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ABSTRACT

A two-phase study examined the skills required of competent end-users of computers in the workplace and assessed the computing awareness and technological environment of first-year students entering historically disadvantaged technikons in South Africa. First, a DACUM (Developing a Curriculum) panel of nine representatives of local business and industry was convened to obtain employer input regarding the end-user computing (EUC) skills required of competent computer users in the workplace. Next, follow-up interviews were conducted with 11 work supervisors from local businesses and industries. Feedback on the DACUM panel's findings was also sought from each member of the DACUM group, lecturers at the Border Technikon's EUC department, the department's client departments, and the work supervisors. The workers and work supervisors were in strong agreement regarding the computing skills needed in the workplace. Ability to create effective documents, typing ability, and a basic working knowledge of computer applications were deemed most important. The second phase of the study established that lack of a computer at home was the biggest disadvantage faced by individuals beginning EUC training at historically disadvantaged technikons. Applications of the DACUM process in improving disadvantaged students' success in EUC courses and other classroom- and institutional-level intervention strategies were discussed. (Contains 40 references.) (MN)

# End User Computing at a South African Technikon: Enabling Disadvantaged Students to Meet Employers' Requirements

Cecille Marsh

**End user computing at a South African Technikon: Enabling disadvantaged students to meet employers' requirements.**

## 1 Context

In terms of the number of end-users of information technology (IT), there has been tremendous growth and an increasing awareness that successful management of end-users is of enormous strategic value to the organisation in which they function. For developing countries like South Africa it is imperative for economic survival that there be a body of workers with sufficient skills in the use of IT to enable the country to participate in the global economy. Thus it is not sufficient for end-users to be equipped with a working knowledge of the currently popular IT application packages only, they need to be educated to become informed and innovative users of knowledge who have the ability to recognise and seize strategic advantage at whatever level they work within the economy. Institutions like the Technikon commit a large percentage of their capital and human resources to the training of computer end-users, and it is imperative that the courses they offer be evaluated as to their effectiveness in producing innovative end-users, and that they be improved upon or restructured if necessary.

The South African government, too, is aware of the need to raise the technological skills and work competencies of the workforce. To quote from the 1997 White Paper on Science, Engineering and Technology:

> *Government has a responsibility to promote a science culture, science education and literacy among both children and adults to keep them up to date with the impact of new technologies. As part of this drive government can strongly influence the attainment of equity by providing incentives to encourage disadvantaged groups to study mathematics, science and computer literacy.*

Hager et al (1994) define a competency as the ability to transfer and apply skills to new situations and environments as they occur in the workplace. The Finn Report (1991) defined several key competencies for tertiary institution education and training programmes. Among them was an understanding of technology along with problem-solving capability.

Stevenson (1990) points out that occupational analysis has emerged as a primary basis for curriculum design and that industry is playing a greater role in curriculum design at TAFE's. (Training and Further Education institutions). He goes on to say (Stevenson, 1991) that the development of key areas of competence such as those identified by Finn (1991) will require close attention to the learning tasks set for students and the skills that these tasks are designed to develop. Some research into end-user computing (EUC) education and training refers to a profile of an effective, innovative end-user in the developed world. Panko (1988) refers to a skills hierarchy that can be used to map the development of the end-user. This skills hierarchy goes from basic use skills through comfort use skills to good practice and finally to innovation. Panko is not alone in the attempt to classify end-user skills and categories of end-users. Juliff (1990) maintains that there is a continuum of skills and involvement within the end-user community that goes from an "informed user" to a "proficient user" to a "developer". In a study on learning the Unix operating system, Doane *et al* (1990) found that students only moved up from novice to intermediate level, or intermediate to expert, but not novice to expert during the two-year period of their investigation. Moreover some performances actually regressed over this time. Nilsen *et al* (1993) also discovered that MBA students with 16 months spreadsheet experience were considerably less skilled in some associated tasks than people with 4 years spreadsheet experience. Thomas (1998) showed that, on average, the slowest freshmen computer scientists just caught up in 2 years to the typing speed their fastest colleagues enjoyed at entry to university, but of course the faster typists had by then become even more rapid. Such skills profiles could prove to be very valuable when attempting to establish the goals at which technikons' EUC students and trainers might aim.

The Technikon's EUC department offers a course on basic end-user skills to 11 client departments that range from Fashion Design to Mechanical Engineering. The current course is identical in structure and curriculum for each of the client departments' students. In some client departments the course runs for a semester whilst in others it runs for two semesters. The students work in laboratories containing 25 computers on average and each class is given a 135-minute lecture/practice slot per week. Owing to a shortage of computers, there is not any practice time allocated and students have to stand in line in the evenings to get a chance to use a computer in the heavily populated laboratories. While teaching second and third year Information Technology students at the Technikon, the researcher has frequently observed that these students do not use EUC software appropriately and effectively. These students were among those who took the EUC course in their first year and considering the nature and content of their diploma course could justifiably be expected to be amongst the more proficient student computer end-users.

The majority of students entering historically black technikons come from schools and communities who do not enjoy the same technologically-rich environment as that of the developed world, yet are expected by employers to be able to perform effectively within a technology-driven economy bent on competing globally. Many of the students registered at the Technikon come from rural areas of the Eastern Cape. In these areas many homes still do not have electricity and running water. A preliminary analysis of the Eastern Cape student background questionnaires from the Third International Mathematics and Science Study (TIMSS) found that only 54% of the children surveyed had electricity in their homes (Howie, 1998). The schools are similarly without essential services and are very poorly equipped. It is not unusual to find few textbooks and very little apparatus of any type. Computers are not even dreamed about! The urban schools in the black townships also suffer from the legacy of the inequalities of apartheid education, even six years after the advent of democracy. Here schools are targets for vandals and criminals and what little equipment there might be is under constant threat. Schools and parents are reluctant to spend money on electronic equipment that is likely to be stolen as soon as it is installed.

The handicap imposed by the lack of basic equipment and computing facilities is further compounded by the rigidity of the teaching/learning process employed in most of the schools under discussion. Many of the teaching staff are under-qualified and as a result are inclined to cling to their authority and to a tranmissionist approach to teaching and learning. The students are encouraged to learn by rote and laboratory activities (in those few schools that have laboratories) are inclined to be of a cookbook type. In most historically black Eastern Cape schools the students are not given many opportunities to think for themselves, to plan individual or group investigations or (in the rare instances where computers are accessible) to use computers as cognitive tools. It is unlikely that these students will have had much opportunity to develop good basic work competencies by the time they enter tertiary institutions.

The researcher has observed that the Technikon teaching staff often perpetuates this transmissionist approach to teaching and learning. This is not surprising when one considers that only 23% of the lecturing staff have a teaching qualification and that only 32% have a degree senior to a baccalaureate in the subject that they are teaching. (Van Averbeke, 1999). In the case of EUC teaching staff it is likely that the lecturer's epistemology may have a mediating role in student-computer interaction, particularly on the student's utilisation of the computer as a cognitive tool. (Maor & Taylor, 1995).

In the light of the social and economic inequalities in South Africa it appeared essential to the researcher to ground her investigation in the multiple realities of the lives of the Technikon's students. There appears to be a gap between the EUC skills of current technikon graduates and those that their prospective employers consider to be essential. This paper reports on part of a study that looked into the obstacles that seemed to be in the way of these students becoming effective computer end-users in the workplace and ways of overcoming them.

## 2 Research Questions and Objectives

The writer set out to meet the following objectives and to answer their accompanying research questions.

### 2.1 Objective 1

To identify the skills required of competent, informed end-users in the workplace.

**Research Questions**

(1) What specific EUC skills and related work competencies do competent computer users consider important in the workplace?

(2) What specific EUC skills and related work competencies do work supervisors expect from tecknikon graduates entering the workplace?

## 2.2 Objective 2

To assess the computing awareness and technological environment of first year students entering historically disadvantaged technikons

**Research Questions**

(3) What is the nature of entering technikon students' technological environment?

(4) What is their understanding of computers?

(5) What are their expectations of the benefits of an EUC course?

## 2.3 Research Methodology

The over-arching research framework is evaluation research. Evaluation research examines the effect of a programme on its students and teachers according to the goals the programme is meant to achieve. It employs objective and systematic methods to assess to what extent the goals are realised and look at the factors associated with successful or unsuccessful outcomes. (Weiss, 1972; Shulha & Cousins, 1997). The researcher was guided by Denton (1973) who devised a plan for evaluating a vocational programme. The main elements of the plan are: needs assessment, development of philosophy, writing of objectives, data collection, data analysis and formulation of recommendations. Within this framework the researcher acknowledged the importance of interactions between the technology and the social setting in what she was studying and considered it essential that her research design took into account the social and political dimensions of the research setting if it was to be relevant and significant.

# 3 The DACUM approach

In order to address the first research question outlined above the researcher decided to use a DACUM (**D**eveloping **A C**urricul**um**) to identify the skills required of competent computer users in the workplace. The DACUM method closely resembles that of the focus group. Focus groups combine elements of both interviewing and participant observation and capitalise on group dynamics (Lederman, 1990). The hallmark of focus groups is the explicit use of the group interaction to generate data and insights that would be unlikely to emerge without the interaction found in a group. DACUM uses this approach to occupational analysis. Coffin, 1993 claims that it is an effective method of quickly determining at relatively low cost, the skills that must be performed by persons employed in a given job or occupational area. The DACUM method is based on the following assumptions:

- expert workers can describe and define their job more accurately than anyone else
- any job or outcome can be described in terms of the tasks expert workers perform
- all skills have direct implications for the knowledge and attitudes that workers must have in order to perform the skills correctly.
  (Coffin & Morin, 1998; University of Illinois Curriculum Center, 1997).

- According to Coffin, 1993 and Stammen & Vetter, 1994, the profile chart that results from the DACUM analysis is a detailed and graphic portrayal of the duties and skills involved in the occupation or job being studied.

### 3.1 The DACUM and programmes in educational institutions

The skills that are verified as important by the DACUM process can become the research base for developing modules or other units of instruction for educational programmes. During the instructional development phase that follows the DACUM process, the verified skills undergo a skill analysis to determine the specific skills, knowledge, and attitudes the worker needs to perform each skill. The information resulting from the skill analysis is then incorporated into modules, learning guides, or other types of instructional materials for student and teacher use. According to Harris (1982), the DACUM is particularly well suited for educational institutions that are implementing or are planning to implement competency-based education for training programmes since the first essential step in any such programme involves the identification of the skills upon which the instructional programme will be based.

Harris (1982) maintains that the main reason for using DACUM has been the desire of many vocational educators to establish a relevant, up-to-date, and localised curriculum base for instructional programmes. Clearly, a curriculum base that is soundly determined with maximum input from the businesses and industries that are going to employ the students prepared by vocational and technical education institutions is needed. One additional benefit of DACUM is its public relations value to the educational institution or other agency doing the DACUM. When employers realise that an educational institution really wants industry to help them identify the competencies needed by workers in their fields, there is increased support of the educational institution in a variety of ways by local business and industry. Harris goes on to maintain that while the public relations value of DACUM is secondary to its main purpose, its significant, long-term impact is too important to overlook or lightly dismiss.

### 3.2 Using the DACUM to get information from external parties for the EUC course skills

In September 1998 a DACUM was held to get input from local business and industry as to the skills required by competent computer users. In setting up the DACUM process, the researcher was guided by the literature, which states this process relies on two critical factors for its success. The first and foremost is selecting the right panel. A DACUM panel should consist of six to twelve employees who are considered the very best in the field and who are currently doing the function, not lecturers or work supervisors. Lecturers tend to push the panel toward their own training programmes. Some employees can be intimidated by their supervisors and not participate fully in the development of the DACUM. (Norton, 1998.) The second critical factor is a trained DACUM facilitator who can guide the group through the process without prejudice and who can ensure that they can reach consensus on every item on the chart. A facilitator with little job knowledge will produce a better chart than a facilitator with detailed job knowledge. (Coffin, 1993).

Accordingly, a sample of local firms was contacted and each asked to send an employee whom the employer judged to be a competent computer end user to a workshop. The panel that met comprised 9 people. During the workshop a trained DACUM facilitator elicited from the employees the computer skills and personal attributes that they deemed to be vital to an employee entering the workplace. The facilitator was the Academic Development Officer of the Technikon who had attended a two-week DACUM training course. She had a general knowledge of word processing, but did not consider herself to be an expert in the end user field. The facilitator asked the group first to arrange the duties according to process sequence or importance level and then to identify the tasks performed for each broad functional category. These tasks were in turn analyzed for the requisite knowledge and skills and then collapsed into main tasks and rated on a scale for frequency and for importance. The higher the value, the more important the task was to the overall function of the end user. Each panel member had to accept all entries on the charts. Compromises were made and consensus was reached. In the case of consensus not being reached quickly, the facilitator asked the group to "park" the item for later discussion. Such items were then revisited, the differences were worked out and a consensus was reached. This process created for each panel member a very strong sense of ownership in the DACUM chart.

The last step in the DACUM process was to give each member of the DACUM group, the EUC lecturers, and the client departments and work supervisors an opportunity to comment on the DACUM chart. A copy of the chart was sent to each member of the focus group and they were asked to submit their comments/concerns. A structured interview/questionnaire based on the DACUM chart was conducted with work supervisors in industry and by the heads of the departments served by the EUC course. Lecturers of the EUC course were invited to comment on the chart during a staff meeting.

## 3.3 The DACUM findings

### 3.3.1 The DACUM chart

| Functions | Tasks in order of importance | | | | | | |
|---|---|---|---|---|---|---|---|
| ***A* Use the Computer to Create Effective Documents** | A-1 Apply typing rules | A-2 Manage layout | A-3 Manipulate contents | A-4 Import and export files | A-5 Manage printing & graphics | A-6 Create tables & graphs | |
| ***B* Personal Attributes** | B-1 Share knowledge | B-2 Structure individual tasks | B-3 Use initiative | B-4 Work quickly & accurately | B-5 Be willing to learn | B-6 Prioritis e tasks | B-7 Be patient |
| | B-8 Explore | B-9 Use judgement (Creativity vs. Conformity) | B-10 Know own ability | B-11 Work methodically | B-12 Interpret & represent ideas | B-13 Be willing to change | B-14 Participate in ongoing training |
| ***C* Basic Working Knowledge of Applications** | C-1 Identify program functions | C-2 Do word processing | C-3 Manage output | C-4 Use back-up systems | C-5 Use e-mail | C-6 Create a spread sheet | C-7 Access & distribute Internet info |
| ***D* Knowledge of Basic Computer Capabilities** | D-1 Operate computer components | D-2 Know of new computer technology developments | D-3 Manage files | D-4 Navigate operating systems | | | |

*FIGURE 1: DACUM chart summing up focus group's findings on EUC skills*

### 3.3.2 Follow-up interviews with work supervisors

A series of follow-up interviews combined with a questionnaire based on the DACUM chart were held. Eleven work supervisors from local business and industry were interviewed. They were first asked to give their opinions as to which computer-related and non computer-related skills were important for competent computer users The most common responses to these two open-ended interview questions are summed up in the charts that follow (Figures 2,3).

*n=11*

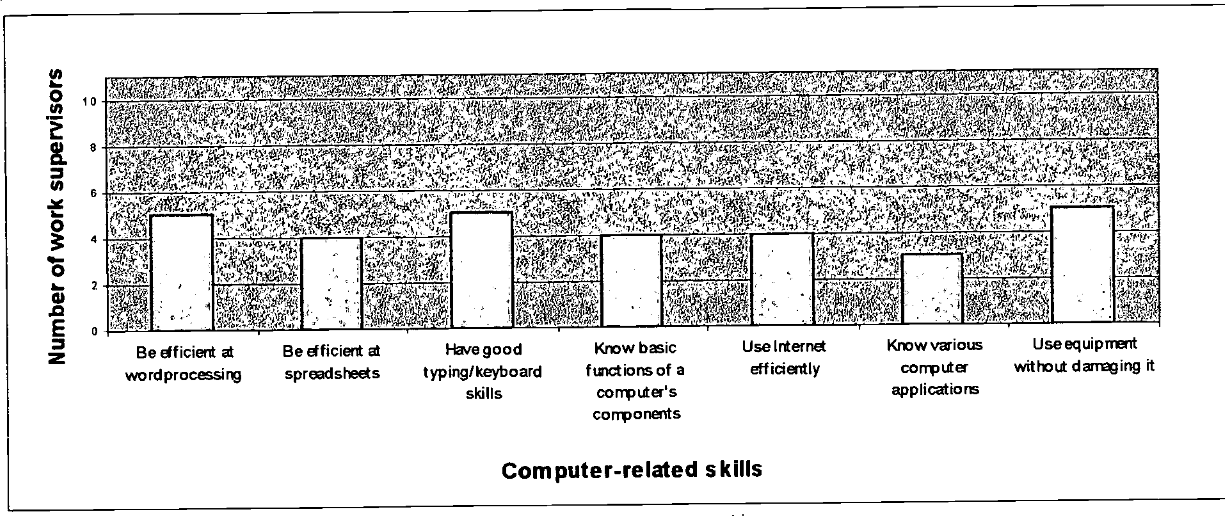


*FIGURE 2: Summary of important computer-related skills according to work supervisors*

*n=11*

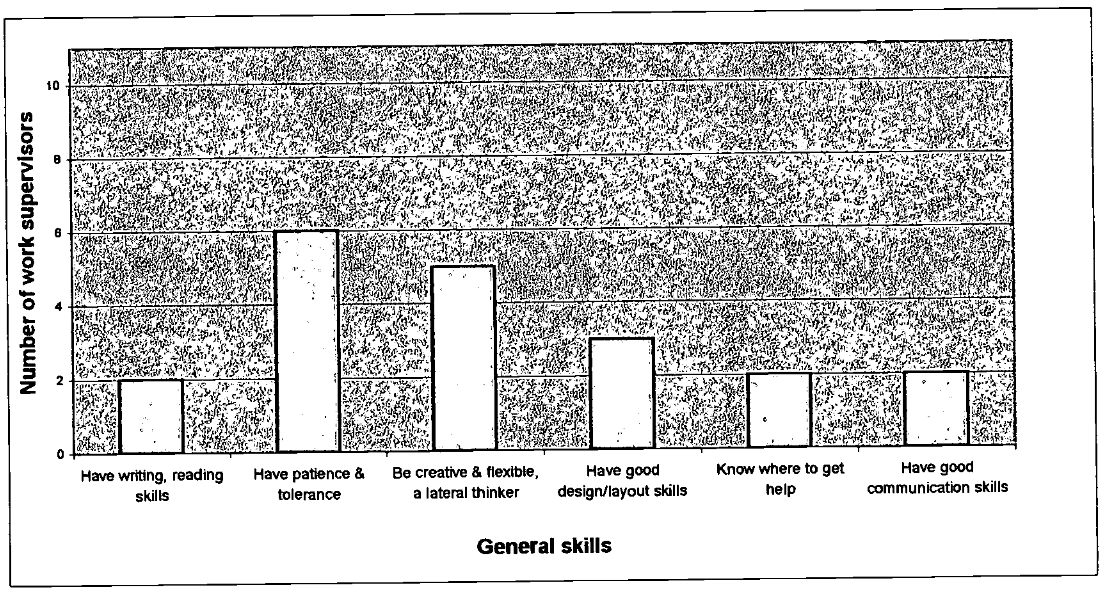


*FIGURE 3: Summary of important general or non computer-related skills according to work supervisors*

They were then asked to rate the findings of the DACUM focus group on a 4-point scale questionnaire ranging from "not important" to "extremely important". Only the first seven of the DACUM's tasks for the "Personal Attributes" function were used for the questionnaire because of time and conformity constraints. The results of the questionnaires are given in the table below (Figure 4). In this table, the tasks that more than 50% of the work supervisors considered to be "extremely important" are italicised.

**SUMMARY OF RESPONSES BY WORK SUPERVISORS TO THE QUESTIONNAIRE BASED ON THE DACUM CHART**

*n=11*

| | NOT IMPORTANT | LIMITED IMPORTANCE | IMPORTANT | EXTREMELY IMPORTANT |
|---|---|---|---|---|
| **USING THE COMPUTER TO CREATE EFFECTIVE DOCUMENTS** | | | | |
| Be able to apply typing rules | 0 | 3 | 3 | 5 |
| *Manage layout* | 0 | 0 | 3 | 8 |
| *Manipulate contents* | 0 | 0 | 4 | 7 |
| Import and export to and from other files | 0 | 4 | 3 | 4 |
| *Manage printing and graphics* | 0 | 0 | 5 | 6 |
| Create graphs | 0 | 5 | 3 | 3 |
| **PERSONAL ATTRIBUTES** | | | | |
| Be able to share knowledge | 0 | 4 | 4 | 3 |
| Be able to structure individual tasks | 0 | 0 | 7 | 4 |
| Be able to use own initiative | 0 | 0 | 6 | 5 |
| *Work quickly and accurately* | 0 | 0 | 5 | 6 |
| *Be willing to learn* | 0 | 0 | 3 | 8 |
| *Be able to prioritise tasks* | 0 | 1 | 4 | 6 |
| Be patient | 0 | 2 | 5 | 4 |
| **BASIC WORKING KNOWLEDGE OF COMPUTER APPLICATIONS** | | | | |
| *Be able to identify the functions of an application* | 0 | 0 | 4 | 7 |
| *Be able to do word-processing* | 0 | 0 | 3 | 8 |
| Be able to manage output | 0 | 1 | 7 | 3 |
| Know how to use back-up systems | 0 | 2 | 5 | 4 |
| Be able to use e-mail | 0 | 1 | 6 | 4 |
| Be able to create a spreadsheet | 0 | 0 | 6 | 5 |
| Be able to access and distribute Internet information | 0 | 2 | 4 | 5 |
| **KNOWLEDGE OF A COMPUTER'S CAPABILITIES** | | | | |
| Know the operation of all the computer's components | 1 | 4 | 3 | 3 |
| Know the new developments on the computer front | 1 | 1 | 6 | 3 |
| *Be able to manage the computer files* | 0 | 0 | 3 | 8 |
| *Be able to navigate around the computer's operating system* | 0 | 0 | 3 | 8 |

*FIGURE 2: Summary of responses of work supervisors to the DACUM chart*

## 3.4 Discussion of DACUM results

### 3.4.1 Personal attributes/general skills

What is most noticeable about the DACUM chart is that although the focus group ranked the ability to use the computer (typing, layout, etc.) to create effective documents as the most important EUC function, they ranked personal attributes a close second - before knowledge of computer applications and computer capabilities. Also of significance was that these personal attributes had 14 related tasks compared to the 6 or 7 of the other functions. These personal attributes are concomitant with lifelong learning and the skills necessary to pursue it - particularly in the IT field where technology is ever-changing. The focus group through their work experience highlighted in practical terms what so many researchers in IT nowadays are stressing, namely that computer literacy is dynamic because the technological medium is changing so rapidly. The constant change and upgrading of computer technology means that people have to adapt in order just to cope with changes in software let alone learn new functionality. (Hatton, 1998; Keissler *et al*, 1999; Thomas, 2000). They have seen in their own work situations that the learning process needs to be increasingly based on the capacity to find, access and apply knowledge. In this new paradigm, where learning to learn is more important than memorising specific information, emphasis is placed on information search and analytical skills and on reasoning and problem-solving skills. During the interviews with the work supervisors, similar competencies were stressed. In Figure 4 it is seen that patience, tolerance, creativity, flexibility and lateral thinking were high on their list of important general skills. On the questionnaire, the majority (91%) of work supervisors agreed that the personal attributes set out in the DACUM chart were important or extremely important.

What is also of interest is that the work supervisors added to the DACUM's pool of personal attributes good communication, organisational, reading and writing skills and knowing where to go to get help. These attributes, not suprisingly, pertain largely to the smooth running of an organisation. Salmi (1999) echoes these views:

*Competencies such as learning to work in teams, peer teaching, creativity, resourcefulness and the ability to adjust to change are also among the new skills to which employers seem to put worth in the knowledge economy.*

### 3.4.1 Computer-related skills

Topping the DACUM focus group's list of computer-related functions was the ability to create effective documents. 82% of work supervisors regarded the tasks that went with this function as important or extremely important. It was interesting that the focus group singled out typing ability to be the most important of the 6 tasks. Landauer (1995) agrees with them and regards touch typing as fundamental for computer literacy. The third function on the DACUM chart was a basic working knowledge of computer applications including the use of e-mail and the Web. During their interviews the work supervisors put forward very similar tasks with efficiency in wordprocessing and keyboarding skills topping their list together with using the computer equipment without damaging it! 92% agreed that the focus group's tasks in this category were important or extremely important. The last function was that of having a basic knowledge of a computer's capabilities and included tasks like knowing how to navigate around the operating system and being upfront with new IT developments. 84% of the work supervisors also thought these tasks to be important or extremely important. The only task on the chart that the work supervisors did not give overwhelming support for was the need to know how all the computer's components operated - only 55% thought this to be important or extremely important. To sum up, it can be said that there was very strong agreement between the worker and the work supervisors on the skills and competencies needed by efficient computer users in the workplace.

## 4 The computer awareness/technological environment survey

In January and February 1999, a sample of 365 entering technikon students in their first week of attendance were asked to participate in a survey of their technological environment and an assessment of their computer awareness. The students were drawn from 3 historically disadvantaged technikons: 262 students (from all client departments) came from Technikon A in the Eastern Cape, 60 Marketing students were drawn from Technikon B in Kwa-Zulu Natal and 43 Human Resource Management students came from Technikon C in the Western Cape. The survey section that investigated the student's technological environment gathered information on the types of technology used in the home (such as microwave ovens, video recorders, computers, etc) and in the school. The computer awareness test was designed to assess basic knowledge of computers as well as the student's understanding of the role of the computer in modern society and his/her expectations of the benefits of a computer literacy/EUC course. Also included in the instrument was a section that gathered information on some of the student's personal details (home language, gender, etc).

The test was composed and administered in both English and the most appropriate mother-tongue language (either Xhosa or Zulu). The students were encouraged to use either their mother-tongue language or English when responding to the questions. Efforts were made to ensure that the translated tests were equivalent to the original by using back-translation (Ellis, 1989).

### 4.1 Students' technological environment assessment

Of a possible 18 modern devices that would be commonly found in the homes and schools of students in developed countries, the majority of the students in the whole sample from the technikons had access to fewer than 9. Set out below in FIGURE 5 are the devices in question and the percentage of students who had access to them.

| Device | % | Device | % | Device | % |
|---|---|---|---|---|---|
| Electricity in home | 87 | Video recorder in home | 41 | Washing machine in home | 32 |
| Electricity in school | 85 | Tape recorder in home | 71 | Microwave oven in home | 30 |
| Computer in home | 10 | Camera in home | 47 | CD player in home | 59 |
| Computer in school staffroom | 65 | Video camera in home | 12 | Calculator in home | 85 |
| Computer in school office | 67 | Telephone in home | 72 | TV games in home | 32 |
| Television in home | 88 | Access to cellphone | 37 | Computer games in home | 9 |

*FIGURE 5: The percentage of positive responses from the whole sample to the question on technological environment.*

The sample from the researcher's own technikon fared less well than the whole sample in that only 6% had a computer at home and 7% had played computer games. In a recent survey (January 2000) of one EUC class at this technikon, (electrical engineering students), the researcher found that only 1 of the 25 students had even touched a computer and that that student had used the machine to play games at his friend's house.

### 4.2 Assessment of students' computer awareness and expectations of the benefits of an EUC course

The computer awareness test comprised 3 sections. The first section tested basic computer facts. The second section assessed the student's understanding of the role played by computers in modern society:
*Example*
*In South African society computers are used in everyday life for lots of things, for example – pilots use them to help them fly the plane. List the places where you think computer technology is being used.*

The third section assessed the student's expectations of the EUC/computer literacy course that he/she was about to undertake:
*Example*
*Write down the benefits that you think that this computer course will have for **you**. In other words how do you think this computer course will be useful to **you**? Write down as many benefits as you can think of:*

The sample as a whole scored an average of 42% for computer awareness. As was to be expected, there was a high correlation factor (0.71) between the students' expectations of the benefits of an EUC/computer literacy course and their computer awareness scores. When the results of each of the 3 sections were analysed it was found that the whole sample scored 73% for computer facts, 27% for awareness of the computer's role and 34% for expectation of the benefits of a computer literacy course. These results are shown below in Figure 6.

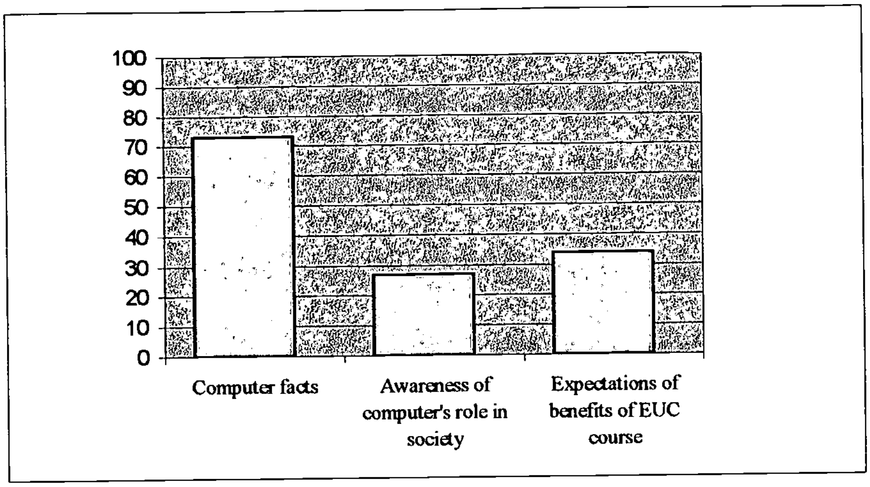


*FIGURE 6: Breakdown of Computer Awareness results from whole sample*

## 4.3 Discussion of the results of the investigation into entering students' computer awareness and technological environment

There are several interesting points that can be made about these results. The most obvious lack is that of a computer in the home. It goes without saying that children who are not brought up with a computer and are unable to use it as a tool in their studies or as an adjunct to imaginative play are seriously disadvantaged in our increasingly computer-based society. It is also of interest that there was a low positive response to those devices that require digital knowledge and dexterity such as computers, cellphones, microwave ovens and video cameras. In the developed world and in the more affluent sections of South African society, children grow up immersed in a world of computers and other information technologies. They play TV games; they use CD-ROM encyclopaedias and the Internet for project work; they help their parents program the computerised controls of videocassette players and edit family home videos from their last holiday. These experiences give them a different way of interacting with information technology compared to those children from technologically disadvantaged home environments. Cultural values that are embedded in software also affect individuals during adolescence as these individuals start playing computer games. Spertus (1991) states that several studies show that individuals who have played computer games are more likely to do well in their first computing course. It seems obvious that individuals, who have used computers during their youth whether as an educational or a recreational tool, will be more experienced in computer use and will display a resulting comfort with and affinity for computing. This can have a strong effect on the study of end user courses (Pearl *et al,* 1990). They go on to state that there is a strong cultural component within tertiary computer skills classes. Students who are knowledgeable about computers are differentiated by special names (such as wizards, gurus, hackers) and are given elite status. This social structure can seem "chaotic and confusing" to students, and can result in students "dropping out" due to their feelings of being alienated from this foreign culture.

Most of the students in this survey had access to television and tape-recorders, but it must be emphasised that these media are essentially linear and their users have little control over the information they receive; they follow the flow of information according to a predetermined path. This lack of exposure could have consequences for such a student's self -confidence when working with computer hardware and applications software and other interactive technology.

The sample's average score on computer facts was high (73%) and they had obviously heard about computers and what they did. But it is interesting to note that this information appeared to be superficial and of little conceptual value in that the members of the sample as a whole were not very aware of the pervasiveness of computer technology within today's society and were not able to visualise the benefits of an EUC course. Most of the responses received regarding the benefits of a computer skills course fell into the categories of "being able to use a computer" and "sending e-mail to my friends". According to leading educational theorists such as Jonassen (1994), Berryman (1991) it is important for learners to have expectations of the phenomena they encounter if they are to truly create their own meanings and understanding; students who have high expectations of the outcomes of the learning process are inclined to be more successful than those with limited expectations.

## 5 Possible interventions

### 5.1 Using the DACUM chart and follow-up interviews

#### 5.1.1 Curriculum development

There are many ways that a DACUM chart can be used. Because it has been produced by experts in the field and is practical, rather than theoretical. It can be used for developing the EUC course's curriculum. Specific performances that are needed to be successful in computer skills have been identified and lecturers can take these performances, write objectives, create learning activities, and evaluate students' success in achieving them. Advisory committees can assess this curriculum, using the DACUM chart. They can look at specific performance statements and let the technikon know whether these continue to fill a current need in that occupation or have changed. They can easily help the technikon update its course by letting them know of new performances that are needed since the DACUM gives them specifics rather than just a general description of the technology.

#### 5.1.2 Strengthening bonds with local business and industry

One of the biggest obstacles for the students in attaining computer skills at the technikon is the lack of computer access (as discussed above). There is a shortage of both laboratory space and computers. It is acknowledged (Thomas, 2000; Doane *et al,* 1990) that to develop a reasonable level of skill, even in a narrow range of tasks, requires solid practice. If there is little access to the technology, the rudimentary skills learnt in a course will wither. The least skilled will actually go backwards if they do not develop their skill through practice and other means (van Dijk, 1997). Care was taken during the course of the DACUM and during the follow-up interview to involve both expert workers and key work supervisors. This has resulted in those businesses and industries feeling that they are supporting specific skills development. It is hoped that, because of this feeling of support, they will be more willing to donate funds and equipment to the technikon for fulfilling the educational goals. It is also important for the experiential training of the technikon students that such a relationship is formed. There is also the benefit that students who have been trained in EUC skills at the technikon are immediately on a competitive basis with other employees, since their training comes from curricula based on charts developed by industrial and business representatives.

#### 5.1.3 Aiding the articulation process

Another benefit of the DACUM chart to the EUC course is that of articulation. It will be easier to avoid duplication effort on the part of students who could move rapidly to more advanced skills. It will also be easier to assess the prior learning and/or experiences of students coming in with related work or educational experience.

### 5.2 Using the computer awareness results

Strategic interventions are required to improve these students' understanding of the underlying computer concepts and principles and to give them the confidence to use computer applications to solve problems. Recent studies show that there is a distinct relationship between a student's belief structure (self-efficacy) and his/her performance. Bandura (1977) and Betz and Hackett (1997) maintain that self-efficacy is influenced by a person's expectations about his/her capacity to accomplish certain tasks. Furthermore they postulate that there is a distinct relationship between self-efficacy expectations and an individual's socio-contextual environment. When students have a low self-efficacy expectation regarding their behaviour (e.g. mastering computer skills), they limit the extent to which they participate in an endeavour and "switch off" at the first sign of difficulty. It is possible that efficacy-based interventions could increase the range of students' experiences and promote the personal and contextual factors that lead to positive self-efficacy expectations. Some strategies are suggested below.

### 5.2.1 Fast-tracking students' confidence in computers

It is important to remember that many technikon students have had little or no opportunity to work or play on computers. The introductory section of an EUC course should involve intensive activities that promote general computer-handling skills. Use could be made of computer games, multimedia demonstrations or simple keyboarding tutors to promote the students' confidence and to bridge the gap between them and those who have grown up with computers in their homes and schools. Wherever possible students should be made aware of the role played by computers in their everyday lives and within the broader context of the South African and global economy.

### 5.2.2 The EUC course is grounded in contextual and problem-based learning

The EUC course needs to focus on the application of knowledge and skills in the context of the students' real-life experiences and within the context of their diploma curricula. Tasks should be problem-based and reflect the real issues of the students' world.

### 5.2.3 Lecturers should help students improve self-efficacy beliefs

Lecturers need to act more as learning resources rather than as judges. They should regard errors as useful to the learning process and not evidence of failure. Personal standards rather than normative standards should influence their feedback to the students. Assessment should be non-threatening and seen in the light of the overall learning process. In the spirit of outcomes-based education, assessment should be offered to the student when he/she feels ready for it and the student should be able to retake tests if necessary. The lecturer needs to be as supportive as possible.

### 5.2.4 Students play an active role in their learning

Students need to be encouraged to reflect on their performance through practices such as self-assessment, peer review, performance checklists and portfolio assessments and should also be encouraged to support one another and work in groups. A class electronic bulletin board could support peer discussion and teamwork whilst computer-based tutorials and self-tests could help students to monitor their progress. Other areas that need to be focused on include encouraging informal study groups and team projects to provide opportunities for students to interact more closely (Bana and Hassoun, 1997). They also focus on ensuring students have access to things like e-mail discussion groups or formal or informal gatherings. Margolis, Fisher and Miller (1999) echo this opinion by stating that there is a need for peer-to-peer support. They found that many students are unaware that other students are struggling and thus attribute their difficulties to their own individual inadequacies rather than a larger scale, institution wide problem.

### 5.2.5 Institution-wide strategies

Bana and Hassoun (1997) also recommend that educational institutions focus on recruiting, hiring and retaining black faculty, as well as seeking black visiting faculty. It is also important that there are staff designated to provide additional help to students. These individuals must be approachable, knowledgeable and willing to help. Lastly, there needs to be an effective feedback mechanism that allows students to report on their experiences in the department (Bana and Hassoun, 1997). Cunningham (1994) supports this viewpoint and adds that educational institutions must also ensure easy access to hardware. In computer laboratories that work on a first come first serve basis, the senior, more computer literate, students are likely to shoulder aside the first year students. As a result, there needs to be a strategy in place to combat this. One method is to use sign-up sheets to allocate computers and resources equally and to enforce time limits to each work session.

Frenkel (1990) also addresses the issue of computer access. She suggests that tertiary institutions bury the costs of computers in tuition so that they fall within the expenses covered by student loans. This will allow computers to be set up in the residences and would give each student a sense of control and with this will come increased self-confidence. Computers in the residences would also promote peer-help and collaborative learning as discussed above. Possibly, as mentioned in 5.1.2 above, local industry and business that have been involved in the DACUM, might be persuaded to fund such projects.

## 6 Conclusion

It seems apparent that the technological environment of the majority of students entering historically disadvantaged technikons is inadequate. Technikon EUC courses need to be restructured to enable this technology gap to be bridged. These courses need to focus not only on the workings of computer hardware and applications software, but on how students can use the computer to gather, manipulate and communicate data and knowledge. The most desired outcome of such courses is for students to learn the underlying computer concepts and principles so that they are able to use computers to solve problems from a variety of disciplines. They should also develop the ability and the self-confidence to use new computer applications to solve new problems on their own. They should increase their expectations of what computer technology can help them achieve. Students who have to overcome internal and external barriers to self-efficacy because of a poor technological environment are especially in need of positive learning experiences that integrate learning computer skills with the real-life conditions of their existence.

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