The Design of a Computer Literacy Test for University Students

School of Mathematics, Statistics,
Computer Science and Information Systems

— Prepared by —

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Introduction

This report was commissioned by the previous Department of Computer Science and Information Systems to advise the department on the best way to assess whether incoming first-year students are computer literate. The result of this assessment will be used to either exempt students from the Computer Literacy course (CS101) or to advise/ require them to do that course. (The Appendix describes the background to this report in more detail.)

The major deliverable of the report is the basic design of a computer literacy test which will be implemented by staff of the School at the start of first semester 1999. A secondary deliverable was a clear theoretical framework which would justify the testing procedure. This report is the final product which includes both these deliverables.

- Section A describes the nature of Recognition of Prior Learning (RPL) and the use of Biggs's SOLO taxonomy for designing appropriate assessment techniques.

- Section B describes the process by which the assessment instrument was derived from the Intended Learning Outcomes of the existing Computer Literacy course (CS101). The assessment instrument itself is given, followed by an evaluation of how closely it matches the objectives.

- Section C describes the overall process which will need to be implemented to use the assessment instrument.

- Section D comments on how the effectiveness of the Computer Literacy Test can be evaluated.

- Section E raises a number of issues which the School needs to either decide or keep in mind.

It will be essential that any future changes to the assessment procedure be made with due consideration to the motivations and theories underlying the establishment of the test.

Section A :— The Theoretical Basis for the Computer Literacy Assessment Instrument

Recognition of Prior Learning (RPL)

New education and training policy in South Africa has legislated that a national qualifications framework be established within which all human resource skills can be accredited. It is hoped that this framework will promote equality and justice by giving all South Africans the chance to have their skills recognised and accredited, regardless of how these skills were acquired. It is out of this national initiative that the Accreditation or Recognition of Prior Learning movement has arisen in South Africa. (The movement has been around for some time in the United States, Australia and England.)

The University of Natal does not have any formal policy on RPL yet. However, it is considered to be a promising and important initiative to increase access to the university's programs. A formal university policy document on RPL is planned for next year. The School of Rural Community Development completed a pilot RPL project during 1998 for access into their diploma programme[1].

For prior learning to be effectively recognised and accredited, RPL theory requires that the assessment instrument/ s be:—

Valid	The instrument tests what it is meant to test in the appropriate way — fitness for purpose
Reliable	The instrument would produce comparable results if used on the same candidates more than once with different assessors
Sufficient	The instrument generates sufficient evidence for the assessors to make sound judgements
Authentic	The instrument ensures that the evidence produced was the candidates own work
Currency competent	The instrument tests current levels of competence of the candidate

The assessment instrument used for the Computer Literacy test needs to be judged according to these criteria. This evaluation is shown at the end of Section B.

RPL[2] requires that candidates be well prepared for their assessments so that they are not disadvantaged because of inadequate understanding of what to expect. To this extent, it is important for them to be fully informed about what skills and content will be tested. For RPL to be used effectively as a means to encourage candidates to pursue goals of lifelong learning, the results of the test and the interpretation of the marks need to be 'fed back' in a responsible manner. Ideally, some educational guidance needs to follow publication of the results so that the experience is positive for the candidates. A step-by-step procedure for implementing the test is documented in Section C.

[1] Information on this project is available from K. Luckett (QPU) and the unpublished *Report on the pilot study using RPL for access to the certificate in Rural Resource Management*.

[2] All references to RPL theory are from the UK's Open University publication *Accrediting Prior Learning Modules 1 and 2*.

Included in this are some ideas about how to orient students for the test, and how to give them appropriate feedback.

Biggs's Structure of the Observed Learning Outcome (SOLO) Taxonomy

Biggs's Structure of the Observed Learning Outcome (SOLO) taxonomy[3] is based on a constructivist theory of education. This school asserts that learners make their own knowledge and meaning through use of different levels of cognitive processes, and that, contrary to the objectivist tradition, meaning is neither imposed by reality, nor transmitted by direct instruction.

Recent educational research indicates that there is a hierarchy of understanding, that is, one can understand at different levels. Biggs's taxonomy focuses on the *performative* aspect of understanding i.e. if you understand something differently, you will act differently in contexts involving the content understood, particularly in unfamiliar contexts. SOLO is a systematic way of describing how a learner's performance grows in complexity in relation to different levels of understanding, when mastering a task.

The SOLO Taxonomy

Prestructural	The task is not tackled appropriately; the student hasn't understood the point
Unistructural	One or a few aspects of the task are picked and used (understanding as *nominal*)
Multistructural	Several aspects of the task are learned but are treated separately (understanding as *knowing about*)
Relational	The components are integrated into a coherent whole, with each part contributing to an overall meaning (understanding as *appreciating relationships*)
Extended Abstract	The integrated whole at the relational level is reconceptualised at a higher level of abstraction, which enables generalisation to a new topic or area, or is turned reflexively on oneself (understanding as *metacognition* which enables *transfer*)

A teacher in any teaching/ learning context needs to ensure that curriculum, teaching method and assessment methods are aligned so that the desired cognitive level of understanding is reached. An important step in this process is to make explicit both the desired learning outcomes and the desired levels of cognitive skill. If these are made explicit, then it is more likely that the assessment will be assessing the correct things with the correct emphasis determined by the teacher. That is, the assessment instrument will be valid. If the learning outcomes and cognitive demands of the learning task are made explicit, it will be easier for the assessor to interpret the data or marks and provide informed feedback to students in relation to the target performances of understanding.

[3] Biggs, J. (1996) *Enhancing Teaching through Constructive Alignment* in Higher Education, **32**, 347–364.

In designing the assessment instrument, we need to operationalise the desired levels of understanding so that we can assess performance in as authentic a manner as possible. To design a valid instrument in this context, four steps need to be followed in order:—

1. We need to be clear about what we want the students to learn and how they should manifest their learning in terms of 'performances of understanding'

2. The learning outcomes need to be arranged in a hierarchy from most essential to least essential and the performance objectives from most satisfactory to least satisfactory.

3. Students need to be placed in situations most likely to elicit the required learning

4. Students need to provide evidence that their learning can match the stated objectives in terms of content and performance understanding[4].

The process we followed in designing the Computer Literacy RPL assessment instrument is based on this model.

[4] This model is documented in Biggs, op. cit. (p. 360). An almost identical model was recommended by K. Luckett from QPU and by H. Griesel of the Teach-Test-Teach programme at UND.

Section B :— The Design of the Computer Literacy RPL Assessment Instrument

Design Process

The following is the process behind the design of this Computer Literacy assessment instrument.

1. Based on Biggs's SOLO taxonomy, categorise each of the CS101 learning outcomes in terms of the cognitive demands — multistructural, relational and extended abstract

2. Consider what the School views as essential or fundamental in computer literacy

3. Weight each outcome in each cognitive category as essential or non-essential for student knowledge

4. Cluster common essential outcomes in each category, prioritising them in terms of importance for student knowledge

5. Discuss the amount of time required for students to spend on each cognitive category and the number and type of questions or tasks for each category

6. Discuss the mark required for each cognitive category

7. Facilitate a progress meeting with the School to discuss the appropriateness of the process so far

8. Think about suitable assessment tasks which will test the essential content and demand the appropriate cognitive skills in line with the learning outcomes and cognitive demands of computer literacy

9. Check that all essentials have been tested in the appropriate way to ensure a valid assessment instrument

10. Present the final report to the School.

Advertised Intended Learning Outcomes for CS101

The following list indicates what you should learn from this course. During the semester we will distribute more detailed objectives for each section of the course. By the end of the course you should be able to *know*, *understand* and *do* the things described below. The course assessment will be based on this list, so if you can do all of it you will pass with flying colours, but if you can't do them then we will probably see you again next semester!

Please note that this list of intended learning outcomes is not a chronological description of the course structure. These outcomes will not be taught to you one after the other from the first to the last.

1. By the end of the course you should be able to understand and use common computer software.
   - 1.1. Use a computer as an effective communication tool
     - 1.1.1. Word processing (WP)
       - 1.1.1.1. Understand the purpose and advantages of a word processor
       - 1.1.1.2. Know the basic WP *objects* — document, page, margins, fonts, ruler, menu, header, footer
       - 1.1.1.3. Know the basic WP *actions* — save, open, print, word wrap, format (including bold, underline, centre, indent, alignment), copy, spell check, thesaurus, search and replace
       - 1.1.1.4. Apply the knowledge in 1.1.1.2 and 1.1.1.3 by using a word processor effectively to produce substantial documents
     - 1.1.2. Desk top publishing (DTP)
       - 1.1.2.1. Understand the role of computers in the design and production of high-quality publications
       - 1.1.2.2. Know the basic terminology of DTP — leading, kerning, fonts, typeface, pixel, resolution
       - 1.1.2.3. Understand how graphical images are both displayed on a computer screen and printed on paper
     - 1.1.3. Electronic mail (email)
       - 1.1.3.1. Understand the role of email as a medium of communication
       - 1.1.3.2. Know the basic terminology of email — address, message, mailbox, send, reply
       - 1.1.3.3. Use an email system to send and receive email, and to reply to messages which you have received
   - 1.2. Use a computer to process numerical information
     - 1.2.1. Spreadsheets (SS)
       - 1.2.1.1. Understand the purpose and advantages of a SS
       - 1.2.1.2. Know the basic SS *objects* — worksheet, row, column, cell address, label, value, formula, range
       - 1.2.1.3. Know the basic SS *actions* — save, open, print, change column width, change cell format, copy, automatic recalculation, cell protection
       - 1.2.1.4. Use built-in SS operations and functions to calculate logical, mathematical, statistical and financial values
       - 1.2.1.5. Understand the difference between relative and absolute addressing and the significance of this difference when copying formulae from one cell to another
       - 1.2.1.6. Apply the knowledge in 1.2.1.2 to 1.2.1.5 by using a SS effectively to produce substantial models of real-life situations
     - 1.2.2. Graphs
       - 1.2.2.1. Understand how graphs help to summarise and visualise complex information
       - 1.2.2.2. Know which type of graph is most suitable for particular purposes
       - 1.2.2.3. Use a SS to produce appropriate graphs of real-life data
   - 1.3. Use a computer to store and retrieve structured information
     - 1.3.1. Understand the difference between data and information
     - 1.3.2. Relational databases (DB)
       - 1.3.2.1. Understand the purpose and advantages of a DB
       - 1.3.2.2. Know the basic DB *objects* — file, table, record, field/ attribute, datatype, report

1.3.2.3. Know the basic DB *actions* — save, open, print, define fields, add data, modify data, delete data, querying
1.3.2.4. Create and maintain single-table databases for real-life situations
1.3.2.5. Understand the logical operators "and", "or" and "not" and their effect in compound search expressions
1.3.2.6. Retrieve data from a DB using simple and compound queries on a single table
1.3.2.7. Generate structured reports with both detail and summary lines from data in a DB

1.3.3. Searching for information on the Internet
1.3.3.1. Understand the nature of the Internet and its use as a source of information
1.3.3.2. Understanding the purpose and structure of Internet Newsgroups
1.3.3.3. Use a Newsgroup reader to read and post to a Newsgroup
1.3.3.4. Know the basic terminology of the World-Wide Web (WWW) — home page, URL, hypertext link
1.3.3.5. Use a WWW browser to navigate through Web pages
1.3.3.6. Use WWW search facilities to look for information on any topic

1.4. Integrate information which is in multiple forms and comes from multiple sources
1.4.1. Understand the importance of such integration in real-life situations
1.4.2. Extract data from a database into a spreadsheet in order to create a graph
1.4.3. Generate form letters by incorporating information from a database into a word processing document
1.4.4. Use the copy function to move data between documents and applications

1.5. Organise computer files on a disk
1.5.1. Know the basic filing *objects* — documents, files, folders/ directories
1.5.2. Know the basic filing *actions* — creating a folder, renaming, copying and deleting files and folders, viewing the contents of files and folders
1.5.3. Understand the purpose of and procedures for backing up computer files
1.5.4. Use appropriate commands to organise and maintain computer files on a disk in a well-structured fashion

1.6. Use and recognise standard human-computer interaction techniques
1.6.1. Understand the difference between command driven and GUI interfaces
1.6.2. Know the basic *objects* of a user interface — pointing device, window, dialog box, menu, icon, intermediate (paste) buffer, toggle switch
1.6.3. Know the basic *actions* of a user interface — selecting and moving objects, choosing options from menus, responding to dialog boxes, cut/ copy/ paste, insert/ typeover
1.6.4. Use a WIMP interface
1.6.5. Transfer the above knowledge and skills to other modern software packages

2. By the end of the course you should also have acquired some *theoretical knowledge* in the following areas —

2.1. Understand the means by which information can be entered into and retrieved from a computer
2.1.1. Know the main characteristics of a range of input devices, including keyboards, pointing devices (e.g. mouse, light pen, touch screen), and scanning devices (e.g. scanner, bar code reader, MICR, OCR)
2.1.2. Know the main attributes of computer screens — pixel size, resolution
2.1.3. Know the main characteristics of a variety of printers, including dot matrix, ink jet and laser

2.2. Understand how simple data is represented inside a computer
2.2.1. Know the basic terminology of computer storage — bit, byte, kilobyte, megabyte, gigabyte
2.2.2. Calculate and interpret data storage capacities

2.3. Understand the ways in which a computer can remember (store) information
2.3.1. Understand the difference between primary and secondary storage and why both are required
2.3.2. Primary storage
2.3.2.1. Know the purpose and limitations of RAM
2.3.2.2. Know the purpose and limitations of ROM

- 2.3.3. Secondary storage
  - 2.3.3.1. Understand the basic structure of computer disks — tracks and sectors
  - 2.3.3.2. Understand the differences between stiffies, floppies and hard disks
  - 2.3.3.3. Know the main characteristics of various other storage technologies (including magnetic tape and CD-ROM)
- 2.4. Understand the way a computer processes information
  - 2.4.1. Understand the Input-Processing-Output model
  - 2.4.2. Know the major hardware components of a computer
  - 2.4.3. Understand how CPU model and clock speed interact to make one computer faster than another
- 2.5. Understand the role of software
  - 2.5.1. Know the difference between hardware and software
  - 2.5.2. Know the difference between operating systems and applications software
  - 2.5.3. Understand the role of an operating system
    - 2.5.3.1. Know how a computer "boots" itself
    - 2.5.3.2. Understand the role of the operating system as a resource manager
    - 2.5.3.3. Understand the role of the operating system as an interface between the computer and the user
    - 2.5.3.4. Understand how documents are spooled to a printer in a multi-user environment
  - 2.5.4. Compare and contrast MS-DOS and Windows, especially in terms of interaction style
- 2.6. Understand how data can be transferred from one computer to another
  - 2.6.1. Understand the role of inter-computer communication in real-life situations (e.g. electronic funds transfer)
  - 2.6.2. Understand the nature of computer viruses and how to prevent them infecting your computer
  - 2.6.3. Understand the function of a modem and related concepts such as transmission speed, analogue and digital signals, data communications media
  - 2.6.4. Calculate and interpret simple data transmission statistics
  - 2.6.5. Understand the purpose and structure of local-area networks (LAN) and wide-area networks (WAN)
  - 2.6.6. Understand the general structure of the Internet
- 2.7. Understand how to go about buying computers for individual use
  - 2.7.1. Know how to recognise an individual's computer needs
  - 2.7.2. Know what criterion to use when comparing computer systems
- 2.8. Understand the wider social implications of computing technology
  - 2.8.1. Understand the relationship between technological change and social change
  - 2.8.2. Understand that a computing system includes hardware, software *and* people
  - 2.8.3. Know the major advantages and disadvantages of computers in terms of their impact on human society

3. By the end of the course you should also have gained some *life-skills*—
   - 3.1. Improved ability to find and assimilate new knowledge
   - 3.2. Improved ability to organise and communicate your knowledge to others
   - 3.3. Appreciation of the enjoyment and the rewards which can accrue from the effective use of computers
   - 3.4. Strategies for dealing with the frustration of using computers

Course Outcomes Categorised According to Cognitive Demands

Multistructural	Relational	Extended Abstract
Know the basic WP **objects** — document, page, margins, fonts, ruler, menu, header, footer Know the basic WP **actions** — save, open, print, word wrap, format (including bold, underline, centre, indent, alignment), copy, spell check, thesaurus, search and replace Know the basic terminology of DTP — leading, kerning, fonts, typeface, pixel, resolution Know the basic terminology of email — address, message, mailbox, send, reply Know the basic SS **objects** — worksheet, row, column, cell address, label, value, formula, range Know the basic SS **actions** — save, open, print, change column width, change cell format, copy, automatic recalculation, cell protection Know the basic DB **objects** — file, table, record, field/ attribute, datatype, report Know the basic DB **actions** — save, open, print, define fields, add data, modify data, delete data, querying Know the basic terminology of the World-Wide Web (WWW) — home page, URL, hypertext link	Use a word processor effectively to produce substantial documents Understand how graphical images are both displayed on a computer screen and printed on paper Use an email system to send and receive email, and to reply to messages which you have received Use built-in SS operations and functions to calculate logical, mathematical, statistical and financial values Understand the difference between relative and absolute addressing and the significance of this difference when copying formulae from one cell to another Use a SS effectively to produce substantial models of real-life situations Create and maintain single-table databases for real-life situations Understand the logical operators "and", "or" and "not" and their effect in compound search expressions Retrieve data from a DB using simple and compound queries on a single table Generate structured reports with both detail and summary lines from data in a DB Understand the purpose and structure of Internet Newsgroups Use a Newsgroup reader to read and post to a Newsgroup	Understand the purpose and advantages of a word processor Understand the role of computers in the design and production of high-quality publications Understand the role of email as a medium of communication Understand the purpose and advantages of a SS Understand how graphs help to summarise and visualise complex information Know which type of graph is most suitable for particular purposes Use a SS to produce appropriate graphs of real-life data Understand the difference between data and information Understand the purpose and advantages of a DB Understand the nature of the Internet and its use as a source of information
Know the basic filing **objects** —	Use a WWW browser to navigate through Web pages	Transfer the above knowledge and

Multistructural	Relational	Extended Abstract
documents, files, folders/ directories Know the basic filing **actions** — creating a folder, renaming, copying and deleting files and folders, viewing the contents of files and folders Know the basic **objects** of a user interface — pointing device, window, dialog box, menu, icon, intermediate (paste) buffer, toggle switch Know the basic **actions** of a user interface — selecting and moving objects, choosing options from menus, responding to dialog boxes, cut/ copy/ paste, insert/ typeover Know the main characteristics of a range of input devices, including keyboards, pointing devices (e.g. mouse, light pen, touch screen), and scanning devices (e.g. scanner, bar code reader, MICR, OCR) Know the main attributes of computer screens — pixel size, resolution Know the main characteristics of a variety of printers, including dot matrix, ink jet and laser Know the basic terminology of computer storage — bit, byte, kilobyte, megabyte, gigabyte Know the purpose and limitations of RAM Know the purpose and limitations of ROM	Use WWW search facilities to look for information on any topic Integrate information which is in multiple forms and comes from multiple sources Understand the importance of such integration in real-life situations Extract data from a database into a spreadsheet in order to create a graph Generate form letters by incorporating information from a database into a word processing document Use the copy function to move data between documents and applications Understand the purpose of and procedures for backing up computer files Use appropriate commands to organise and maintain computer files on a disk in a well-structured fashion Understand the difference between command driven and GUI interfaces Use a WIMP interface Calculate and interpret data storage capacities Understand the difference between primary and secondary storage and why both are required Understand the Input-Processing-Output model	skills to other modern software packages Understand how to go about buying computers for individual use Know how to recognise an individual's computer needs Know what criterion to use when comparing computer systems Understand the wider social implications of computing technology Understand the relationship between technological change and social change Know the major advantages and disadvantages of computers in terms of their impact on human society Demonstrate an improved ability to find and assimilate new knowledge Demonstrate an improved ability to organise and communicate your knowledge to others Appreciate the enjoyment and the rewards which can accrue from the effective use of computers
Understand the basic structure of computer disks — tracks and sectors Understand the differences between	Know the difference between operating systems and applications software Understand the role of an operating system	Develop strategies for dealing with the frustration of using computers

Multistructural	Relational	Extended Abstract
stiffies, floppies and hard disks Know the main characteristics of various other storage technologies (including magnetic tape and CD-ROM) Know the major hardware components of a computer Know the difference between hardware and software Know how a computer "boots" itself Understand the general structure of the Internet Understand the function of a modem and related concepts such as transmission speed, analogue and digital signals, data communications media	Understand the role of the operating system as a resource manager Understand the role of the operating system as an interface between the computer and the user Understand how documents are spooled to a printer in a multi-user environment Compare and contrast MS-DOS and Windows, especially in terms of interaction style Understand the role of inter-computer communication in real-life situations (e.g. electronic funds transfer) Understand the nature of computer viruses and how to prevent them infecting your computer Calculate and interpret simple data transmission statistics Understand the purpose and structure of local-area networks (LAN) and wide-area networks (WAN) Understand that a computing system includes hardware, software **and** people	

Clusters of Essential Outcomes

In this Table, the most important outcomes from the previous Table are clustered. Within each cluster, the outcomes are list in an approximate order of priority. Those marked with a two asterisks are tested by the proposed assessment instrument, one asterisk indicates those partially tested (see comments in the later section headed "Evaluation of the Computer Literacy RPL Assessment Instrument in terms of RPL Theory").

Multistructural	Relational	Extended Abstract
Hardware terminology** • input and output devices • modems • storage • RAM and ROM Software terminology** • word-processing • spreadsheets • filing system • user interfaces • databases • world-wide web • e-mail • graphics	Hardware — knowing the difference between disks** Computer systems • hardware, software and people** • difference between hardware and software** • difference between operating systems and applications* Using software • WP** • structuring files* • using windows** • spreadsheets** • databases — create • e-mail • graphs in SS • database — queries and reports* • WWW Difference between GUI and Command Interface Abstract concepts • appropriate use of graphs • logical operators* Numeracy • SS formulae** • calculating storage capacity Operational implications • integration of SW** • viruses • backup*	Transfer between packages** Purposes and Advantages of • computers** • WP* • SS* • DB* • email • Internet • data communications Information Processing • integrating information** • use of graphs Buying a computer • assessing individual needs** • choose the right computer**

Assessment Instrument

Introduction

After everyone is seated and their names recorded, a welcoming speech should explain the nature of the test and the consequences of passing and failing. This should follow a written script for consistency.

We will provide a brief (10 min) introduction to MS Works, indicating how to start, exit, use help, and create, open and save documents. Students should either be told to use the H: drive or be each given a stiffy.

Since we don't want to make the test a negative experience of computers, it will be important to try to put students at ease. Anyone who knows they are not computer literate may leave straight away, and anyone may give up and leave at any time during the test. There should be several invigilators who try to assist students, not by doing the work for them, but pointing them towards the Help system and perhaps suggesting what topic they should look under.

To force the students to use the spreadsheet facilities, we will not allow calculators.

Detailed instructions for the rest of the test should be given to each student on paper.

Time — Max 20 min.

Part 1 —Terminology

This will consist of 15 questions, administered via Question Mark software. The questions need to be worded simply (e.g. no double negatives) and should not contain any trick questions.

The first 2 questions should be examples which the group does together under instruction. These 2 and the next (maybe) 3 should gather student details such as name, student number, their self-assessed level of computer literacy, and prior experience of MS Works.

The remaining questions should be straight-forward recognition tasks assessing the students' knowledge of terms and fundamental concepts such as —

- RAM and ROM
- Bits, bytes, kilobytes and megabytes
- Hardware and software
- Input and output devices
- Basic UI terms — icon, window, menu, save, open, file, folder, search and replace, cut and paste
- Word processing terms — font, spelling checker, header and footer, page margins, tabs and ruler
- Spreadsheet terms — cell address, formula, automatic recalculation, range
- Database terms — table, query, report, data entry, field, record
- Internet terms — world wide web, email, modem
- Backup
- Viruses

These questions should be randomly selected from a database of maybe 50 questions. They could be multiple choice or require a number of options to be selected from a list, but should not require students to recall and enter answers as words. The students should be given their mark at the end of this section.

The final screen should give instructions about how to exit Question Mark and start Part 2.

Time — approx. 20 min.

Part 2 — Practical Skills and Broader Appreciation

This part assesses students' abilities to use software with which they are not familiar but which uses a standard WIMP-style UI. The software should be an integrated suite which includes DB, SS and WP — in our case probably MS Works. The task will require them to use each of the three components in an integrated fashion to produce a single final document. The task also requires the student to reflect on their appreciation of the broader role of computers.

It is expected that they will have to experiment and use the Help facility to discover for themselves how to work the software, however, the instruction sheet should guide them as to the structure of the task. When students ask questions, they should nearly always be directed towards the Help system rather than given a definitive answer. Under no circumstances should the supervisors touch the keyboard or mouse.

Instructions to Students

[Comments in these brackets are for us, not the students.]

1. Your task is to help Thembi Govender to decide which computer system to buy.

Information about Thembi Govender

Thembi is a secretary who has never used computers before but her boss has just been given a budget of R7 000 to buy a computer for her. Thembi has to arrange the purchase of a computer and she has asked you for advice.

Most of Thembi's work involves typing letters and other company documents. Sometimes these documents include graphs and tables of numbers showing the company's financial details. She has always done this using a typewriter and drawn the graphs by hand and doesn't really think that she needs a computer.

- What you need to do is write a letter to Thembi with your advice. The instructions below show you what to put in the letter.

- At the end you will have to print a copy of your letter. Your assessment for Part 2 will be based solely on that final print-out.

2. To write the letter, you will use a software package called Microsoft Works. You have probably never used this software before, but don't worry — nobody else doing the test has used it either. We have specifically chosen this software to see how well you can discover for yourself how to make it work.

Information about MS Works

MS Works includes a word processor, spreadsheet and database. You can work on these three types of document separately but can also copy information from one to the others quite easily.

There is also a Help system which we expect you to make extensive use of.

You should save your work to the H: drive frequently in case anything goes wrong.

- Start MS Works by ...

3. Luckily, we have a database which contains a recent catalogue of computers for sale. You will use this database to find the best computer to meet Thembi's needs. The database has records for each of 50 different computers and fields for the computers' model, clock speed, hard disk size, memory capacity and price. All computers come with mouse, keyboard, screen and Windows-98.

    - Get a copy of this database by opening the file ...

4. Use Help to find out how to sort records in a database.

    - Sort the catalogue of computers for sale from the most expensive to the least expensive.

5. Remember that Thembi cannot spend any more than R7 000, so find all the computers selling for less than that. (There should be 10 of them.)

6. Copy all the details for those computers and paste it into a new spreadsheet document.

7. The prices in the database exclude VAT, so we will use the spreadsheet to add VAT.

    - In a new column, enter a formula which will take the original prices and increase them all by 14%.

    - It's a good idea to save this spreadsheet so that your work so far can't be lost.

8. Now create a word processing document and write a letter to Thembi. The letter should include the following —

    - A list of the 10 computers in your spreadsheet along with their price (including VAT).

    - Which of those 10 computers you recommend that Thembi should buy. You need to explain to her *why* that is the best one to buy. [Some will now be over R7 000 due to VAT. There will be one which is obviously superior in terms of clock speed, RAM and hard disk.]

    - Apart from buying the computer itself, there will be other costs which the company will have to pay before Thembi can make productive use of the new computer. List at least three of these other costs. [Training, software, printer]

    - Since Thembi doesn't really think she needs a computer, you need to explain the sort of benefits she will gain by using a computer — list at least three.

> **Please note that what you write in this letter is important. We do not just want to know that you can type, but that you understand about broader issues of computing such as their advantages and disadvantages.**

9. Save this document and then print a copy.

Time — approx. 1 hour.

Shortened Version

The test is intended to be conducted in a double-period practical session in a lab accommodating 50 students. If the pilot-run of this test suggests that the total time exceeds 100 minutes, the test may be shortened by omitting the spreadsheet component but making the database manipulation more complex. That is, replace points 4 to 7 with the following —

1. Thembi cannot spend any more than R7 000, but she needs a computer with a large hard disk. We need to find the computers in the database which match these two requirements.

    - Use the Help facility to find out how to do database queries

    - Find all computers which cost no more than R7000 and which have hard disks no smaller than 500mb. (There should be 10 of them.)

2. Copy all the information for these 10 computers and paste it into a new word processor document.

This revised test does not refer to spreadsheets at all, but we may assume that students who can handle databases either already know spreadsheets of could master them easily. If required, more spreadsheet questions could be added to the MCQ section. The revised test should take less time since, although the database manipulation is harder, the student only has to interact with two of the sub-systems in MSWorks rather than three.

Evaluation of the Computer Literacy RPL Assessment Instrument in terms of RPL Theory

In the earlier table showing the clustered essential outcomes, asterisks indicate those outcomes which are assessed by the proposed test. All of the Multistructural outcomes are covered by the multiple choice questions in Part 1, and the majority of important Relational and Extended Abstract outcomes are covered by Part 2. We did not consider it necessary to explicitly test every outcome and considered such an exhaustive test to be too lengthy. It is more practical to test a subset of the outcomes and infer the overall level of competence from this subset.

For prior learning to be effectively recognised and accredited, RPL theory requires that assessment instruments meet the five criteria described in Section A. It follows that we need to evaluate our instrument in the light of these.

Validity	Yes. The process of categorising learning outcomes according to cognitive demands, and according to how essential they are to computer literacy, has ensured that our test is valid. It is designed so that we are explicitly aware that we are testing for particular understanding and knowledge in an applied way, on a computer.
Reliability	Yes, there is a degree of objectivity in this test. The multiple choice questions and the use of integrated software are objective tasks. Since the open-ended questions are more likely to be marked differently by different markers, it will be important to agree on the standard and quality of these answers before marking is commenced. Reliability will also be affected by the decision of whether students can have more than one chance at the test and related security issues.
Sufficiency	It is difficult to assess an entire course in ninety minutes. We have tried to identify the most essential aspects of computer literacy and tested as many of these as possible so that we can appropriately infer competence. If time is still a problem, we believe it is reasonable to leave out the work on the spreadsheets in favour of more work on the database. It is (arguably) reasonable to infer competence with spreadsheets from competence with databases.
Authenticity	Yes. Candidates have to work individually under test conditions.
Currency competent	Yes. Evidence of prior learning is required on a computer in the present.

Section C :— Implementation of the RPL Assessment Instrument

This section describes the process which must now be followed to put the test design into practice. It includes samples of an orientation flyer with which to advertise the test and a feedback form.

Process of Implementation

1. Set up the testing environment.
   - ♦ Create the multiple choice question set and configure the appropriate testing software.
   - ♦ Create a database of computers for sale to be used in Part 2.
   - ♦ Write a script for the administrator so that the instructions and introduction to MS Works are consistent across test groups.
2. Pilot the test on ten students including some for whom English is not their mother tongue.
3. At registration give all potential candidates an orientation flyer (see below for suggestion of content) and a copy of the intended learning outcomes for CS101.
4. Make one staff member available for student questions and to provide personal orientation and advice before the test. In strict RPL circumstances, this is not the assessor as it puts both the student and assessor in compromised positions. The advisor cannot prepare the candidate freely for the test if he/ she is also the assessor.
5. Set a date by when all candidates need to register for the test.
6. Administer the test.
7. Mark the test.
8. Interpret the test scores. In most cases the interpretation should be simple given the design of the test. However, be prepared for discussion of border line cases or for students who pass one level of understanding excellently and one not sufficiently — see issues for consideration. Ideally, interpretation should be done in a small group.
9. Make marks and 'feedback form' available to students (see below for suggestion of layout of feedback form).
10. Make one staff member available for student queries and to provide educational guidance to the students. Ideally, this should be the initial advisor as students will be familiar with him/ her. Future educational guidance is an essential feature of RPL.

Orientation Flyer

Four purposes of the Orientation Flyer:—

- Potential candidates will be able to make informed and accurate judgements about whether to proceed with the RPL computer literacy test.
- Participants will be made aware of what they need to do to obtain credit for their prior learning.

- Participants will be able to identify their advisors and assessors, and know the role that each will play.

- Participants will have sufficient information about the content, structure and procedure of the test.

Suggested Content

The School of Mathematics, Statistics, Computer Science and Information Systems is instituting a new test for students in 1999. The test is designed to assess students' level of prior knowledge to determine:—

- if students who want to enrol in CS101 are sufficiently computer literate so that this prior knowledge can be recognised and formally accredited by the university and they can be granted exemption from the course,

- if students who want to enrol in CS130 are sufficiently computer literate to manage and cope with the academic demands this course will place on them.

The School believes that having an appropriate level of prior knowledge in computer literacy is essential for academic success in computer science and business information systems. We hope that this test will be used as a guide to direct students into the most suitable course to enhance their chances of academic success in computer science and information systems.

Our School's Definition of Computer Literacy

For the purposes of academic work at the university level, we consider computer literacy to involve each of the following things —

- Adequate knowledge of computer terminology
- The ability to interact with a modern user interface to the extent that you can teach yourself how to use a new software package
- Understanding of the appropriate role of computers in organisations and society, given their benefits and limitations.

Structure of the test

You will be allowed 100 minutes to complete the test, including some time for us to introduce you to the software used in the test. In that 100 minutes, students need to demonstrate that they have appropriate understanding and knowledge of computer terminology, a modern user interface, and the appropriate role of computers in organisations and society.

The entire test will be assessed on computer using a software package which you probably haven't seen before. In order to pass the test, you need to prove your abilities in each of three aspects of computer literacy described above. The test will involve multiple choice questions, open-ended questions and the practical use of a word processor, spreadsheet and database.

Invigilators will be available for support and guidance during the test, however, they will not actually do any of the work for you.

Students are allowed to leave at any point during the test, and they are allowed to sit the test more than once [??? School still needs to decide].

Procedure for Registration

If you wish to register for the test, times and dates and people and places are [??? School still needs to decide].

[Alternatively...] All students in the following categories need to do the Computer Literacy Test in the Computer Science laboratory (G24 of the Science Block) during the first week of semester. [Followed by a list of categories (CS130, Law etc) and the time they should come for the test.]

Advisors

If you have more questions regarding the test, please contact [??? School still needs to decide]. This person will advise you about the test. She or he will not be included as one of the assessors to maintain fairness and objectivity.

Results

Results of the test will be made available by [??? School still needs to decide] on this date. All students will receive a form which will explain their strengths and weaknesses in relation to the School's definition of computer literacy. Should you wish further clarification students should see their advisor as directed above.

Sample Feedback Form for Computer Literacy Test

Student Name *Student Number*

Well done for attempting our test to recognise your level of prior understanding and knowledge of computer literacy!

As explained earlier, our School defines computer literacy as:—

- Adequate knowledge of computer terminology
- The ability to interact with a modern user interface to the extent that you can teach yourself how to use a new software package
- Understanding of the appropriate role of computers in organisations and society, given their benefits and limitations.

In order to pass the test, you needed to achieve the required mark in each of the three sections:

Multiple choice questions to test your knowledge of computer terminology. Pass Mark: ???%	Integrating different applications to test your ability to interact with a modern user interface to the extent that you can teach yourself how to use a new software package. Pass Mark: ???%	Open-ended questions to test your understanding the appropriate role of computers in organisations and society. Pass Mark: ???%
Your result	Your result	Your result

Interpretation of your result shows that you :—

- did achieve the appropriate result in all three sections and that the School considers you computer literate.
- did *not* achieve the appropriate result in all three sections and that the School considers you insufficiently computer literate.

The School advises you to :—

- apply for exemption from CS101
- enrol in CS101 to meet your course requirements
- enrol in CS101 before you enrol in CS130 to give you greater chance of academic success

Please contact [test advisor] for further direction.

Section D: — Guidelines for Project Evaluation[5]

The intervention is designed to meet two goals —

1. RPL for granting exemption from CS101 for certain students (e.g. Law students)
   - ♦ The purpose of evaluation here is to ensure that the test appropriately assesses the level of computer literacy. That is, to evaluate whether the test is pitched correctly so that the right students are exempted.

2. RPL in order to advice or guide students to the appropriate course (either CS101 or CS130)
   - ♦ The purpose of evaluation here is to determine whether computer literacy is indeed necessary for achieving academic success in computer science.

Evaluation should not be restricted to the test itself, but needs to include the role that resources, procedures and management have played in the success or failure of the test. With this in mind there are several possible evaluation questions —

- Did the test assess the appropriate level of computer literacy, both in terms of content and cognitive level?
- Did the test fit the purpose for which it was designed?
- Did the way the test was managed and implemented and the resources made available for the implementation contribute to its validity as an instrument?
- Is computer literacy a necessary pre-requisite for computer science?

Some suggestions about strategies for evaluating the two goals —

Goal 1

- Allow the students who were surprised that they failed the test to prove their computer literacy by other means. For instance they could be given an individual oral/ practical test, or demonstrate a portfolio of their work. If significant numbers of such students were then seen to be acceptably computer literate, it would indicate that the test was too strict.
- In order to establish whether the 100 minute time limit was a significant restriction, one test group should be given unlimited time. The difference between the results for this group and those of the time-restricted groups could be analysed for significance.
- Students who have already passed CS101 could be asked to do the test (either with MS Works, or more properly with other software with which they are unfamiliar). If significant numbers fail, then it either calls into question how they passed CS101 or suggests that the test was too strict.

Goal 2

- Compare the results of students who failed the test and took our advice to do CS101 before CS130 with those of students who failed the test but still went straight into CS130.
- Select a small group of students taking CS130 and interview them during the semester. The qualitative data from these interviews could indicate which aspects of CS130 are most difficult. The responses of students who failed the computer literacy test could be compared with those of the students who passed the test in order to establish whether the inadequacy of prior computer experience is a significant factor.

[5] The structure for these guidelines are taken from Gall, M. D., Borg, W. R. & Gall, J. P. (1996) *Educational Research: An introduction* (6th Ed). Longman, New York.

Section E :— Issues for Further Consideration

The following are issues which the School will need to consider. The represent either decision which need to be made, or issues to keep in mind while running the test.

1. **The School needs to be very clear on their motivation for this test.**

   The RPL framework is a good model to use. It encompasses the two motivations for the test, that is to test students' level of prior knowledge to determine if they have sufficient competence to be accredited the course and be exempt from the Computer Literacy; and to test students' level of prior knowledge to determine if they have sufficient competence to manage CS140.

   Issues of validity and reliability are criteria used to judge any assessment instrument. Using Biggs's SOLO taxonomy to make explicit the learning outcomes of the course has helped us to design a valid instrument within the RPL framework.

   RPL is politically correct and will be used more frequently within the university and South Africa in the near future.

2. **The School needs to be very firm and explicit about its definition of computer literacy. As teachers, the School sets the required standards of learning outcomes. The School needs to justify its decisions with reference to their understanding of computer literacy.**

   Proposed definition

   To be considered computer literate, candidates need to:—

   - Have adequate knowledge of computer terminology
   - Be able to interact with a modern user interface to the extent that they can teach themselves how to use a new software package
   - Understand the appropriate role of computers in organisations and society, given their benefits and limitations.

   The School needs to be aware that they are asserting that computer literacy requires high level cognitive skills. Teaching students on MS Works with the hope that they can transfer what they have learnt to other software packages requires extended abstract levels of cognitive understanding. The School might need to justify this decision in terms of the nature of technology and their discipline.

3. **Decide on the percentage in each category of understanding the student requires in order to 'pass' the test.**

4. **Ensure that there is a common understanding of the quality of the open-ended questions and how they will be marked between the markers of this section.**

5. **The School needs to be prepared for a situation where a student might score very highly in one or two performative aspect of understanding, but not in the other. For example one student might do well in his/her relational and multistructural performative aspect of understanding, but might not fair well enough to pass the extended abstract task demands. Will this student be exempt from the course? Will the student be asked to enrol in the course? Will the School exempt him/her from the course and provide resources for self-study to 'catch-up' the 'understanding gap' requiring the student to do a simple assessment at a later date?**

   This could become an ongoing question. It is unlikely that all students will fit neatly into our definition of the required level of prior knowledge. Because this is the pilot test, there should

only be two categories: exempt/ not exempt. Students should be made aware of this before sitting the test to prevent too many queries.

The future evaluation of the assessment instrument and future experience and institutional changes might give more insight into this question at a later date.

6. **Will students be allowed to sit the test more than once in a limited period of time, that is have repeated chances at the same test?**

   We are unsure. It depends on the School's concern for security. It is possible that a student would be advantaged if he/ she then went and learnt the package, Microsoft Works, so that he/ she could then do the relational task demands of the test. This might subvert the process if it is a high priority that a student be able to interact with a modern user interface to the extent that they can teach themselves how to use a new software package. However, a student who is familiar with Microsoft Works would be advantaged in this case anyway, and the test would then not be a valid instrument to test extended abstract performative aspects of understanding.

7. **How will issues of security be addressed, for example what will happen if candidates tell each other what is in the test?**

   This relates closely to the concern above. The multiple choice questions will be randomly selected from a large set and so redoing Part 1 should not be a problem. If security is a high concern, it could be possible to develop several versions of Part 2.

8. **The administrators of the test need to be prepared for students who approach the assessment in a prestructural and unistructural manner. In these instances it will soon become clear that these students do not know what to do and might ask a lot of questions during the assessment time. How many answers are the invigilators allowed to give? What type of answers?**

9. **Should all students be given a copy of the intended learning outcomes for CS101?**

   This could be given out with the orientation flyer at registration. It will help orient students more and enable them to make a better decision if they want to enrol in the course.

Proposed Process for Establishing an Exemption Test for Computer Literacy

November 1998

Background and Aim

The University is committed to encouraging computer literacy in all students and to that end the Department of Computer Science and Information Systems has offered a course in computer literacy (Computer Science 101) for many years. However, there are a growing number of students who arrive at university having already completed Computer Studies at high school, or having gained adequate knowledge and skills in computing through some other means. For such students, the CL course is redundant.

The Department has also noticed that many students without prior experience of computers find the first course of the Computer Science major (CS130) to be very difficult. Rather than reduce the level of this course, we want to re-direct students at risk into the CL course.

We plan to address these issues by creating a pre-test of computer literacy which enables us to judge which students should be required to complete the 8-credit CL course and which students should be exempted.

Target Groups

The test will be given to students before they commence their first year of study. There are several target groups for this test —

- All Law students will be required to pass the CL course except those who attain a sufficient level in the pre-test.
- All Commerce students doing the new 8-credit End User Computing course will also need to pass CL except those who attain a sufficient level in the pre-test.
- Science students who register for CS130 must either have already passed CL or have attained a sufficient level in the pre-test.

Pilot Study

It is difficult to formalise the recognition of prior learning and the design of effective placement tests is not straight-forward. We propose to enlist the help of some educational specialists to design a test which can be piloted at the beginning of 1999. The effectiveness of this test will be evaluated at the end of the first semester and adjusted accordingly.

Responsibilities of Educational Consultant(s)

1. Investigate previous research regarding the design of placement tests and advise us which educational models are appropriate for our context.
2. Investigate how our initiative relates to others within the university, especially with regard to the university's proposals on the recognition of prior learning.
3. Discuss the Department's understanding of computer literacy and assist us in the overall design of the pre-test.
4. Develop a set of evaluation criteria which can be applied to the test. This evaluation should include a comparison of the pre-test results with the students' grades in CL, EUC and CS130.
5. Evaluate the effectiveness of the test at the end of first semester and advise whether and how the test should be adjusted.

Deadlines

1. 31 Dec 1998 — Design of pre-test to be completed
2. 31 Jan 1999 — Pre-test to be implemented and tested
3. 15 Feb 1999 — Pre-test to be given to first-year students
4. 30 Jun 1999 — Evaluation of pilot to be completed