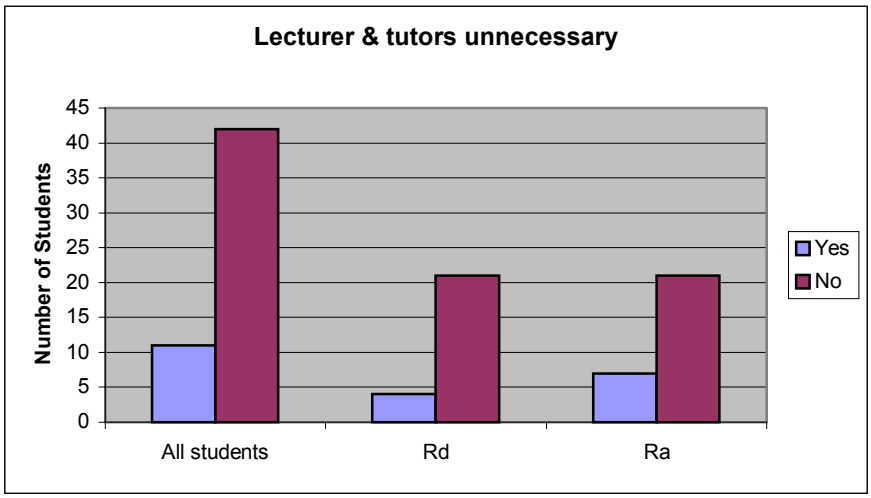


Figure 4.3.b.4 *Could the students have completed the assignments without the lecturer and the tutors?*

An overwhelming 80% of the students felt that they would not have been able to complete the assignments without the presence of the lecturer and the tutors.

The results shown in Figures 4.3.b.3 and 4.3.b.4 are in accordance with the findings of De Villiers (2001b), that undergraduate students still feel the need for face-to-face contact with the lecturer and tutors. Web-based course material should thus be used as a supplement to classroom activities only.

In order to asses the students' feelings about the Web-based course, the data making up Figures 4.3.b.1 to 4.3.b.4 has been summed for each student according to the following table, with one point for the response shown and zero for the response not shown. This would put each student in a category ranging from zero to four.

Table 4.3.b.1 *Responses used in generating Figure 4.3.b.5*

Question	Response
32. Did you cope without lectures?	Yes
33. Would you have liked some lectures?	No
34. Could you have completed the assignments without the lecturer and tutors?	Yes
35. Was there sufficient information in the Web pages for you to complete the assignments?	Yes

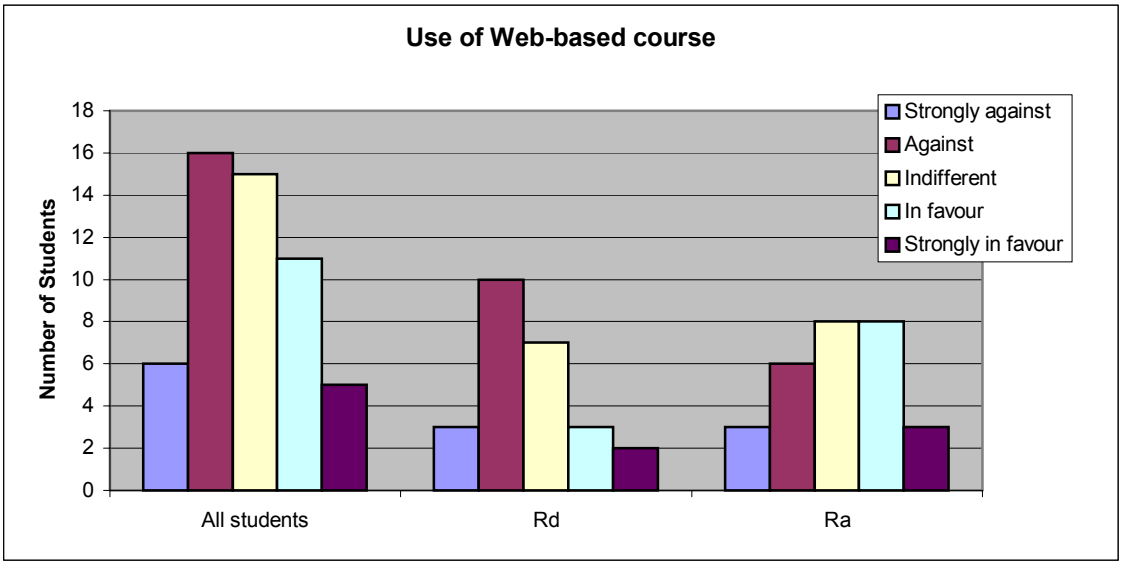


Figure 4.3.b.5 *Students' overall view of the Web-based course*

From the above figure it is evident that 42% of the students were against the Web-based course, while 30% were in favour of it, with the rest being indifferent. More Rd students than Ra students were against the Web-based course (13 *vs* 9), while twice as many Ra students as Rd students were in favour (11 *vs* 5). McIntyre and Wolff (1998) found that 75% of their students felt that a Web-based course should not be used as a total replacement for a classroom-based course. This is in keeping with the findings of Hart and Gilding (1997). Their students missed the interaction between the lecturer and other students found in a classroom setting.

Figure 4.3.b.5 can be extended to take into account the examination marks achieved by the students in each of the categories.

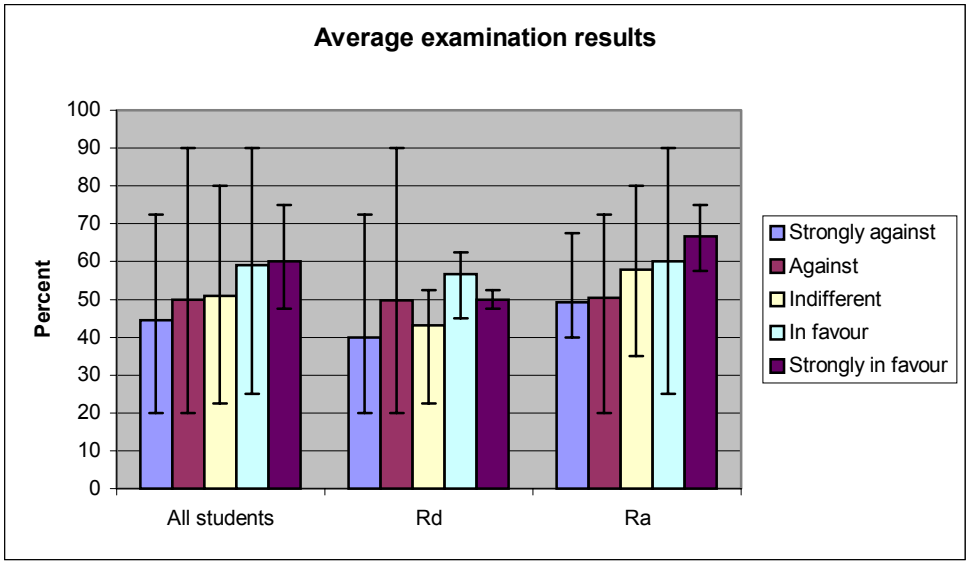


Figure 4.3.b.6 *Average examination marks achieved by students who responded as shown in the different categories in Figure 4.3.b.5*

Error bars have been used in Figure 4.3.b.6 to indicate the maximum and minimum marks achieved by students in each of the categories. The trend shown by the group "All students" is expected, where students "in favour" of the course should have done better than those "against" the Web-based course. Of special interest in this figure, however, is that the top-scoring Rd students were against the Web-based course. The top-scoring Ra students were either indifferent to the Web-based course or merely "in favour" of it. Note that the scatter of marks in the "strongly in favour" category is small in both the Rd and Ra groups.

4.3.C Could other courses be run from the Web?

Students were asked in Question 10 whether they felt if any of their other courses could be run from the Web.

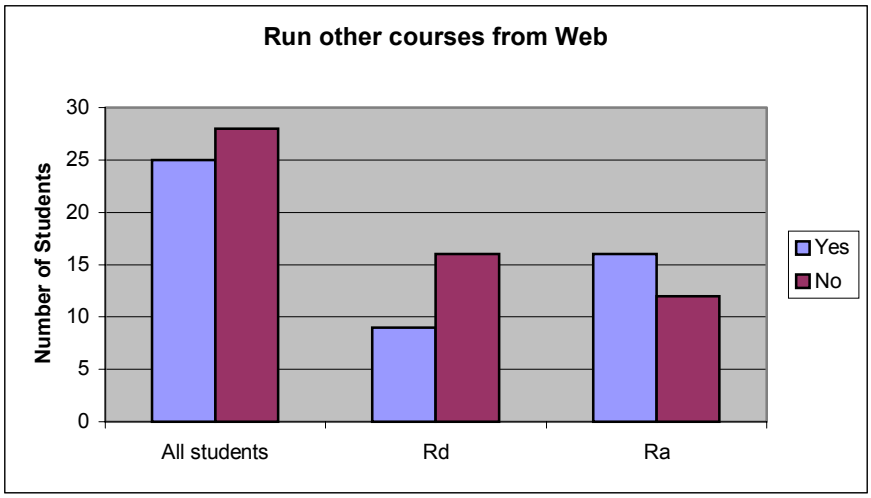


Figure 4.3.c.1 *Students' view as to whether any of their other courses could be run from the Web.*

Students' views were fairly evenly split on this question (25 in favour, 28 against). However, more Ra students were in favour of Web-based method of lesson delivery, with the shape of the responses for the racial groups being symmetrically opposed (64% of Ra students against and 57% of Rd students in favour). This is in keeping with the findings shown in Figure 4.3.b.5, where more Rd students were against the Web presentation of the SCI 152 course, and more Ra students in favour.

4.3.D Solution pages

As mentioned in section 4.2.C, one of the most important activities of a Web-based course is comparing model answers from the course presenter with one's own. In Question 27, students were asked if they had compared their answers with those on the solution pages.

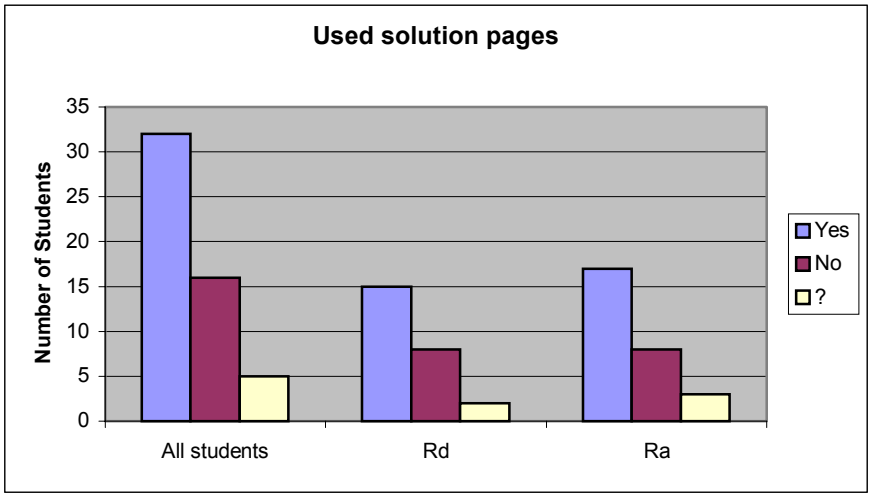


Figure 4.3.d.1 *Students' response to whether they had compared their answers to the solution pages.*

60% of the students said they had indeed compared their answers with those on the solution pages, but the statistics regarding the hits on the solution pages, given in Table 4.2.c.1, show that while students were fairly conscientious in the first half of the course, they were extremely lax in the second half. Unfortunately, the students seemed to misinterpret Question 28, "Which solution pages have you looked at?" by considering instead the **number** of solution pages they had looked at. Answering this question correctly could have given some insight into Table 4.2.c.1.

The worrying aspect in Figure 4.3.d.1 is that 5 students (almost 10% of the class), had not found the solution pages, which means they had never gone back to the assignment pages after receiving their marks (furthermore, they did not go back to these pages in revising for the examination). As mentioned in section 4.2.C, a link to each solution page was put on the home page in 2001 to make the existence of these pages more obvious to the students (see Figure 3.2.c.1). In spite of this, four out of the 26 students who completed a questionnaire in 2001, also did not find the solution pages.

In an attempt to find the students' main problem areas regarding the solution pages, Question 29 asked which solution pages gave insufficient information.

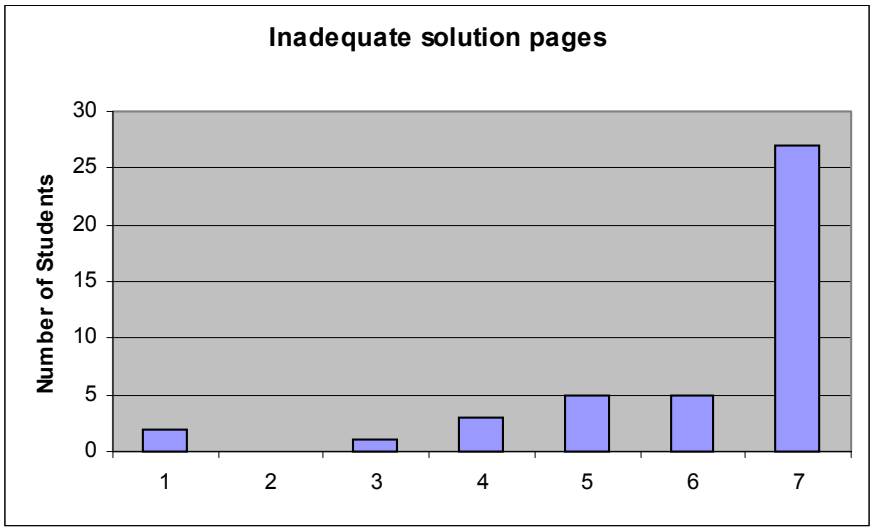


Figure 4.3.d.2 *Students' response to which solution pages were inadequate (In the figure, 7 refers to the response* "All were adequate".)

From the above figure, 51% of the class felt that the solution pages **that they had looked at** were adequate. However, what is interesting about this figure, is that although Table 4.2.c.1 shows a lower number of hits for the solution pages of Assignments 4 to 6 than those of Assignments 1 to 3, more students were unhappy with solution pages 4 to 6. In some ways, the response that there were problems with the solution pages was somewhat of a surprise. Although the students frequently discussed their problems regarding the assignments, in both years that the Web-based course was run, there were never any queries nor comments on the solution pages.

4.3.E Honesty in answering the questionnaire

In preparing and analysing a questionnaire of this nature, one implicitly assumes that the respondents are being honest in answering the questions. The issue of honesty with this questionnaire can be tested with Question 25: "Did you read the course objectives?".

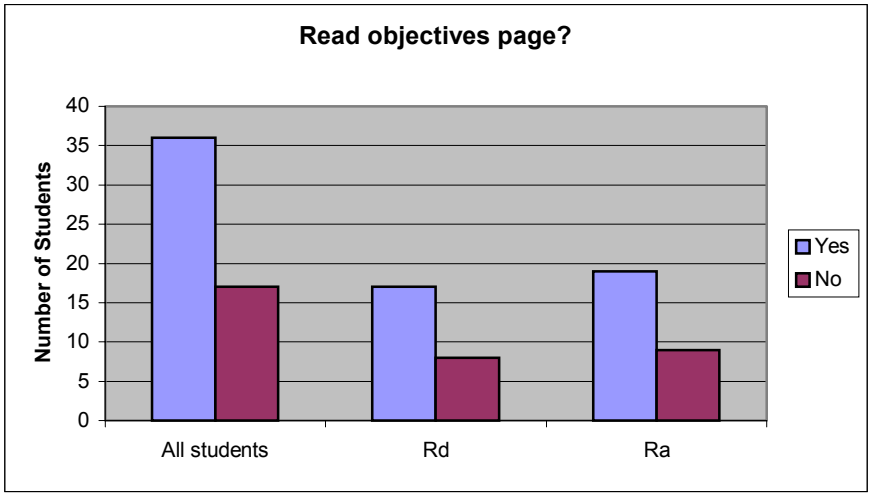


Figure 4.3.e.1 *Students' response to whether they had read the Objectives page.*

From this figure, 36 students (68% of the class) claimed that they had read the Objectives page. However, from Table 4.2.a.1, it can be seen that there were only 25 hits on the Objectives page prior to the examination. From the reasoning given in section 4.2.A, the author feels that only six students could actually have **read** this page, which means 30 students were not answering the question honestly. Even if the students had equated *read* with *looked at* it still means that at least 11 students were not answering the question honestly. As it is not possible to find out who had answered the question honestly, from those who answered *Yes*, only those who answered *No* were completely honest in answering the questionnaire.

If the data making up Figure 4.3.b.5, which gives the students' view of the Web-based course, is recalculated using only the results of the "honest" students, the following table is obtained.

Table 4.3.e.1 *A comparison of students' views of the Web-based course between the whole class and the "honest" students*

	All students (53)	**"Honest" students (17)**
Against	42%	29%
Indifferent	28%	42%
In favour	30%	29%

From the table, it can be seen that the "honest" students are split evenly between being in favour and being against the Web-based course. However, more of this group of students were indifferent to the Web-based course when compared with the whole class. This is not unexpected if one considers the question which generated these "honest" students ("Did you read the course objectives?"). What is probably being measured here is not their indifference to the Web-based course, but rather these students' indifference to the course as a whole.

4.4 Time management

An important aspect of a Web-based (or any distance-based) course is the students' ability to manage their time effectively (*e.g.* Sherry, 1996). In the absence of formal lectures, time must be set aside to complete assignments within the deadlines set by the lecturer. By monitoring the dates on which the students saved their assignments, a measure of the effectiveness of the students' time management strategies was obtained. Just-in-time completion of assignments would not suffice as a measure of good time management as the students had to work ahead in order to "gain time" for their Church Project.

4.4.A 2000

In the questionnaire completed by the students in 2000, Question 20 asks whether they had scheduled time to complete the assignments. 83% of the students responded that they had used some form of time management. Yet, the dates on which the assignments were submitted show that only two students had worked ahead consistently. These two students completed their assignments a full month ahead of schedule, and their Church Project a week ahead of schedule. A further two students had completed Assignment 5 a month ahead of schedule, but finished Assignment 6 just before the due date.

45% of the students were more than a week ahead by the time the fourth assignment was due to be submitted, but by the end of the course had slipped back to the due date for submission. This was probably due to a disruption in academic activities caused by two short vacations in April 2000 (10 days at the beginning of April and 12 days at the end). Laurillard (1993: 219) finds, in situations such as this, that students lose contact with the issues being studied. She prefers block teaching rather than distributed teaching (*ibid*: 220).

In spite of five hours being allocated to the course on the University timetable, students seemed to view this as free time, since there were no formal lectures. Thus, they regarded using the Gold Fields Computer Centre during practical times as "having to manage their time".

4.4.B 2001

Students in 2001 used a completely different time management technique to the students in 2000. Several of these students would complete two assignments in a single session, and then would wait until the assignment following these two was due before completing another two assignments.

Only one student completed his Church Project ahead of schedule and a further six completed their assignments a week ahead of schedule. As with the students in 2000, the rest of the students in 2001 did not try to work ahead at all.

4.4.C Assistance with time management

The students in 2000 felt that a Web page on "Time Management in the SCI 152 course" would have been useful.

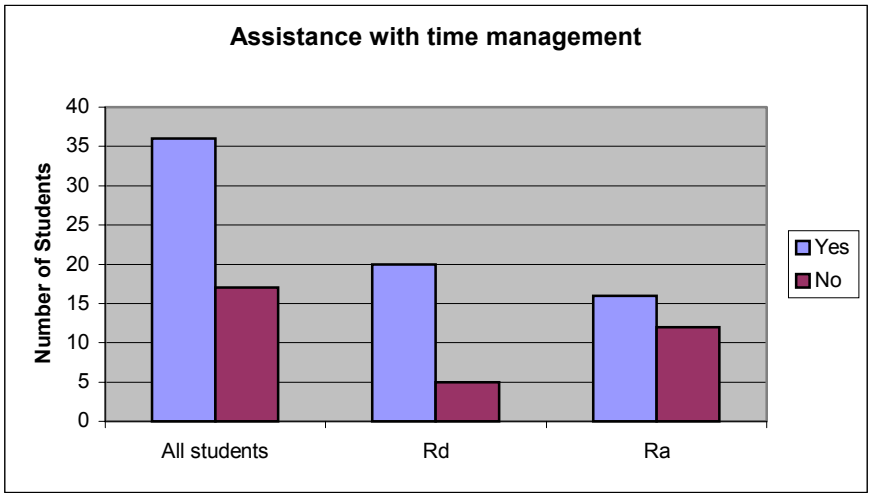


Figure 4.4.c.1 *Response to Question 22 of the questionnaire:* "Do you think a Web page on 'how you could possibly manage your time on this course' would have helped you?"

From the above figure it is clear that 80% of the Rd students felt that they needed some kind of assistance with time management, whereas only 57% of Ra students felt that this may have been of some benefit. This result is in stark contrast to constructivist approaches to learning, where students are expected to decide for themselves on how to study (Sing 1999).

It should be noted that all the students on the course in 2000 were also enrolled on the SCI 153 course (Academic Skills). One of the topics covered on this course is time management, so it is evident that students have difficulty in transferring skills learned in one subject to another.

4.4.D Reading ahead

One of the major advantages of a Web-based course is that all the course material (apart from the solutions to the assignments) is available at the start of the course. Students were encouraged to read and work ahead as far as possible so that they would have sufficient time to complete their Church Project.

While the Web logs do show many hits on assignment pages before they were due, there is no way of knowing whether these hits represent a cursory glance or an in-depth preview of the page. The students in 2000 responded positively as to whether they had read ahead.

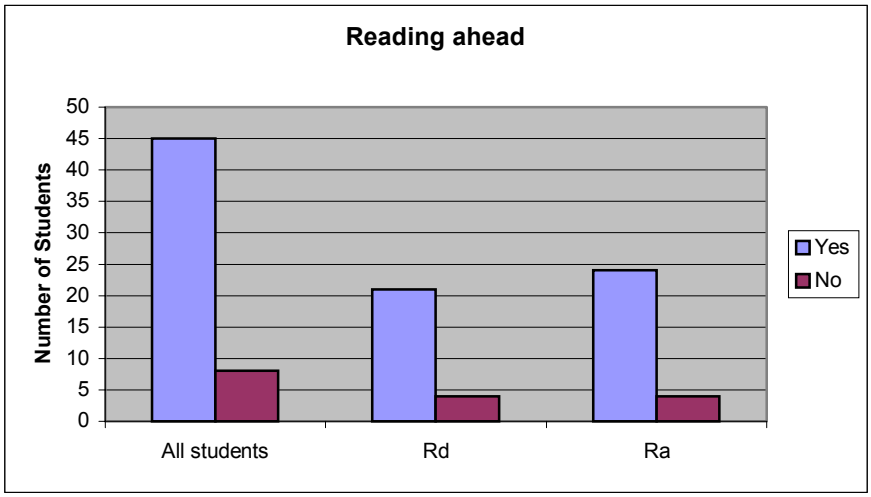


Figure 4.4.d.1 *Response to Question 18 of the questionnaire:* "Did you, at any stage, read assignments that were not yet due?"

An overwhelming 85% of the students in 2000 claimed that they had read assignments which were not yet due. However, as discussed in section 4.4.A, this reading ahead was not translated into working ahead.

It is important to note that the ideal learning situation is where a student can choose his or her own path through the study material (Candy, 1991:50-73). In the two years that the Web-course has run, only four students tried exercises from assignments out of sequence (in all cases the exercises were from Assignment 6 before Assignment 5 was completed). The rest of the students followed a linear path in completing the assignments.

4.5 Off-task activities

In 2000, students only had access to the Internet during the course of their Internet awareness practical. After that they were restricted to the Intranet of the University of Pretoria. In 2001, students had unrestricted access to the Internet after their Internet awareness practical. According to Nortje (2001), this was an oversight on the part of

network management at the University of Pretoria, as open access to the Internet from computer laboratories is restricted to the hours 18:00 to 22:00 on weekdays. Normally, special permission has to be obtained for open access outside of these times.

Observations of the students in 2001, while they were active on the Internet in the Gold Fields Computer Centre, showed that most had obtained Web-based email addresses by the end of the course. As the author had given no instructions in this regard, the more experienced Internet users amongst the students must have exposed novice users to this technology. Another favoured activity was the search for lyrics to popular songs. There is no doubt that the free Internet access led to self-empowerment amongst the novice users, in that they had learned to use the Internet as an aid in finding information. This is best illustrated by the way in which most students approached a task in which they had to draw a map of the King's Quest world. (King's Quest is a computer game used in the computer literacy component of the SCI 152 course to expose novice users to the idea of using the computer as a source of entertainment.) In previous years, this map was often copied (with errors) from colleagues who had completed the game. In 2001, the map was "discovered" in various forms on the Internet, and so, as in the past, students were able to submit a map without playing the game. [Plagiarism of Web-based information by students in collecting information for assignments is a serious problem (Carr, 2001b; Cronjé, 2001). Tapscott (2001) maintains that the Web encourages users to become critical thinkers by forcing them to use their judgement in evaluating the information they find. The author disagrees with this as his observations have shown that the majority of students copy information from Web pages without even bothering to read it (Carr, 2001b). Meintjies (2001) has a further problem in that information, when found, is often dated. Do students have the ability to discern the relevance of the information?]

The high novelty value of Internet activities for the novice computer users led to misuse of the available tools. The most overused was Internet-based SMS to mobile phones of friends within the Centre. The incessant beeping of these phones gave the author the impression that very little academic work was being done by these students, especially closer to the examinations. In a similar vein, sending emails to peers in the Centre was another big time waster. Interestingly enough, the author received no emails from the students, but did receive an SMS from one student thanking him for assistance with a problem.

Figure 4.1.b.1 and Table 4.1.b.2 clearly show a decrease not only in marks for the assignments, but also a decrease in the number of assignments being handed in as the semester progressed. Although the data was not presented in this document, the decrease in the number of assignments handed in, shown in Table 4.1.b.2, was found mainly

amongst the 2001 students. Distractions, caused by unrestricted Internet access, is the most likely cause of this laxness.

Although the data presented in this section is somewhat subjective, it shows that unrestricted access to the Internet could have had a detrimental effect on the students' academic performance.

4.6 Interaction

Prior to the Web-based SCI 152 Logo course going live on 22 March 2000, the author asked several friends and colleagues to check the pages for spelling, grammar and logic errors that may have been overlooked. However, most of these people commented on interaction. Brown (2000) and Erasmus (2000) felt that some form of interactivity should be built into the pages to make sure that students had grasped the concept that they were required to work with. Vermaak (M, 2000) and von Glehn (2000), on the other hand, would both have liked to have had Logo software to try the exercises. Both mentioned being frustrated at not being able to follow the arguments being developed without the Logo software.

The author, agrees with Cronjé (1997) about the static nature of Web pages. These pages are nothing more than a vehicle for presenting the information. In order to create the necessary knowledge to proceed with the course, the students had to interact with the Logo software **in conjunction** with the information on the Web pages. The author feels that this aim was achieved, as can be seen in the video clips taken of the students on the first day of the Logo course presented via the Web. These clips are in the directory VideoClips on the enclosed CD (see especially KATE.avi and NKOSI.avi).

Student interaction is discussed further in the chapter 6, *Future work*, under JavaLogo.

Interestingly enough, the Institute for Higher Education Policy's report on benchmarking Internet-based distance education emphasises the importance of interaction. However, the interaction they refer to is not with software, but rather interaction between students and the lecturer/tutors, and interaction between the students themselves (IHEP, 2000).