Assessing Student Performance in a Theoretical Computer Literacy Course

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Abstract

Students studying to become Chartered Accountants at a large South African Open Distance Learning (ODL) institution are failing an introductory course in computer literacy at an alarming rate. Over a period of five years the responsible lecturers proposed various methods to students on how to study and prepare for the examination of the subject, with some degree of success. The literature suggests that the problem emerges even before school level or at least as early on as primary school education. In an ODL environment students are faced with the absence of a classroom environment, a facility which many students, fresh from school, still have a need for. However, having marked a few thousand scripts twice a year over the past five years, the lecturers identified a number of sub problems all part of the larger problem of students having to use English as their second or third language to master a content subject. Other problems include ignorance of the study material and an inability to determine the relevance of a formulated answer to a question.

Keywords: Computer literacy, home language, language proficiency, pass rate, second language, student performance, student responses, teaching environment.

Introduction

Over the past five years I have been involved in the teaching and assessment of a theoretical computer literacy course for Chartered Accountant students.

The pass rate of this particular course was unacceptably low (e.g. 17% in 2005). We are faced with a number of challenges as our students come from vastly different backgrounds. Figure 1 indicates the broader composition of the students enrolled for this course over the past two years.

Groupings	2008	% of total	2009	% of total
Indian	1,600	13.26%	1,463	11.57%
African	6,498	53.84%	7,300	57.71%
Coloured	695	5.76%	776	6.13%
White	3,277	27.15%	3,111	24.59%
Total	12,070	100.00%	12,650	100.00%

Figure 1: *Composition of students enrolled for the course for 2008 and 2009 (Heda, 2009)*

If we consider the home language of the enrolled students and compare it with the language in which students study and also receive their study material, it becomes clear that many students have no option but to enrol for this course in a second or even third language.

Figure 2 shows a comparison between home language and language of tuition (also called correspondence language) for 2008 and 2009. Approximately 30% (32.48% and 27.64%) of students are native English speakers and this leaves 70% of students with the option of receiving tuition and study material in a second or third language.

Correspondence Language				
Language	**2008**	**%**	**2009**	**%**
Afrikaans	1,576	13.06%	1,426	11.27%
English	10,494	86.94%	11,224	88.73%
Total	**12,070**	**100.00%**	**12,650**	**100.00%**
Home Language				
Language	**2008**	**%**	**2009**	**%**
Afrikaans	2,013	16.68%	2,056	16.25%
English	3,920	32.48%	3,496	27.64%
Other languages	6,137	50.85%	7,098	56.11%
Total	**12,070**	**100.00%**	**12,650**	**100.00%**

Figure 2: *Comparison of correspondence language with home language (Heda, 2009)*

Other languages in Figure 2 include: French, German, Greek, Italian, Ndebele, Ndonga, Northern Sotho, Portuguese, Shona, Southern-Sotho, Spanish, Swati, Tsonga, Tswana, Venda, Xhosa and Zulu.

Problem Statement

A large number of Chartered Accountant (CA) students fail a first-year introductory course in Computer Literacy and this paper aims to identify reasons for the failure of this course.

Research Questions (RQs)

The following research questions are addressed:

1. What is the students' attitude towards the available study material? – RQ1
2. What is the effect of language proficiency on the pass rate when a second or even third language is used for study? – RQ2
3. What are the typical mistakes made by students when answering examination or assignment questions? – RQ3
4. What is the effect of the ODL model on the pass rate? – RQ4

Literature Survey

Students who are studying a subject which is content related, in a different language than their mother tongue are faced with the problem of content literacy. Content literacy is defined by Hurley & Tinajero (2001:87) as: 'the ability to use reading and writing to learn subject matter in a given discipline and how a student uses literacy to learn'. It is well known that students who have to use a language in which they are not proficient in (typically their second or third language) to master course content, for example a theoretical course dealing with computer literacy, experience serious problems in mastering the subject matter (August, 1994; Collier, 1995; Tinajero & Schifini, 1997). Although the course in question is a supportive subject for the qualification, the South African Institute of Chartered Accountants (SAICA) prescribes a comprehensive syllabus that Universities should adhere to (SAICA, 2009). The integration of the use of computers into other

courses for CA students is one of the aims of SAICA and is in line with other international universities (Larres, Ballantine and Whittington, 2003). However, this integration can only be successful if students understand the underlying theory of the subject.

When studying course content using a second or third language, students first need to become proficient in the particular language before they can sensibly utilise this knowledge to comprehend the content of the subject. Language plays a fundamental role in the understanding of technical terms and may therefore seriously affect the student's success in a content-related subject if not correctly addressed (Vacca and Vacca, 2007, Met, 1994). This dilemma is also highlighted by Hurley and Tinajero (2001:87) when they claim that 'non-English speaking students are expected to adapt to two or more languages and still make sense of content reading'. In the same vein Wang (1996:8) reports about a course conducted in English that 'the higher the proficiency in English, the better the academic achievement (in that course)'. Cummins, Chow and Schecter (2006) report that the 'development of literacy in two or more languages (additive bilingualism) constitutes a positive force in children's educational and personal development'. They also state that the encouragement of a child's mother tongue development will not hamper the development of English academic skills. It is plausible, therefore, that the language literacy problem starts even before school (Welsh Assembly Government, 2008). Naturally it is the purpose of a language to assist a student to comprehend what is happening, to understand and to be understood. Language and semantics are, therefore, closely intertwined and cannot sensibly be separated. Poor vocabulary knowledge of students affects their language proficiency (Li, 2007, Brassel and Furtado, 2008) and may hamper students in grasping the content of a course.

When studying, students are increasing their information literacy and the use of a computer may assist students in their quest for information and how to find and evaluate the information. According to Dunn (2002) students' information literacy need to be assessed and this is why a theory course may assist students to be more knowledgeable. Computer literacy courses of a theoretical nature normally cover vast amounts of technical terminology and many students attempt to master such terminology using their second or third language. Students need to develop the cognitive and academic skills required already at school level to succeed in learning

academic subject matter (Collins, 1995). Teachers need to integrate language learning with content learning, making use of the students' experiences and to focus on higher-level cognitive skills (Hurley & Tinajero, 2001). Cummins et al. (2006) emphasise the importance of extensive reading and writing to develop 'academic self-confidence and academic language proficiency'. If the problem is not addressed adequately at both primary and secondary school level, the student has a disadvantage when studying at a Tertiary Institution. The problem is compounded when the medium of tuition is primarily through distance learning.

Students who receive study material in a language that is not their mother tongue may often experience some degree of negativity towards their studies. One may therefore argue that our research question 1 above is closely linked to the literacy problem of research question 2.

ODL may be defined as: 'A type of education, typically college-level, where students work on their own at home or at the office and communicate with faculty and other students via e-mail, electronic forums, videoconferencing, chat rooms, bulletin boards, instant messaging and other forms of computer-based communication' (Webopedia, 2009). In this paper we argue that the ODL model may in part be responsible for the problem discussed further on. With the advance in technology, ODL models may become more efficient in the use of media supplements (Lupo and Erlich, 2001), but currently the South African ODL scene is still some distance away from the full usage of such technologies.

The following section presents the teaching environment of the course followed by the research methodology, namely, data collection and data analysis. Student responses are categorised thereafter into the following groups: 1) relative ignorance of the prescribed material, 2) limited comprehension of English as second language and 3) incorrect pattern fitted onto a question. The research questions are revisited and some relationships among the sub problems are identified and collated in a diagram as part of research question 3. The attitude students may have towards their study material is considered throughout and the impact the ODL environment may have on all these is considered. Towards the end a number of steps are presented to solve some of these problems. The paper concludes with an analysis and some pointers for future work.

The Teaching Environment

The course under discussion is a theoretical computer literacy course for first-year accounting students at a large ODL institution. It is a semester course and examinations are written during May and October every year. The material for the course consists of a prescribed text book (which the students have to buy from an official bookseller) and a study guide which is included in the student's study package upon enrolment for the course. The student enrolment comprises an average of 7 000 students during the first semester and 6 000 for the second semester. The pass rate for this particular course has always been low (see above), despite the fact that the lecturers embarked on a number of measures in an attempt to improve the pass rate. These measures include the following:

As a first measure we introduced by means of a tutorial letter a number of generic guidelines for studying the particular subject. These guidelines were simultaneously published on the web page for the course and also included as a hard copy document returned with the marked assignment of each student. This measure appeared to have had some effect, since our pass rate increased with about 3% (from 27% to 30%) during the October/November 2006 examination.

With a next student intake we employed two further measures: (1) we rewrote the study guide, incorporating a step-by-step study method, aimed at explaining the character of the course and (2) learning outcomes previously presented as pure statements were rewritten as questions, known in Outcomes Based Education (OBE) terminology as *knowledge tests*. Note, however, that these were just the questions and the students still had to determine the answers themselves. Before these measures our pass rate has increased from 17% during October/November 2005 to 30% in the October/November 2006 examination. However, after the above two measures were implemented our pass rate decreased to 27% during the May/June 2007 exam. This was somewhat disturbing, especially given the fact that the new study guide was written according to the guidelines proposed by experts in tuition, internal to our institution.

Research Methodology

Content analysis was used to analyse and interpret data as shown in the two sections below:

Data Collection

Having observed low pass rates for a number of years (16.99% for October/November 2005 – 43.81% for May/June 2009), I decided to analyse a number of low-mark examination scripts of students, a large number whose first language is not English. When marking between 5 000 and 7 000 scripts during each exam, similar and recurring mistakes made by students become apparent. Copies of scripts with these recurring mistakes were made during each exam and a number of these copies are used in the discussion further on in this paper. The data collected was for the period October 2005 to May 2009.

Data Analysis

The aim of this phase was to perform a content analysis (Mouton, 2004) on the exam scripts identified in the collection phase and classify typical incorrect responses to questions as well as problematic type of examination questions. It became clear that a lack of language skills and content literacy are the main contributors of the low pass rates. Lack of language skills could lead to frustration with prescribed study material while the lack of content literacy could in part be attributed to the ODL model.

The observations made during the analysis are categorised and presented below.

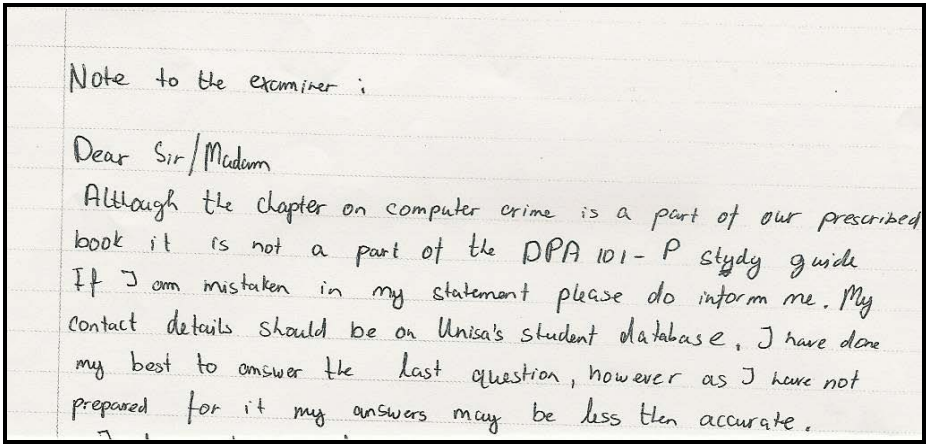
Categorisation of Student Responses

A preliminary account of the problems given below was presented at a recent conference (van der Poll and van der Poll, 2007).

Relative Ignorance of the Prescribed Material

The first problem that was identified is that students are relatively unfamiliar with the prescribed study material. Of course, this phenomenon is nothing new, but it is plausible that the non-classroom, non face-to-face contact characteristics of the ODL model could aggravate this problem. The attitude of a student towards prescribed study material could also lead to unfamiliarity with the content.

An example is given in Figure 3. The student claims that although the prescribed text book contains a section on computer crime, the study guide does not include this topic.


Note to the examiner :

Dear Sir/Madam

Although the chapter on computer crime is a part of our prescribed book it is not a part of the DPA 101-P stydy guide If I am mistaken in my statement please do inform me. My contact details should be on Unisa's student database, I have done my best to answer the last question, however as I have not prepared for it my answers may be less then accurate.

Figure 3: *Student's note in an examination script*

The above claim by the student is, however, incorrect. Section 8.1 of study unit 8 in the study guide for the course does indeed cover computer crime. The statement made by the student may be as a result of not following the guidelines that we propose in the study material or because of complete ignorance of selected parts of the study guide, as can be seen in Figure 4 which is an extract from the study guide in question.

8.1 Computer Crime

Computer crime includes a wide variety of criminal activities of a traditional nature, for example, theft, fraud, forgery and mischief. The abovementioned has spread to the computer environment. The use of computers has lead to a large number of new forms of misuse of technology.

Activity 8.1

Read the text book, chapter 9 (page 193 – 197) carefully.

Figure 4: *Extract from the 2009 study guide for the course*

In the next section we identify a number of sub problems of the larger language proficiency problem discussed before.

Limited Comprehension of English as Second Language

In figures 5, 6 and 7 below three different students reveal anything from a minor to a complete lack of understanding of their second or third language. Naturally, if a student does not comprehend the language used to communicate in (and owing to the ODL model, the lecturer is not physically present to assist), it is difficult, if not impossible, to understand the subject content, leading to a despondent attitude towards the study material.

The answer in Figure 5 was given by a student in answer to the question: *Define computer crime*.

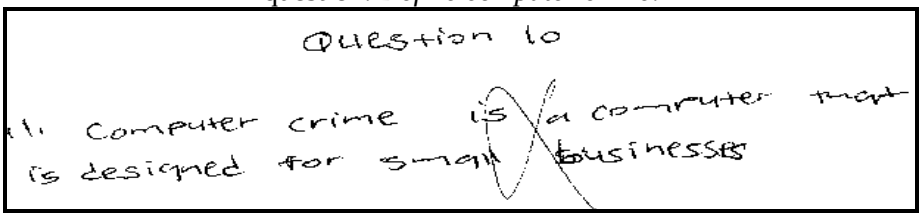


Figure 5: *Answer from a student to a straightforward content question*

Figure 6 shows an email from one of the first year students accentuating the challenges that students with a second or third language face when trying to communicate. It is very difficult to really comprehend what the student is articulating.

Subject: clueless about the course

Hi

i'm sorry to bother you but i'm new in the field and its been so difficult for having to take a clueless course that has a DPA101P module in it.
my plea to you is that, is it possible for to light with a bit of information towards the module and which contacts should i consider for help during my second semester?
Regards

In a classroom environment the student could have been assisted by the lecturer to formulate the question and subsequently receive a sensible answer. In an ODL environment students have to rely very much on email contact with lecturers.

Figure 7 is an answer given by a student to the question: *Briefly discuss fraud by means of computer manipulation with specific reference to data diddling*. Incorrect word sequences and grammar mistakes make it virtually impossible to understand what the student was attempting to articulate. This may be because of a serious inability on the student's side to efficiently use his or her second or third language.

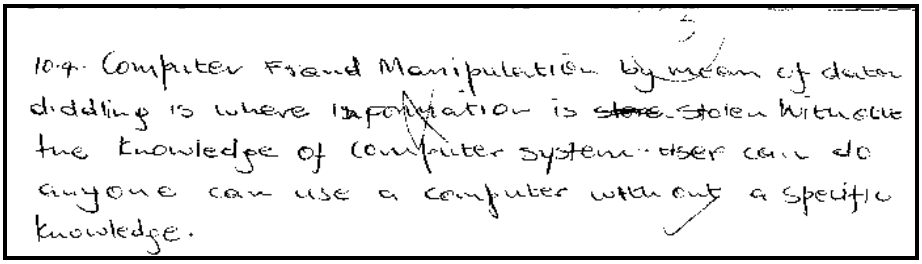


Figure 7: *Quote from student's examination script: 1st articulation problem*

In the next case students were asked to *name five (5) types of computer crime*. From the partial answer given by the student in section (iv) in Figure 8, namely, *unauthorised protective the computer system develop*, it becomes clear that this student is also battling to express him- or herself in a second or third language.

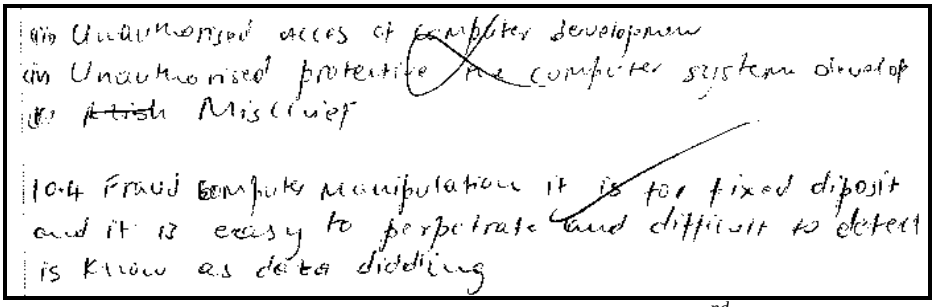


Figure 8: *Quote from a student's examination script: 2nd articulation problem*

In the answer to the same question reflected in Figure 9, namely, *it can happen when someone pay with money at lower costs*, it is also clear that language literacy plays a vital role in expressing oneself correctly.

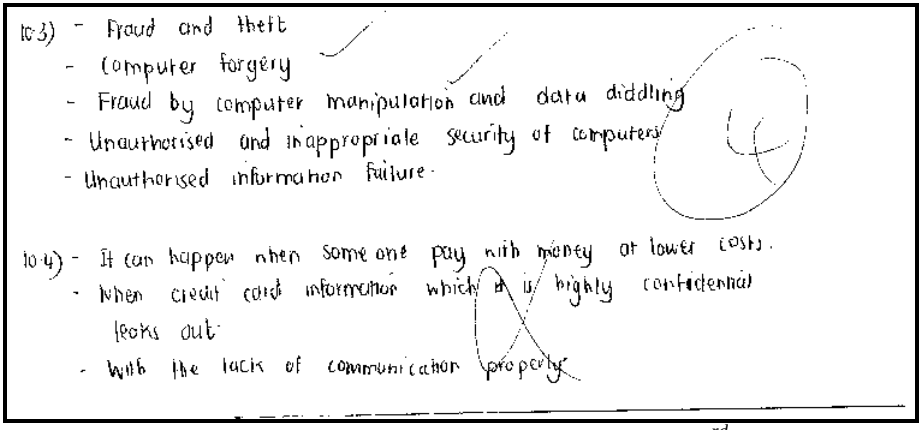


Figure 9: *Quote from a student's examination script: 3rd articulation problem*

The questions above are all based on the final study unit (i.e. study unit 8) in the study material supplied to the students. The reason for failure is either because they do not get round to studying the final study unit or the language problem addressed in this paper, coupled with the attitude problem mentioned before.

Next we discuss scenarios that relate to RQ3 above, namely, common mistakes made by students when giving an answer to a question.

Incorrect Pattern Fitted onto a Question

A well-known researcher in Computing, namely, Michael Jackson (1994) discusses an approach taken by the ancient Greek mathematicians who separated the study of problems (i.e. exam questions in our case) from the related study of solutions (i.e. answers to these questions) and solution methods. A problem has an architecture part given by its principal parts and solution task. Jackson (1994) and Polya (2004) both explain the differences between, for example, problems to *find* or construct such as: *Given a transaction, show how it will be analysed according to GAAP and entered*

into the books of a company and problems to *prove* such as: *Prove that a company is applying income smoothing from one year to the next* (Van der Poll, 2003). GAAP (Generally Accepted Accounting Principles) is a set of guidelines for conducting accounting practices in South Africa (Sowden-Service, 2008).

All the problems in our first-year accounting course are of the first kind, namely, to find the solution to a problem. Jackson (1994) coined this, the *problem frame* approach and the essence of his approach is to first concentrate on the architecture of the problem instead of immediately concentrating on the solution. Having established the architecture of the problem by determining its principal parts and solution task, one fits a problem frame or template, for which there is a known solution onto the current problem. Nowadays this technique is generally known as establishing *patterns* for actions or problems (Fowler, 2003).

The major challenge with the problem frame or pattern approach emerges when one identifies the principal parts of the problem incorrectly, i.e. we try to fit the wrong frame or pattern onto a problem. Students seem to fall into this very same trap in the sense that they misidentify the frame to be fitted onto a particular examination question and subsequently fit the wrong answer onto the question. Some examples are given below.

Question 9.2 in the examination under discussion was: *Name the items which should be dealt with in a system/development report*. The student simply writes down words or phrases he or she loosely recalls from the entire study material (prescribed book and study guide).

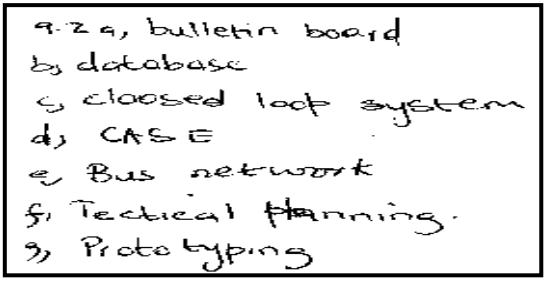


Figure 10a: *Student's incorrect answer (shotgun approach)*

a) Key decision analysis
b) System framework
c) Information flows
d) Database design
e) Controls
f) Authorities
g) Build proposals

Figure 10b: *Correct answer*

The student's incorrect answer is reflected in Figure 10a and the correct answer is given in Figure 10b. In this paper we call this the *shotgun* approach. The shotgun approach may be viewed as a pattern-matching problem since parts of the answer given by the student may be relevant to the question (e.g. *Prototyping* – Figure 10a is related to *Build proposals* – Figure 10b, but these concepts are not the same).

In Figure 11a the student lists the characteristics of useful information when asked to '*List the components of computerised systems*'. The correct answer to the question appears in Figure 11b. A possible parallel to be drawn between the student's answer and the correct answer is that *Data and Information* (Figure 11b) must have (e.g.) *Relevance* (Figure 11a).

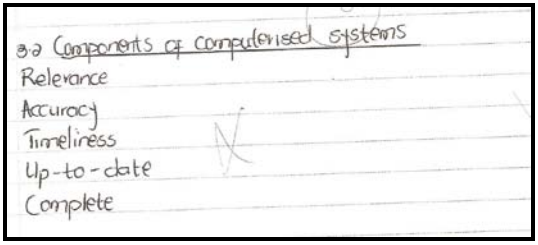


Figure 11a: *Student's incorrect answer (shotgun approach)*

- Computer system
- Data, Information, Database
- Users
- Objective
- External environment

Figure 11b: *Correct answer*

In Figure 12 a student wishes to list *uses* (i.e. looking for a verb) of communication systems but instead lists *users* (i.e. misinterpretation as a noun).

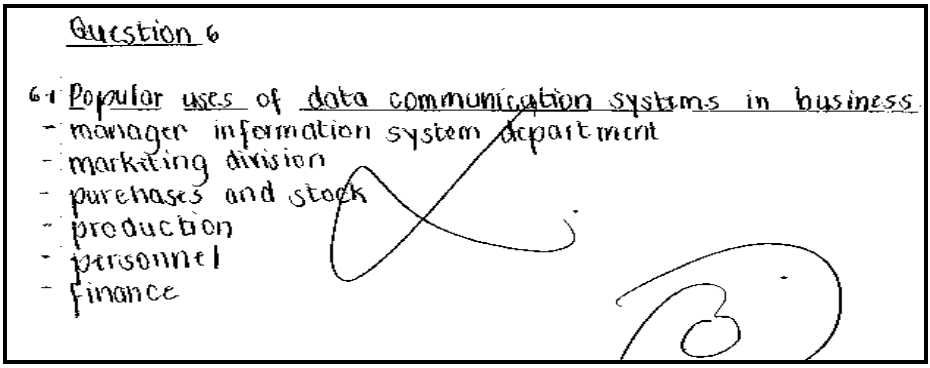


Figure 12: *Verb-noun misinterpretations*

It appears as if the student either misinterpreted the question as *users* or decided to write down the users instead of uses because he/she happened to know this answer instead. This could be a language problem or simply an incorrect pattern matched onto the question.

The question asked to the response in Figure 13 was to *supply reasons why an information systems strategy is necessary*. The student knew *users* of an information system and decided to list them instead of reasons. In this case there was a mismatch of two nouns on the part of the student. It is clear that this student knew something but we did not ask the *correct* question which this student was prepared for. This may be an instance of the well-known 'spotting' problem related to an attitude towards study material.

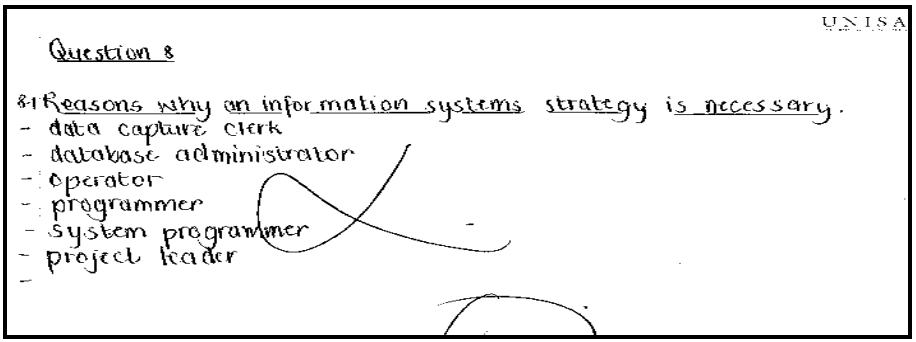


Figure 13: *Conceptual misinterpretation*

Revisiting the Research Questions

The above observations shed some light on the 4 research questions:

RQ1: What is the students' attitude towards the available study material?

It was observed that students often display much ignorance of the study material, so much so that one claimed certain material was not covered in a study guide. Ignorance of study material could relate to an attitude problem towards the study material and indeed the course itself.

RQ2: What is the effect of language proficiency on the pass rate when a second or even third language is used for study?

Numerous language problems were observed above. It is clear that students studying and receiving study material in a language other than their first language experience serious problems when answering examination or assignment questions. This uphill language battle for students may affect their attitude (RQ1) towards their studies negatively. Statistical analysis with appropriate hypothesis testing would be called for to confidently substantiate this result.

RQ3: What are the typical mistakes made by students when answering examination or assignment questions?

A number of mistakes have been revealed in the above analysis. These mistakes are interrelated in the sense that some mistakes are subclasses of larger classes which in turn are subclasses of the super class which we call *Student problems*. These interrelationships among the problems discussed

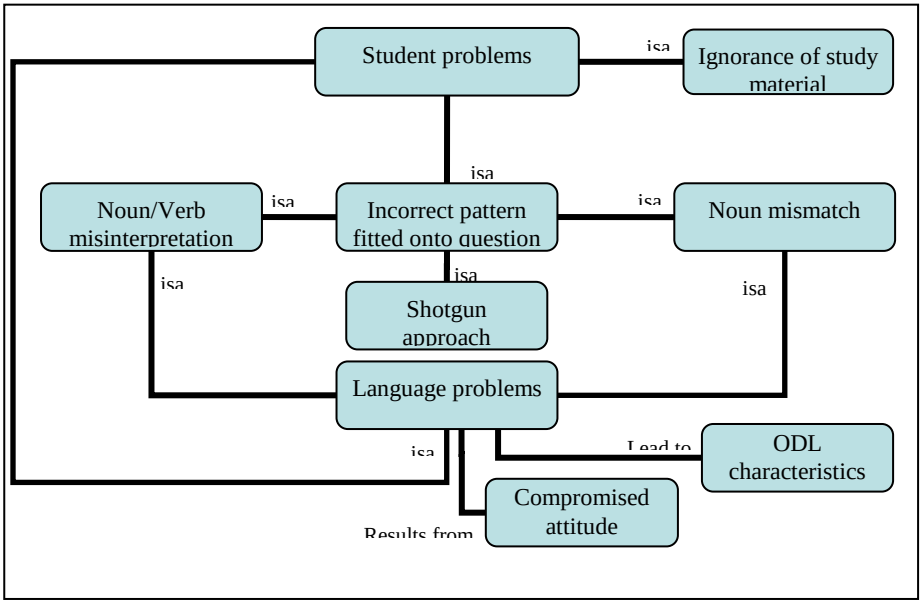


Figure 14: *Diagram relating student problems*

above are summarised in Figure 14. In this figure we borrow the familiar *isa* (cf *is-a*) notation from the object-oriented paradigms (Booch et. *al*, 2007) to denote that some instances of a class are actually occurrences of a larger super class.

Figure 14 shows that the class of all student problems discussed in this paper are divided into three subclasses, namely, *ignorance* of the study material, *incorrect patterns* fitted onto questions and *language* problems. The class of incorrect patterns is further partitioned into three subclasses, namely, the shotgun approach, noun/verb misinterpretations and noun mismatches (e.g. confusing users with reasons). These latter two classes are hybrids in the sense that they are also instances of the larger class of language problems.

RQ4: What is the effect of the ODL model on the pass rate?

The use of an ODL model is usually unavoidable for a correspondence, distance-learning institution. While it fulfils an extremely important need for students who cannot attend a residential learning centre, it brings about a number of problems, some evident above. Many of the language problems indicated in this paper could in part be attributed to the absence of a classroom environment where a facilitator could otherwise have assisted the students in articulating their answers and questions appropriately.

A worthwhile (yet difficult to set up) experiment would be to run the exact same course at both a residential and an ODL institution and observe possible differences in student examination answers and performance.

In the next section we propose some preliminary solutions to the problems presented in this paper. The solutions are suggested keeping in mind the 4 research questions.

Preliminary Solutions

The following mechanisms may be implemented. In each case an action is proposed and the particular problem which our action aims to address is given in brackets:

1. Introduce a bridging course, e.g. English for Accountancy students studying computing concepts [RQ2 - language problems]. This is a

suggestion that has recently been proposed at the particular ODL institution.

2. Perform a more frequent evaluation of students [RQ1 to RQ4 – Ignorance of the study material]:
   2.1. Add practical work to supplement the theoretical content.
   2.2. Let the practical work count as part of the final mark.
3. Give a questionnaire in the form of an assignment to the students to get a further grip on the whole problem [RQ1 to RQ4 – super class: student problems].
4. Organise contact sessions with students. Note, however, that this is not really the aim of an ODL institution [RQ1 to RQ4 – super class: student problems].
5. Investigate the feasibility of using advanced IT tools, e.g. the use of an interactive, multimedia CBT (Computer-Based Training) environment [RQ1, RQ3 & RQ4 – super class: student problems]. To this end an interactive CD, guiding the student through the theory, will be provided with the prescribed text book for the course as from 2011.

Naturally, the introduction of the above mechanisms assumes the availability of qualified staff to implement these ideas since it would introduce additional workload for the lecturers involved, typically 7 000 students for a first semester and 6 000 during the second semester.

Conclusion

The course under discussion in this paper is a compulsory first-year course for students studying to become Chartered Accountants. In general students may fail a subject for various reasons. One rather obvious reason may be a simple lack of interest in the subject. However, two other aspects clearly emerged through the analyses presented above:

1. A proper comprehension of a language is a non negotiable prerequisite for the understanding of a content subject presented in that language.
2. Studying all, or at least a reasonable amount of the content referred to in the study material (i.e. prescribed book and study guide), and not just selected, small parts of it, is a further prerequisite to pass an exam.

3. Students should also develop the skill of fitting the correct problem frame or pattern onto a given examination question.

Students should be made more aware of the generic reasons as to why students fail and of the value of using their study material to the full extent when preparing for an examination. The crucial part of helping students to pass content subjects is to start at school level and to encourage full comprehension of a common second language. The drawbacks on an ODL model should be considered here as well.

The purely theoretical nature of the course under discussion may also have to bear part of the blame for the poor performance of its students. A possible remedy to this problem is to include compulsory practical work aimed at improving the underlying theoretical knowledge of the average student in the subject.

Currently we are negotiating a virtual lab for our students to enable students who do not have access to their own computers to access the necessary programs at internet cafes and to enable them to do and submit their assignments electronically, thereby empowering them with knowledge on how information systems can be put to use.

Future work in this area would be a further analysis of student scripts in upcoming examinations as well as starting to implement the steps proposed above to help solve some of the problems pointed out in this paper.

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