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# Second-language intervention for prospective ICT learners at a University of Technology

**A B S T R A C T** Information and Communication Technology (ICT) has been identified as one of the key pillars of growth in the South African economy. Currently a skills gap exists in formally trained black and coloured ICT professionals. Concurrently, higher education institutions experience a changing demographic profile of learner enrolments with high dropout rates, failure rates and an English proficiency level below the required Grade 12 level. The Vaal University of Technology (VUT) particularly experienced a high failure rate in the module, Programming 1.

Researchers at the VUT introduced an entry-level certificate in ICT, which includes an English Proficiency module in order to improve the learners' English proficiency and to provide articulation for a diversity of learners into the Higher Diploma in ICT. The results indicate that the English Proficiency module had a positive correlation with the results of the Programming 1 module. Results also indicate the successful implementation of a teaching strategy based on collaborative constructivism.

**Keywords:** English proficiency; comprehension; ICT; programming logic

## **1. Introduction**

Kilfoil (1999: 46) makes the following statement:

English is an important language for South African learners studying science subjects at tertiary level, partly because it is a medium of instruction, but also because most scientific writing is in English.

South Africa (SA) has a complex situation in which the internal population uses at least 11 languages. According to the census figures of 1996, English is the home language of only 8.6% of the population. In South African universities, English is the medium of instruction for most

learners and most information and communication technology (ICT) textbooks are published in English. Furthermore, especially amongst the educated, English functions as a lingua franca, and is a primary language of government, business and commerce (Gough, 1996) in which ICT professionals communicate, collaborate and operate.

At the VUT, an English Proficiency module was designed and implemented as part of an entry-level certificate for learners who have the aptitude, but not the base skills to enrol for the National Diploma in ICT. The program, named the ICT BootCamp program, is an attempt to counteract the underpreparedness of learners and to upgrade the learners' level of proficiency so as to assist learners with the lack in language skills, basic understanding of computer science concepts and in problem-solving skills. This article reflects on the rationale, implementation and results of this intervention.

Language proficiency is identified as a key to success in tertiary education, while English language proficiency levels of learners who enter higher education (HE) are inadequate (Van Rooy 2004). Results obtained by Janse van Rensburg, Du Plessis and Van Staden (2004), Coetzee-van Rooy (2002), Weideman and Van Rensburg (2002) and others offer evidence that the majority of learners entering tertiary education have English language skills below the expected level of Grade 12.

The National Plan for Higher Education (NPHE) identifies poor throughput rates in tertiary education as one of the key problems in SA, with black learners accounting for a larger proportion of dropout and failure rates than white learners (Department of Education, 2001). In general, learners entering higher education institutions are academically underprepared (Du Prè, 2003: 2). Similar problems have been experienced internationally, where there has been an influx of English second-language learners to HE. Holder et al. (1999) state that these learners "lack the prerequisite literacy skills for successful university study" and that these literacy deficiencies are associated with failure to finish a degree in the minimum time.

ICT has been identified as one of the key pillars of growth for the South African economy, and the development and availability of skilled manpower in this sector is becoming crucially important. It is therefore crucial that universities and universities of technology (formerly technikons) train high-level ICT workers (Mdladlana, 2003; HSRC, 2004).

Problem solving plays a profound role in computer science. Learners need to use cognitive functioning skills, such as logical thinking, conceptualisation with prior knowledge, relationship forming and analyzing, in both computer science and mathematics (Engelbrecht, Kriegler & Booysen, 1996: 438). Problems to be solved are normally presented in a descriptive manner and require the learner to perform at a rather high and complex cognitive level (Goosen, 2004: 266). Learners with poor language skills invariably have a weak understanding of the subject content because of an inability to keep up with the lectures, and because of poor reading abilities. Furthermore, they are unable to express themselves clearly, either verbally or in writing. This problem is further exacerbated by a weak understanding of the topic (Amos & Quinn, 1997: 187). Every subject area in education has its own terminology and each science its own concepts, formulated in technical language. A person who cannot comprehend this terminology cannot follow the scientific discourse (Griessel, 1992: 9). The learner needs to grasp what the educator (expert) has to say in technical language or in a module such as Programming Logic that uses

computer languages. Therefore the programming taught in computer science can be linked to the development of language competency (Goosen, 2004: 266). A programming language has its own vocabulary, syntax and semantic structure that need to be mastered. To implement a program, the learner should also understand how to solve the problem.

The change in learner profiles over the past 10 years of democracy in SA and in particular at the Vaal University of Technology (VUT) (Table 1) results in increasing pressure for HE institutions to rethink their curricula and teaching strategies in order to accommodate learner diversity, provide better educational support and to ensure quality learning and teaching. The VUT developed from a traditional white Afrikaans-speaking institution to a majority black institution with English as the medium of instruction and communication.

Table 1: Change in demography of learners at different campuses of the VUT

	Black learners		Coloured learners		Indian learners		White learners	
	1992	2000	1992	2000	1992	2000	1992	2000
Satellite campuses	58	3108	9	133	37	51	458	935
Main campus	1093	9743	16	50	45	51	5920	997
<b>TOTAL</b>	1151	12851	25	183	82	102	6378	1932
Percentage change	+1017%		+632%		+24%		-230%	

Pretorius (2002) listed the following deteriorating English language proficiency levels of learners enrolled at Gauteng technikons (Table 2).

Table 2: Functional literacy levels at Gauteng technikons

YEAR	Functional literacy – Grade 8 or above
1990	51%
1995	25%
2000	18%

## 2. Linguistic incompetence of second-language learners

Various types of interventions at South African higher institutions achieved very little improvement in language proficiency (Parkinson, 2001). Despite interventions such as reading and writing skills, language courses for at-risk learners, study skills courses and mathematical courses, the pass rates of learners doing programming courses at higher institutions are problematically low and the situation is still deteriorating (Borkosky *et al.*, 1998; Cloete, Bunting & Bunting, 2002; Du Prè, 2003; Naudè & Hörne, 2004).

Complete language courses are mainly offered to whole (and large) groups of learners, without differentiating between areas of specialty, or without integrating these courses with the learners' specific curriculum. Internationally, similar courses have been designed to close the gap in perceived proficiency in English in Australia, Canada, the United Kingdom and the United States, for example for learners from Asia, Africa, Europe and the Middle East (Kaplan, 2003).

Kaplan (2003) states that at present, language is a casual add-on to many international programs and suggests that language learning should be rewarded with appropriate academic credit and be offered over a longer period of time. According to Van Rooy (2004), learners whose language problems are not uniform do not receive individualized feedback, and consequently, the intervention or support does not always adequately address their unique individual needs.

Research suggests several factors contributing to the underpreparedness and corresponding low throughput rate in higher education institutions. They are briefly listed below:

Poor vocabulary and problems associated with the interdependency of language and concept development hamper effective learning in the sciences (Sanders & Nhlapo, 1994).

Every subject area in education has its own terminology and each science its own concepts, formulated in technical language. A person who cannot comprehend this terminology cannot follow the scientific discourse (Griessel, 1992: 9).

A lack of 'academic literacy', which refers to the ability to read and write effectively within the higher education institution context (Amos, 1999; Hay & Marais, 2004: 59).

A lack of sophistication in a learner's cognitive functioning (Woollacott & Henning, 2004: 2).

The linguistic incompetence of second-language learners is clearly regarded as being a prime factor in the occurrence of underpreparedness (Moyo, 1995; Miller *et al.*, 1998). The research objectives with regard to the implementation of the English Proficiency module were to determine the effectiveness of a teaching strategy based on collaborative constructivism for English second-language learners; and to establish whether the enhancement of language comprehension has a positive influence on programming and logic skills.

In the following section, the core curriculum of the ICT BootCamp course is summarized and discussed with specific reference to the English Comprehension module.

### **3. The ICT BootCamp course**

Three aspects, apart from ICT skills, namely English comprehension skills, life skills and numerical skills characterize the course. Computer competency is the theme throughout the course, into which all the above-mentioned skills are integrated. The course is concluded with fundamentals of programming, through which the Department of ICT anticipates to provide the learners with the necessary prior knowledge in order for them to achieve success, particularly in computer-programming modules. A pilot project was launched in June 2003 during which the first group of 69 learners enrolled for the course. Of the 69 learners, 53 learners (77%) were successful and gained entrance to the National Diploma in ICT. The required pass mark for each module of the course is 60%.

The course comprises four modules, namely English Proficiency, Life Skills, Numerical Skills and the ICT modules. Table 3 gives an indication of the linear offering of the modules as well as the number of weeks required to complete the ICT BootCamp course. Learners were provided with timetables and milestones at the start of the semester. The milestones also contained the assessment dates.

Table 3: Linear scheduling of modules

Modules	The weeks that each module utilized															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
English Proficiency																
Numerical Skills																
Life Skills																
ICT modules																

The English Proficiency module is scheduled first in a block in order to allow learners to approach other modules with the required and appropriate reading, writing and comprehension skills. The objectives of the module are to equip learners with English language and communication skills for business, public and professional careers in the field of ICT and to improve each learner's skills in listening, speaking, reading and writing in English.

Language proficiency and vocabulary are interwoven and are two categories that play a profound role in cognitive development, conceptualisation and learning, which in turn influence the learner's ability to solve problems in computer science. Through speech, one explains a concept to the learner. The learner forms a specific perception of it in his mind and will retrieve it when needed. If the learner's language development is poor, the learner might have difficulty understanding the real meaning of the concept the educator is trying to explain. Role-playing was used during oral presentations in order to simulate real-life situations, such as interviews and sales presentations in the field of ICT.

Santrock (2004: 191) mentions that the development of vocabulary and the development of concepts are closely related. Through words, learners can manipulate ideas. Learners' vocabulary not only consists of the words they use in speech or can recognize on a printed page, but also the words they use in comprehension. It is through this 'understanding' vocabulary that learners gain knowledge and mastery of the world (Louw *et al.*, 1998: 62; Santrock, 2004: 8; Schickedanz *et al.*, 2001: 12).

Cultural background could influence the fact that the learners' exposure to and experience of language is limited and, therefore, such learners have difficulty in grasping the basic concepts of learning (Schickedanz *et al.*, 2001: 21; Santrock, 2004: 8). In addition to vocabulary, syntactical differences also influence educational performance. Sentence structure is another indication of thought, and may influence thought as well as communication. How the learner arranges words influences the actual meaning of the sentences and further influences good communication. The meaning learners assign to words, which reflects their real understanding of the words, influences their ability to use the words to arrive at concepts, which may often differ from meaning held by subject experts. They assign 'common sense' meanings that grow out of their own experiences rather than the 'technical' meanings the educator uses (Louw *et al.*, 1998: 9; Kairuz, 2000: 10).

If language comprehension is improved, the ability to generalize through the use of words contributes to thought and thinking and, in turn, contributes to further vocabulary development,

greater precision in the use of words, and a larger area of common meanings learners can share with others (Schickedanz et al., 2001: 21). The development of these abilities was kept in mind in the design of the English Proficiency module, which is discussed in the following paragraphs.

#### 4. A strategy for intervention

Ashman and Conway (1993) found that education programmes based upon cognitive classroom methods affirm and enhance successful learning. The cognitive-constructivist perspective view of learning emphasises that learners create or construct their own knowledge through reflection, from meaningful actions and interactions with the world (Woolfolk, 1995: 196). Formulated outcomes for the English Comprehension module were reached by means of activities contained in the collaborative constructivist teaching strategy that is schematically presented in Figure 1.

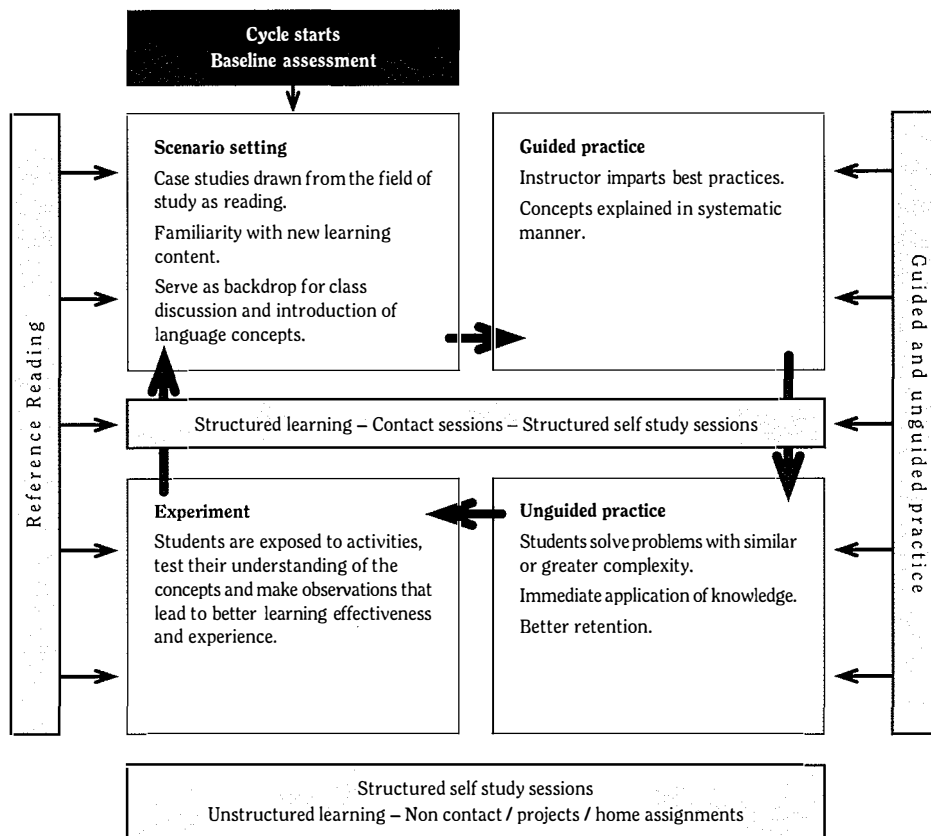


Figure 1: Teaching strategy based on collaborative constructivism

#### Baseline Assessment: Scenario setting and reading

Each lesson starts with a factual reading passage, mostly relating to ICT and topical to their age. This includes topic passages on topics such as email usage, ergonomics, system software, uses of the Internet and other ICT concepts. The curriculum was compiled through close collaboration between die Language and the ICT departments. During the planning of the

course, ICT lecturers were invited by the Language Department to submit subject-oriented passages and glossaries of terms to be included in the curriculum. These passages serve as a reading exercise and questions focus mainly on recall of what was read and limited extent on understanding. This also functions as baseline assessment for both the lecturer and the learner.

*Guided practice: language issues*

Each lesson covers different parts of language usage, for example nouns, pronouns, verbs, adjectives, adverbs, conjunctions or prepositions, punctuation, synonyms, antonyms, homophones and homonyms. This is followed by examples and then by adaptive testing exercises, which become progressively complex.

*Unguided practice: comprehension test*

The comprehension test is accompanied by questions in order to indicate what learners are able to understand and whether they are able to interpret what they read. A typical example is presented in the following paragraph that appeared in a passage in the learners' workbook (Erasmus & Vosloo, 2003).

...And the benefits can be great. Unlike Windows PCs, Linux software upgrades are almost always free. It almost never crashes. And not only is Linux less vulnerable to hackers, but because much of the world runs Windows, most hackers and virus writers target that operating system.

Two examples of questions that followed the passage are listed below.

- 1) Using the dictionary entry, provide the best definition of the word as it is used in the passage (Pearsall, 2002).

**Vulnerable, a**

1. Having power to wound; wounding. *Obs.*
2. a. That may be wounded; susceptible of receiving wounds or physical injury.  
b. *fig.* Open to attack or injury of a non-physical nature; *esp.*, offering an opening to the attacks of raillery, criticism, calumny, etc.
3. a. Of places, etc.: Open to attack or assault by armed forces; liable to be taken or entered in this way.

- 2) Give the opposite of the following words, in regard with the meaning of the sentence:  
2.1) less  
2.2) much

*Experiment: observations and reflections*

Learners test their understanding of concepts through feedback on their work, through one-on-one conversations (speeches) with the lecturers and by doing homework as part of unguided practice.

## 5. Research design and measuring instruments

The research design of this project was based on educational research and is, as such, exploratory, because of the social behaviour and experiences of learners (Creswell, 1994: 1; Babbie, 2002: 84). The population consisted of a total of 69 learners who enrolled for the ICT BootCamp course, of which 53 learners were successful in the course at the end of 2003. At the start of 2004, only 41 learners returned to enrol for the ICT diploma. The reason that not all learners returned is that some found employment, or changed their course or did not have sufficient funds to enrol. Of the 69 learners, 61 were black, 5 coloured, one white and two were Indian.

Of the original 69 learners, 48 completed both a pre- and post-language test, namely the VaalScan test. Hough and Hornè (Consultants: Functional Literacy and Communication Skills) developed VaalScan to measure the level of English literacy of first-year learners with specific focus on vocabulary and familiarity with English (Hough & Hornè, 1994). This test was extensively tested for validity and reliability before implementation at the VUT. The test consists of two vocabulary sections where learners have to fill in missing words and complete sentences.

Learners are required to complete a set of 30 multiple-choice questions within 10 minutes for the vocabulary-in-context questions. In the multiple-choice section, a learner has to select the correct meaning of the words in order to verify the learner's level of vocabulary skills. The tests are marked and graded according to the following results as prescribed by Hough and Hornè.

- 0 - 19 – Below Grade 8
- 20 - 25 – Grade 8 to 9
- 26 - 30 – Grade 10 to 11
- 31 - 50 – Grade 12 and above

The total score gives an indication of the level of English competency of learners.

The vocabulary-in-context component of the VaalScan is used to measure learners' level of understanding the vocabulary in context and their familiarity with English at different levels (Table 4), by using the scores as summarized in Table 5.

Table 4: Vocabulary-in-context scores

Scores	Description of score
29 - 30	Excellent
27 - 28	Well-developed
22 - 26	On a par with scholastic level claimed
15 - 21	Slightly below scholastic level claimed
8 - 14	At least 2 levels below scholastic level claimed
3 - 7	Inadequate
Below 3	Totally inadequate

Table 5: Familiarity with English

Levels of measure	Rating
16 - 20	High degree
12 - 15	Limited
9 - 11	Rare/lacking
Below 8	Very little

Apart from the pre- and post-VaalScan tests, assessment results were also used as measuring instrument for the effectiveness of the English Proficiency module. Correlations between assessment results of the English Proficiency module and the Programming and Logic module



were used to determine whether the enhancement of language comprehension had a positive influence on the learners' programming and logic skills.

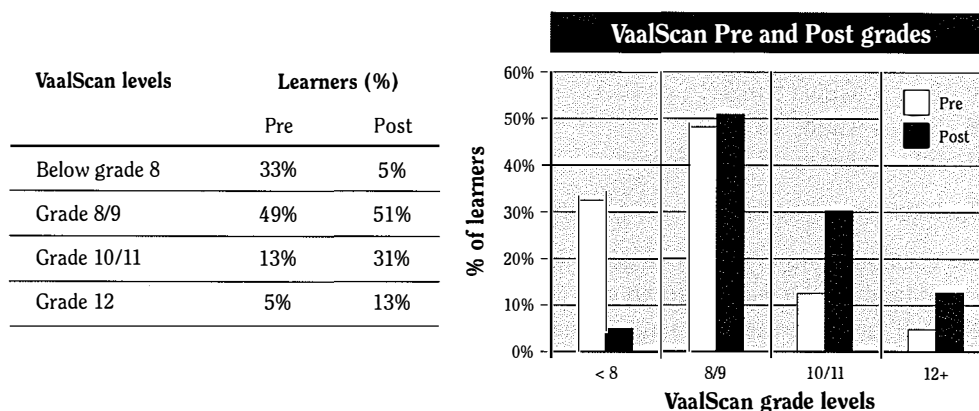
## 6. Research results

The following paragraphs refer to the VaalScan pre- and post-results, in respect of the number of learners who scored on different levels, statistical data, frequency change from pre- to post-results and the difference between the pre- and post-results. In the discussion, a comparison between the pre- and post-results of the VaalScan is given to indicate the increase in VaalScan scores and the statistical results that reflect the statistical significance of the VaalScan measuring instrument. Secondly, the correlation results display the direct relationships between English and the different ICT BootCamp modules as well as the learners' performance in English and in Programming I. Lastly, the assessment results of the English Proficiency module will be discussed.

### *VaalScan pre- and post-results*

Table 6 indicates the percentage of learners who scored in each level of the pre- and post-VaalScan test.

Table 6: *Distribution of learners according to VaalScan test results*



It is clear from the graph that the majority of learners improved from the pre-test to the post-test. It is, however, still a problem that the majority of learners (51 %) are on a Grade 8/9 level – it would be ideal if the majority of learners were on Grade 12. A statistical analysis of these results is reflected in Table 7.

Table 7: *Statistical results of the VaalScan pre- and post-test*

Pre-test		Post-test		Difference	Difference (%)	Standard Deviation Difference	P-value
Mean	Standard Deviation	Mean	Standard Deviation				
1,90	0,82	2,51	0,79	0,62	32%	0,75	0,000009

A t-test was performed on the results obtained by the learners. The mean of the VaalScan has increased from Grade 8/9 to a Grade 10/11. The difference in the means from pre- to post-VaalScan resulted in a 32 % increase. The standard deviation for the pre-VaalScan is 0,82 and for the post-VaalScan 0,79. The p-value is less than 5 %, which indicates that the VaalScan test scores are significant ( $p = 0,000009$ ). Table 8 represents the frequency of the pre- and post-VaalScan measuring scores.

Table 8: *The VaalScan frequency table*

Post / Pre	Below grade 8	Grade 8/9	Grade 10/11	Grade 12	Row totals
Below grade 8	2	7	4	0	13
Grade 8/9	0	12	6	1	19
Grade 10/11	0	1	2	2	5
Grade 12	0	0	0	2	2
All groups	2	20	12	5	39

The frequency table indicates the number of learners who showed a decrease, increase or no change from one level to the next between the pre- and post-test scores of the VaalScan. In total 38 % of learners increased by one grade while 13 % increased by two grades in the VaalScan test from pre- to post-tests, which is in total a 51 % increase. Only one learner decreased by 1 grade and 46 % of learners showed no change. The VaalScan measuring instrument also determined the learners' scholastic levels in terms of their understanding of 'vocabulary in context' as summarized in Table 9.

Table 9: *Vocabulary-in-context scores of learners as measured by VaalScan*

Scholastic levels	Pre-VaalScan	Post-VaalScan
Excellent	0%	0%
Well-developed	0%	0%
On a par with scholastic level claimed	0%	0%
Slightly below scholastic level claimed	5%	15%
At least two levels below scholastic level	51%	72%
Inadequate	44%	13%
Totally inadequate	0%	0%

The learners were rated according to the categories specified in Table 3, in descending order from 'excellent' to 'totally inadequate'. Table 9 shows that the learners improved from 5% to 15% for the 'slightly below scholastic' level. The course had a definite impact as only 13 % of the learners are still categorized as 'inadequate' in contrast to the 44 % who were 'inadequate' before. There is also major improvement from 51 % to 72 % for the 'two levels below scholastic' level. The results imply that the learners' vocabulary thus improved from 'inadequate' to 'slightly below scholastic' level. It is however not 'well-developed' or 'excellent' as anticipated.

The VaalScan also determined the learners' exposure to and 'familiarity with English'. Table 10

demonstrates the learners' exposure levels to English as measured by VaalScan, ranging from the 'high degree' to 'very little', in descending order (see Table 5).

Table 10: English familiarity levels of learners as measured with the VaalScan

Level	Pre-VaalScan	Post-VaalScan
High degree	5%	13%
Limited	28%	23%
Lacking	38%	49%
Very little	28%	15%

The intention of the English Proficiency module was to improve the learners' levels of 'familiarity with English' to the 'high degree' level away from the 'very little' level. However, the majority of learners are still on the 'lacking' level (49 %), but the 'high degree' level increased from 5 % to 13 %. The majority of learners improved from 'very little' to 'lacking' and a few improved from 'limited' to a 'high degree' of the 'English familiarity' component of the VaalScan. Gamaroff (1999) suggests two main considerations in understanding this inability to improve cognitively, that the researchers will deal with in another study. Firstly, learners may not have the inborn capacity to achieve in an academically demanding environment, or secondly, they may have the inborn capacity, but it may remain underdeveloped by adverse social, economic and educational conditions.

#### *Correlations between English Proficiency, BootCamp modules and Programming 1*

It was possible to calculate correlations between the different modules such as Numerical Skills, English Proficiency, ICT modules, and the Programming I results of the ICT diploma learners. Table 11 represents the correlation between the results of the 69 learners as well as of the 26 learners who completed the Programming I examination in June 2004.

Table 11: Correlations between the BootCamp modules

	ICT modules	Numerical Skills	English Proficiency
ICT modules	1	0,36	0,53
Numerical Skills	0,36	1	0,19
English Proficiency	0,53	0,19	1
Programming 1	0,45	0,08	0,41

A statistically and practically significant 0,53 correlation exists between the ICT and English Proficiency modules, which implies that an increase in either of the two modules is associated with a change in the other module and that there is a direct relationship between these modules.

A statistically and practically significant correlation of 0,41 exists between the English Proficiency and the Programming I modules, which implies that an increase in English comprehension corresponds to an increase in Programming I results. The correlation reflected a direct relationship between English proficiency and programming competencies.

*English Proficiency assessment results*

A total of 86% of the learners who enrolled for the ICT BootCamp course were successful with the English Proficiency module. Learners needed a minimum of 60% to pass the module. Table 12 reflects the English Proficiency module results.

Table 12: English Proficiency mean and assessment results

Descriptive data	Response (%)
Mean – average score	63%
The percentage of learners who passed the module	86%
The percentage of learners who failed	14%

The implemented system further supports the improvement of English by making it compulsory for the learners who were unsuccessful with the English Proficiency module or the VaalScan, to enrol for a first year Vocational English module as part of the ICT diploma.

*Programming 1 assessment results*

Table 13 reflects the Programming I results for the past five years. Included in the June 2004 results are the 69 ITBC learners who continued with the ICT diploma, plus 20 learners who were either repeating the Programming I module or who were not required to do the ITBC course at the start of 2004.

Table 13: Programming I: June results for the last five years

Year	Enrolled	% Pass
2000	183	42%
2001	119	3%
2002	32	69%
2003	93	57%
2004	81	85%

This indicates a positive impact on the BootCamp course on the Programming 1 results.

**7. Conclusion and recommendation**

The English Proficiency module did indeed fulfil its objectives in the short term with regard to the significant improvement in the learners' English comprehension from *Grade 8/9* to *Grade 10/11*, which is an improvement of 32%. Only three learners improved to Grade 12, however: the rest continued with the Vocational English module in their first year of enrolment for the diploma in ICT, providing them with a further opportunity to improve their English skills over a longer period of time.

The research team found that English comprehension is a very important component for ICT modules, and recommends strongly that learners do an English Proficiency module or have an appropriate level of English (such as Grade 12) before enrolling for an ICT diploma. The language

intervention program positively contributed to the success rate of learners enrolled for Programming I.

ICT has been identified as one of the key pillars in the development and availability of skilled manpower in SA. One of the concerns of the research team was the gap in the base skills level and maturity of a great percentage of learners who wish to enter the ICT stream directly from secondary school level. This research, however, emphasized the importance of English proficiency for English second-language learners in the success of their first-year studies.

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