COMPUTING IN HIGHER EDUCATION
IN THE DOMINICAN REPUBLIC

by

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ABSTRACT

The purpose of this study was to evaluate the current status of educational computing in higher education in the Dominican Republic by describing the computing resources available, and how they are utilized. The computing environment of seven universities was studied, with particular attention to respondents' perception of the availability and quality of physical, human, and logical resources for computing. In addition, the general disposition toward computing on the part of administrators and professors was examined, as well as the uses of computers in the areas of information, instruction, and productivity.

A review of the literature on educational computing was conducted, including aspects such as computer literacy, the roles of computers in education, characteristics of educational computing, and attitudes toward computers. Particular attention was paid to those aspects of major relevance for the Latin American context, such as transfer of technology and computing issues unique to that region.

Seven private universities were selected for the study, based on the size of their student population and location within the country. A total of 194 professors from all faculties and departments of these universities completed a questionnaire concerning the physical, human, and logical aspects of computing, as well as their knowledge about, and attitudes toward computing. Technical and administrative information was gathered by interviewing a total of 12 individuals who were able to provide accurate information about universities' policies on computing, as well as the hardware and software technologies currently in use.

Patterns of particular interest among the universities surveyed were identified, and the following conclusions were drawn about the current status of educational computing and the use of computers in the universities surveyed, the two focus questions of the study:

1. Dominican educational computing is geared mostly to the areas of administration and com-

puter science; other aspects of the field are relatively neglected. Although some progress is evident, economic limitations and problems such as the poor electrical infrastructure of the country are slowing the evolution of computing in education. Training of professors in educational computing is almost non-existent; and, although computing is considered very important by both professors and administrators, few training, and support programs are in place. In general, Dominican educational computing presents all of the characteristics mentioned in the literature as typical of developed countries: lack of planning, inequitable access to computing, inadequate software, need for integrating computers into the curriculum, and need for training.

2. Dominican universities are well-developed in the use of computers for the management of administrative information, although use of computers for research and communication is very limited. The use of computers for personal productivity is increasing, but the cost of this technology is a major impediment to progress in this area. Instructional uses of computers are only common for computer literacy and computer science courses; but, they are virtually unknown for courses in which the computer is a medium of instruction, rather than the subject of instruction. Both computer-using and non-using professors showed highly positive attitudes toward learning about and working with computers. University officials also favor a change toward a more widespread use of computers in most universities, and seem to regard them as important tools for the development of individuals from all areas in society today.

Based on these results, three basic recommendations were made. First, Dominican universities should develop local educational computing policies to help in planning and implementing culturally appropriate uses of computers in educational settings. Second, Dominican universities should improve the availability and quality of the human element of computing, especially their teaching staff, through training on educational computing. Finally, universities should optimize the available physical resources, which appear to be under-utilized in many areas.

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CHAPTER 1: THE PROBLEM

Background to the Problem

Dominican universities, like many others in Latin America, began using computers, particularly microcomputers, only recently; and they are now facing a number of educational computing issues that need to be resolved (Gómez Moreno, 1989). As some authors have stated (Galvis, 1987; Harvey, 1983; Weston, 1988), there is a need to gather information about the use of computers in Latin American universities, and the unique characteristics of their computing environments. This information should be used for planning and analysis of appropriate uses for the computing technology that is available to these universities. At the present time, context-specific information of this kind is not readily available.

The present study analyzes the use of computers in higher education in the Dominican Republic in an effort to understand and improve how technology is being used in this third world country, where technological resources are few and expensive. Thus, the purpose of the study is to assess the present status of educational computing in the major universities, as well as to describe the general disposition toward educational computing on the part of professors and administrators.

Educational Computing in Higher Education

Computers have been used in higher education in developed countries since the 1950s for scientific and administrative applications, but their use has since greatly expanded, and universities are now using computers for both academic and administrative purposes (Becker, 1982; Bork, 1984; Dockerill, 1987; Graham & Karlsson, 1987; Mudd & Wilson, 1987). The rapid development and evolution of microcomputer technology over the last fifteen years has triggered significant changes in the way computers are perceived and used by college and university personnel, who now view the computer as a multi-purpose rather than a specific-purpose tool (Gillespie, 1983). However, the education community

is still struggling with other more complex issues in educational computing including, for example, computer literacy and the effectiveness of using computers for instruction (Collier, McGowan & Ryan, 1987; Marshall, 1984). Indeed, the impact of computers on education appears to be limited and most successful implementations of educational technology have been in a few specific areas, such as design tools in engineering and administrative systems, rather than in other areas where expectations have historically been very high, for example, when computers are used for teaching purposes (Becker, 1982; Gilbert & Green, 1986). Even so, the use of computers in higher education institutions has been increasing steadily over the last decade and is still increasing (Collier et al., 1987; Ploch, 1984).

Universities today seem to have little choice as to whether or not to provide computing services and computer education. As Gilbert and Green (1986) state, "The microcomputer revolution comes with forces that are difficult to resist" (p. 34). It is difficult to deny the importance of teaching about computers in the developed world. Computers now form part of our everyday life in many ways, and knowing about computers will eventually be as important as knowing how to read or write (Marshall, 1984). The fact that businesses of all kinds already assume that potential employees are "computer literate" puts pressure on the educational system to provide (or appear to be providing) such knowledge (Collier et al., 1987).

A model of how computers can be used in education can be devised by examining the literature on the subject, and in particular, the ideas of Gilbert and Green (1987), Taylor (1980), and Schultz and Hart (1983). Three fundamental roles of computers in education—information, instruction, and productivity—and their interaction are identified as the components of the model. Information refers to the use of computers for research, science, and management, as described by Gilbert and Green (1987). The role of computers in instruction refers to the use of the computer in the classroom for teaching purposes, as well as its use as an object of instruction. Finally, productivity refers to the use of general-purpose computer applications by students and faculty personnel to enhance their work. A thorough discussion of this model of the roles of computers in education is presented in Chapter 2.

It has been claimed that the greatest importance of computers in education stems from their usefulness as tools (Chan, 1989; Gillespie, 1983). However, the effectiveness of their use may be hampered by economic, intellectual, environmental, social, and cultural factors which vary from one educational setting to another. Many authors have pointed out that careful planning and assessment of needs is the key to effective implementation of any technology (Blankenship, 1985; Carter, 1990; NTFET, 1986; Sybouts & Stevens, 1986). In particular, Brine and Johnson (1990a) suggest that successful implementation of educational technology must first address curricular issues and specific educational policies.

Educational Computing in Third World Countries

As industrialized nations move toward a more highly computerized society, third world countries struggle in their efforts not to be left behind (Marshall, 1984). These countries face many obstacles in trying to implement educational computing efficiently, including high cost, poor hardware reliability, poor quality of software, deficient telecommunications infrastructure, poor definition of goals, inadequate governmental support, lack of information on computing, and shortage of personnel trained in the use of educational media and technology (Alvarez, Smiley & Rorhmann, 1985; Araujo, 1989; Hungwe, 1989).

One of the most important problems in educational computing that third world countries face is transfer of technology. Importing technology from developed countries has been mistakenly regarded as the solution for all educational problems in developing countries (Chadwick, 1983; Marshall, 1984). Because of their poor technological development, third world countries are forced to import technology from developed countries. It is important therefore to evaluate and modify this technology and adapt it to each country's specific educational needs (Galvis, 1987).

To be able to achieve this goal, it is essential that third world countries develop their own culturally appropriate tools. This requires "new organizational structures, new personnel and new ways

of thinking, doing and organizing" (Hungwe, 1989, p. 22). In general, all of these objectives can be achieved through education and training, but it is a process that takes time and it is not free of obstacles. Araujo (1989) describes a number of possible solutions if some investment is made, and if the use of available resources is optimized. Among these solutions, the first to be examined should be investments in the areas of personnel development, enhancement of the quality of instructional material through educational planning, and improvement of educational administration.

For many third world countries, such as the Dominican Republic, educational computing is fairly recent, and many of the issues mentioned must be examined in order to arrive at appropriate implementations, including the educational system itself. The next sections provide some insight into the Dominican Republic, its educational system, and especially its higher education system, so that the reader can better understand the context in which this study was conducted.

The Dominican Republic

The Dominican Republic occupies the eastern two thirds of the island of Hispaniola, which it shares with the Republic of Haiti. The island is located in the Caribbean Sea, with Puerto Rico to the east and Cuba to the west. The country has an area of 48,000 square kilometres and a population of approximately eight million people. At the beginning of the 1980s, the proportions of rural population and urban population were about equal, but a trend toward migration to urban areas has resulted in the present rate of 40 percent rural and 60 percent urban (Fernández, 1990).

The Dominican Republic's economy is typical of that of many third world countries. About 25 percent of its gross national product comes from agriculture and mining, with the main products being sugar, tobacco, coffee, cocoa, gold, bauxite, and iron-nickel. The main problem currently facing the country is a lack of energy. This energy deficiency has been worsening for the past four or five years, making the country almost totally dependent on foreign oil for transportation and electricity. In fact, the

lack of fuel and electricity has almost brought the country to a halt several times in the past year, and it is proving to be a major obstacle to the development of computing technology which depends on a constant source of electricity.

Another problem is the economic difference among population groups in the country. The richest 14 percent receives approximately 55 percent of the total income, while the poorest 29 percent receives only 6 percent. The rate of unemployment is over 20 percent and underemployment is an even worse problem (Alemán, 1988; Fernández, 1990).

The form of government is a representative democracy with characteristics typical of third world countries, namely a history of dependency and dictatorship. Two political parties have controlled the government alternately for the past 20 years, with opposition from a third party, making unified planning and implementation of what could otherwise be productive governmental policies very difficult at best (Mejía, 1988).

The Dominican Educational System

Preschool, Primary and Secondary Education

The *Consejo Nacional de Educación*, CNE (National Council for Education) is the main regulatory body of the Dominican Republic's educational system. Public education at the preschool, primary, and secondary levels in the Dominican Republic is controlled by the *Secretaría de Estado de Educación, Bellas Artes y Cultos*, SEEBAC (Secretariat of Education, Fine Arts, and Culture). The SEEBAC also sets curriculum for all three levels of education for both private and public educational institutions. Primary education is mandatory, although this is more in theory than in practice, and the high number of drop-outs is a cause for concern (Crespo, 1990; Troxell Sellew, 1987).

Two educational programs are currently in effect. The traditional system includes six years of

primary education, two years of intermediate school, and four years of secondary education. Since 1970, the government has tried to implement a new "reformed program", but this initiative has not been successful. Only a few schools originally set up as pilot projects still operate under this system. The program consists of six years of primary education and six years of secondary school (a four-year basic cycle followed by two years of a specialization cycle).

Higher Education

Dominican institutions of higher education are largely independent of SEEBAC. Laws regulating preschool, primary, and secondary education explicitly exclude higher education, which is regulated by special laws. A brief study of the evolution of the higher education system shows that it has been characterized by a laissez-faire attitude on the part of the government.

Before 1962, only one university operated in the Dominican Republic: the *Universidad de Santo Domingo*. After the downfall of the dictator, Rafael L. Trujillo M., in 1962, many changes took place in all aspects of the Dominican Republic's development, including major changes in the economy and in education.

The most impressive changes in education occurred in the higher education sector. In 1965, there were two higher education institutions with a total enrollment of 6,963 students: the renamed *Universidad Autónoma de Santo Domingo*, which gained autonomy from the government in everything except the obligation on the part of the government to provide funding for the university; and the *Universidad Católica Madre y Maestra*, authorized by a special decree and administered directly by the Catholic Church. By 1975, the number of universities had increased to seven with 41,000 students: an increase in student enrollment of almost 500 percent in only five years. By 1978, there where 14 institutions with legal standing and an enrollment of approximately 78,000 students. By 1982, there were 15 recognized universities (1 public, 5 private with partial government support, and 9 private with-

out public funds) enrolling a total of approximately 100,000 students. Currently there are 24 universities with legal standing in the country, offering technical, bachelor, and doctoral degrees to a total student population of about 150,000 (Alemán, 1988; Férnandez, 1990; Mejía, 1988).

As Mejía (1988) explains, this rapid growth in the demand for higher education is a direct consequence of changes in the national economy. The economic growth experienced by the Dominican Republic after the period of political instability following the downfall of Trujillo has almost no parallel in the economic history of the western hemisphere. From 1971 to 1974 the gross national product grew in real terms at an annual average of 11 percent per year (Mejía, 1988). These changes triggered other social changes as well, resulting in a rapid growth of the urban population from 30 percent of the total population to about 50 percent, caused mainly by a greater demand for human resources for the booming industrial sector.

Up to that point, the only government involvement in higher education had simply been to give the institutions authorization to exist as legal organizations and to grant higher education degrees. The lack of quality standards or control mechanisms and the great demand for education led to a proliferation of profit-seeking higher education institutions, which operated and made their profits based on low budgets and low academic quality.

Due to the growth in student registration after 1965, the establishment of many new universities in subsequent years, and the poor quality of some of those institutions, the need for some degree of government control over post-secondary education became obvious. The pressure on the government to create control mechanisms came not only from the national sector, but also from other countries, since many foreign students were coming to the Dominican Republic seeking higher education degrees, particularly in the field of medicine.

In 1977, a group of five private universities formed the *Asociación Dominicana de Rectores de Universidades*, ADRU (Dominican Association of University Rectors), and it became one of the main

promoters of new legislation regarding higher education. In 1978, legislation was passed forbidding the creation of new universities, and a commission was formed to study the current situation and devise a solution. One of the recommendations of that commission was that a national council on higher education be created. However, the commission did not succeed in getting the proposed legislation through congress because of opposition from several sectors, and nothing was accomplished until 1982. Although no new universities were officially authorized, several institutions were created during that period and operated without official recognition.

During the period from 1978 to 1982, an important turning point in the economy came about when several events basically destroyed the nation's economy. In 1979 Hurricane David caused extensive damage to the nation's infrastructure. Second, increases in fuel prices raised the national fuel bill from 9.6 percent of the income from imports in 1973 to 60 percent in 1982. Third, the price of sugar fell dramatically, particularly in 1982. These and other events brought the Dominican balance of payments from a surplus of 42 million pesos during the period 1973-1977 to a deficit of 768 million pesos (Mejía, 1988).

In March 1983, the *Consejo Nacional de Educación Superior*, CONES (National Council on Higher Education) was created by government decree to study the situation and develop alternatives. The main objective of CONES was to oversee the administration and operation of higher education institutions. With that in mind, CONES developed guidelines specifying the minimum requirements and characteristics of a private Dominican university, in terms of physical facilities, faculty qualifications, and academic standards. For an institution to receive legal standing, it first had to comply with the requirements set forth by CONES and then receive authorization from the Executive Branch. When CONES started operating in 1983, recognized institutions were re-evaluated and non-recognized institutions were obliged to comply with CONES' requirements as well. Legally, CONES has a significant amount of control over universities. Lack of resources, however, has hindered CONES' efforts, and some approved institu-

tions do not comply with standards set by the regulatory unit (Troxell Sellew, 1987).

One of the main problems affecting the quality of higher education in the Dominican Republic today is one common to other third world countries, a shortage of qualified professors. Because salaries are so low (about US$200/month), universities have difficulty attracting qualified personnel for instruction, particularly in computer-related fields. Most institutions hire professionals for teaching on a part-time basis and most professors have several jobs (Troxell Sellew, 1987).

Purpose and Nature of the Study

Latin American universities began to use computers on a relatively large scale only recently (Palmer, 1986). In the Dominican Republic, these implementation efforts have been slow and oriented mainly toward administration and computer science, neglecting the possible benefits of computer use in other areas where similar Latin American countries have found the use of computers beneficial (González Fiegehen, 1987). An examination of the problems faced by other Latin American countries suggests that two possible factors contribute significantly to the Dominican situation: the country's economic situation and its many consequences, and a general lack of knowledge about computers and their applications in educational settings (Galvis, 1987; Hungwe, 1989; Marshall, 1984). However, there is a need for more information to be able to make judgments about these and other factors involved in the Dominican educational computing context.

This study is concerned with gathering information about the Dominican educational computing context by surveying attitudes toward computers and the actual use of computers by professors and administrative personnel in the Dominican Republic's major universities. This information will help to determine what kind of educational computing technology is in place, who is using it, and how it is being used. By examining the policies of the different universities with respect to educational computing and the level of computer literacy of their professors, it may be possible to understand why comput-

ers are being used as they are. This study also includes a review of the literature in order to investigate how other higher education institutions around the world, particularly in Latin America, are implementing educational computing, and to determine the perceived benefits of this technology.

The purpose of the study then, is to assess the present status of educational technology in the Dominican Republic in terms of hardware and software used, applications of computers in education (both academic and administrative), policies of universities regarding computer technology, and awareness of users and non-users of this technology. In addition, the information gathered will be useful to compare universities within the Dominican Republic and to obtain a general idea of the state of educational computing in the country relative to that of other countries.

Research Questions

Two main questions were devised in order to gather as much information as possible while maintaining the feasibility of a study of this nature.

1. What is the status of educational computing in Dominican universities?

This question was directed to both the academic and the administrative aspects of educational computing. Respondents were asked to provide information about the kind of computing technology that is available to Dominican universities in terms of hardware and software, and the availability of physical, human, and logical resources needed to support this technology.

Another objective of this study is to examine the policies that Dominican universities have regarding educational computing, and to analyze the differences between the academic and administrative points of view about computers and computer applications in education. Through this process it will be possible for the reader to evaluate these universities within their local environment as well as in relation to other universities in Latin America and technically advanced countries. The information provided

here is relevant in that it will help identify unique Dominican situations independent of cultural or social issues that differentiate this country from otherwise similar countries. It will also provide information regarding differences in the availability and use of computing technology among Dominican universities.

2. How are computers used in Dominican universities?

The purpose underlying this question is to discover what Dominican universities, and their professors are doing with the computer technology that is available to them. This question relates to both the actual uses of computers and the kinds of application software being used. An important sub-question is: Why are computers being used in these ways? Local conditions may affect both application and hardware selection and use. It is therefore of interest to determine which are the major factors affecting the acquisition and use of computing technology in Dominican universities. Finally, this question will address the issue of awareness of, and attitude toward computers and their use in higher education on the part of professors and administrative personnel.

Justification of the Study

The present study is intended to achieve several goals, both theoretical and practical. On the practical side, research shows that the introduction of computers into education has frequently been based on poor planning (if any planning at all), and this in turn has led to poor implementation of computing technology at all levels of education (Brine & Johnson, 1990a; Galvis, 1987). In addition, unsuccessful approaches to solving the problems of educational computing in Latin America in the past have been identified as being the consequences of a lack of understanding of problems unique to the area. Many of these problems have to do with technology transfer issues (Marshall, 1984). Knowing the conditions and state of affairs in Dominican universities, supplemented with the information gathered through this study, it might be possible to suggest new or alternative uses of computers in different

educational areas that are aimed at optimizing the use of computing technology. Knowing the computing strategies and organizational policies of the universities would also assist in suggesting appropriate implementation. The knowledge needed to carry out this task will come from the understanding of the Dominican context as well as from experiences in other universities around the world.

This study is also the first step in gathering basic information regarding educational computing in the Dominican Republic, and it is intended to provide the foundation for other researchers to build upon, and to carry out new efforts that may have greater practical implications. There is little research done today in Latin American countries even though there is enough evidence to remind us that there is need for such research (Rojas Cortés, 1988). In the Dominican Republic, resources are limited, qualified researchers are few, and there is little tradition of such work (Alemán, 1988; Chadwick, 1983).

Definition of Terms

Educational Technology

The Association for Educational Communication and Technology's (AECT) Task Force on Definition and Terminology (1977) defines educational technology as "a complex, integrated process, involving people, procedures, ideas, devices and organization, for analyzing problems, and devising, implementing, evaluating and managing solutions to those problems, involved in all aspects of human learning" (p. 164). It is a very broad field, combining aspects of educational psychology, media, and the systems approach applied to educational problems (Chadwick, 1983). It is often confused with terms that suggest application of a certain specific technology in education.

Educational Computing

As used throughout this thesis, educational computing represents the field of applications of computers in education, and their role in educational technology. It includes planning, organizational strategies, and all possible aspects and uses of computers in the field of education. Note that it is not simply the physical aspects of computers that are analyzed, but all the topics related to computing in the field of education, as implied by the educational technology definition above.

Technology Transfer

An especially relevant term used throughout this work is "transfer of technology". It represents the process of applying certain technology (as defined above) to a different setting, and in our case, the transfer of educational computing technology from other countries to the Dominican Republic; it involves mainly issues of cultural and social-economic nature.

Computer Literacy

Another important term used is "computer literacy". There is no consensus among so-called "experts" as to exactly what it means. It represents the field of educational computing as it applies to learning about computers, or the view of computers as objects of study; as such, it encompasses all issues regarding the needs and ways to learn about computers in today's society.

In its more general sense, computer literacy could be described as the knowledge about computers needed today to succeed in our everyday life. From this perspective, it is obvious that the exact definition of computer literacy will vary depending upon the actual economic, cultural, and technological setting to which is going to be applied. Different authors have very different views as to what exactly we need to know about computers, and the subject is treated in depth in the following chapter.

Organization of the Following Chapters

In the following chapters a review of the literature on educational computing, a description of the methodology used in this study, its results, and a discussion of these results can be found. Chapter 2 reviews the literature on educational computing and the uses of computers, with particular attention to the Latin American region. Chapter 3 contains a description of the universities selected for this study, the development and administration of the instruments, and the procedure followed for the analysis of the data. The results and findings are presented in Chapter 4, and a summary of those results, as well as recommendations are presented in Chapter 5.

CHAPTER 2: REVIEW OF THE LITERATURE

The purpose of this study is to assess the current status of educational computing in higher education in the Dominican Republic, and to analyze how computers are used in this environment. This chapter is concerned with reviewing the literature on the most relevant aspects of educational computing in general, and the ways in which those aspects relate to both Latin American and third world environments. Its content is divided into two sections covering two main areas of interest: educational computing in general, and educational computing in Latin America and the third world.

Educational Computing

An understanding of educational computing requires an examination of key aspects of the introduction, use, and status of computer technology in the educational environment. This section begins with a review of the literature on computer literacy, and the different approaches to its conceptualization, followed by a description of computers and their roles in education. The most common characteristics of educational computing identified in the literature are also described. Finally, the literature on the attitude toward computers—an important aspect of this study—is reviewed.

Computer Literacy

A number of authors have emphasized the importance of knowing about computers in today's society. They maintain that a certain degree of knowledge about computers and their uses is increasingly needed for any individual to succeed in a computerized world (Agee, 1985; Galvis, 1987; Helms, 1985; Kay, 1989; Marshall, 1984). This kind of knowledge is particularly important if the educational community is to assume the task of educating for a computer age, since educators must be computer literate to achieve this goal. Furthermore, one of the most emphasized aspects of introducing computing tech-

nology in schools and universities is the need for careful planning and definition of goals that a computer literacy program must achieve (Becker, 1982; Brine & Johnson, 1990a; Gilbert & Green, 1986a; Sybouts & Stevens, 1986). This kind of planning and definition of goals requires a thorough understanding of different aspects of the technology in question, and this understanding must include a clear concept of computer literacy. Rather than just attempting to define the term, this section reviews the literature on computer literacy by looking at the different views about what an individual should know to be considered computer literate.

Conceptualization of Computer Literacy

There is no consensus as to what the term "computer literacy" means. Since the early 1970s it has been used to represent different aspects and levels of knowledge about computers. In its most general form, computer literacy refers to the knowledge about computers that every person needs to function properly in today's society. Most authors agree that some degree of computer understanding is necessary in today's society, but they seem to disagree about what specific topics should be included and about what level of specificity is required to be computer literate.

Robin H. Kay (1989) categorized the different approaches to defining computer literacy over the last twenty years. He identified five categories into which articles about the subject mainly fall: specificity, global, planned, evolutionary, and the individual needs approach. This section examines these different views of computer literacy, the basic assumptions behind them, and the ideas that the proponents of the different approaches use to support them.

Specificity Approach

This approach to computer literacy is supported by those who favor concentrating on one aspect of computer knowledge, omitting other aspects. Kay (1989) defines four distinctive areas of specificity:

technology, programming, the computer as a tool, and computer awareness.

Calfee (1985), a proponent of the technology aspect, argues that "power comes from understanding how something works" (p. 1). To use computers effectively we must first understand how they work. Supporters of the programming aspect define computer literacy as being able to control the computer, and to do so one must know how to program, or what they call "communicate using symbols through the computer" (Pickert & Hunter, 1983, p. 7). The next view has to do with considering the computer a multi-purpose information tool, and its supporters believe that the real necessity is to know about software, because it is software that makes computers useful (Farrel, 1984). Finally, the computer awareness advocates believe that the most important component of a computer literacy program should be a set of fundamentals about computers, including computer and application basics, social and economic impact, and the limitations of technology.

In arguing against some aspects of the specificity approach, Zemke (1984) and Rundall (1985) support the idea that in-depth knowledge of computer technology is not really needed to take advantage of it and support their arguments with the simple fact that we all drive cars without the need of knowing exactly how they work. Others refute the programming supporters by stating that, while some benefits may be achieved by learning programming, new powerful software tools and ever-friendlier operating systems permit users to take full advantage of the computer without having to acquire programming skills (Haigh,1985; Hasset, 1984; Jackson, Clements, & Jones, 1985). The other two areas of the specificity approach—tool and awareness—have been less debated.

Global Approach

In reaction to the specificity advocates, a comprehensive approach to computer literacy was born, incorporating a number of topics one should learn to be considered computer literate (Kay, 1989). Among dozens of different learning objectives, topics include applications, hardware, impact, pro-

gramming/algorithms, software and data processing, motor skills, and values and feelings. The obvious limitation of this approach lies in the impracticality of teaching or learning all the proposed material. This limitation led a more moderate group of individuals to reduce the number of topics (Fary, 1984), but Kay (1989) explains it still is nearly impossible for a normal person to gather and maintain that amount of knowledge in a rapidly changing area such as computing technology.

Planned Approach

The planned approach calls for extensive planning before making decisions about computer literacy. Railsback (1983), and Ganske and Hamamoto (1984) explain that we must understand exactly what is happening in the area of computers to be able to plan ahead and prepare well for computing today and tomorrow. However, as Kay (1989) explains, change in the computer industry is too fast to stop and plan ahead, and by the time one devises a plan for an specific area of computer knowledge, the required knowledge may be already obsolete, and therefore useless.

Evolutionary Approach

More recent authors (Calfee, 1985; Naiman, 1987) support the idea that few practical outcomes can be expected from efforts to find a strict definition of computer literacy. Technology is fast-changing so that computer literacy is also changing and the definition of today will probably not apply tomorrow. It is questionable whether this approach is practical, since nothing is gained from just letting the computer revolution happen without taking any action (Kay, 1989).

Individual Needs Approach

The underlying position of advocates of the individual needs approach is that the computer is merely another tool, like the telephone or the typewriter. People should really focus on learning how to

use computers in their specific area of work. One becomes computer literate by learning to use the computer as a tool to help achieve individual goals.

It has been suggested that educational institutions should adopt this approach and apply it directly to education, just as it has been done in the business community. The big difference between the two settings, explains Kay (1989), is that in the business world, the need for computers came before they actually had them. In contrast, the education system has been supplied with a tool without having any use for it. For this reason, the need for focusing on educational goals, rather then on technological goals should be emphasized (Brine and Johnson, 1990a; Hasset, 1984; Moont, 1986).

Computers in Education

The evolution of computing technology has created what many consider to be a new era in our time (Blankenship, 1985; Esteniou, 1987). Computers have been used in educational institutions since the 1950s, but it was not until the last decade that computers became widely available. Since the introduction of the microcomputer in the late 1970s, computing technology has been changing from a centralized to a decentralized approach, and changing from an emphasis on mainframes to the use of personal computers at all levels and in all aspects of educational computing. Most authors agree that the ever-decreasing cost coupled with the increasing power of microcomputers present educational systems and institutions with an unprecedented opportunity to enhance education in many ways (Dwyer, 1980; Fonseca & Schaffer, 1990; Galvis, 1988b; Gilbert & Green, 1986a; Gillespie, 1983; Mariño Drews, 1988; Taylor, 1980; NTFET, 1986; Schultz & Hart, 1983).

The introduction of computing technology in education has been controversial, however, primarily because while implementations of computers in education have met with mixed success, computers keep pouring into educational institutions at ever-increasing rates (Bork, 1984; NTFET, 1986; O'Neil, 1990). As mentioned before, Kay (1989) explains that "the tremendous success of computers in

the business world is probably due to the fact that need came before ability" (p. 42), and that this has not been the case in education. In fact, it has been suggested many times that pressure from society, particularly from the business sector and from families of students at all levels of education, has been a determining factor in pushing computers into the educational field (Bork, 1984; Gilbert & Green, 1986a; Kay, 1989; Mariño Drews, 1988; Marshall, 1984). In addition to that, Tucker (1983) indicated that most failures of computer use in schools have been related to externally-imposed motivators.

Computers have been shown to have many applications in education at all levels. Despite this, expectations about the introduction of computing technology in education have been much higher than the actual outcomes perceived to date (Gilbert & Green, 1986a, O'Neil 1990). O'Neil (1990) states that, even in educational institutions where computers have been available for some time, it is estimated that only a small percentage of them are taking advantage of this technology, while the impact of computers in the great majority of cases is negligible. On the other hand, even though limited access to computers and the relative newness of this technology in education have restricted positive outcomes of educational technology implementations, there is evidence that significant progress can be made in many aspects of education by using computers (Chan, 1990; Mecklenburger, 1990; NTFET, 1986).

Roles of Computers in Education

Although authors have used a number of different approaches to the subject, the literature shows a fairly clear and generally accepted categorization of the basic roles of computers in education. However, authors use different names for the same aspect of educational computing, they concentrate on one or two specific roles, or they approach educational computing from different perspectives. Perceptions of the importance of some aspects of computing over others have also changed over the years as a result of significant developments in those areas (Gillespie, 1983).

For these reasons this review of the literature has been organized by the three areas of

educational computing that are most easily identified as the main roles of computers in education today: information, instruction, and productivity. These three areas of computer usage in education can be graphically represented as shown in Figure 1. These roles of computers in education present some characteristics that are described in the model proposed by Gilbert and Green (1986a). It is a dynamic model, meaning that the three areas mentioned continuously change to reflect changes in the underlying technology. They also show a high degree of interdependence, since it is often the case that one or two of these aspects are used to support the other(s). For this reason, it is impossible to completely separate these roles of computing in education. As an example of this fact, Gilbert and Green (1986a) state that "while the information dimension traditionally involved the generation of new knowledge, today's technology adds the component of affordable, local access to information via databanks and communications networks, access that can aid a student learning and personal productivity" (p. 36).

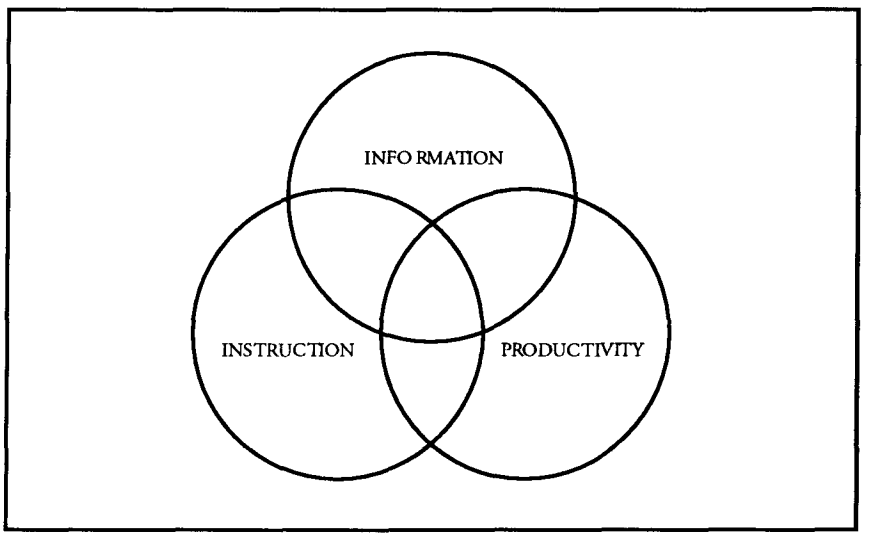


Figure 1 The roles of computers in education.

Information

The information role of computers includes new and varied ways to manipulate vast amounts of data in different academic and administrative areas of higher education. Gillespie (1983) stated that "The original uses of computers—to solve scientific and administrative problems too large or too time-consuming to handle any other way—are now just a small part of the picture" (p. 53). Uses of computers for information handling include research, administration services, electronic mail, library systems, and electronic databases available on universal computer networks (Gilbert & Green, 1986a; Gillespie, 1983; Schultz & Hart, 1983).

The role of the computer in manipulating data has become critical in the area of administration, for example. Budgeting, payroll, inventory, and personnel, are examples of administrative tasks for which computers are used in most educational institutions. Information systems in schools and universities keep track of scheduling, attendance, grades, and other kinds of student-related information (Gillespie, 1983; Schultz & Hart, 1983).

Research is still one of the main uses of computers in the form of data gathering and statistical analyses, and this role is also expanding. Gilbert and Green (1986a) explain that libraries in educational institutions at all levels are using computer systems to allow students to get the data and information they want quickly and easily. Electronic databases are available in most higher education institutions in developed countries, which are in turn linked to one another by worldwide communication networks.

Gillespie (1983) stressed the increasing importance of electronic mail for interdepartmental communication in educational institutions, particularly in higher education. Although it still is mainly a higher education tool, electronic mail has been migrating from mainframe systems to microcomputers, and thus is increasingly becoming available to teachers and students at the elementary and secondary levels (Shor, 1988).

Instruction

This role of computers in education is viewed from two different directions: the use of computers for instruction and instruction about computers. In the first, computers are used as tools for everything from simple drill-and-practice programs to total delivery systems that teach the material and evaluate students' achievement. In the second, the computer is the object of study. This includes everything from computer literacy courses to specific computer-related courses in computer science or engineering.

Use of computers for instruction. The use of computers for instruction has probably been the most controversial aspect of computers in education because of all the disagreement it has created among authors. The literature shows the constant conflicts created by the high expectations from the computer as the ultimate teaching/learning tool on one side, and increasing needs for measurable results on the other.

Experts agree that computers have great potential for instruction, and that they offer the capabilities needed for individualized and self-directed instruction, as well as for creating new and exciting ways of learning (NTFET, 1986; Papert, 1980, 1987). Becker (1982) explains that one of the most interesting features of the computer is its interactiveness, which provides the potential capacity of diagnosing student error patterns and providing corrective tutorial instruction. A special report to the Secretary of Education of the United States, the National Task Force on Educational Technology, NTFET, concluded that computers are creating new teaching and learning methods that help fulfill individual learning needs (NTFET, 1986). It also stated that "students often work more effectively together when computers are involved" (p. 60), emphasizing the positive influence of computers in two (often conflicting) approaches to instruction: individualized learning and cooperative learning (Carter, 1990; NTFET, 1986; Papert, 1987).

But for all the excitement that computers have generated in this aspect of education, it has been difficult to identify improvements of instruction linked to the introduction of computers into the learning environment. Literature on the subject shows conflicting evidence about the results of research on the area of computer-assisted instruction. The NTFET report is definitely optimistic but cautionary, illustrating positive results of research in several areas of computer-assisted instruction at all levels of education (NTFET, 1986). However, other authors maintain that most research and experience on the use of computing technology, instead of conventional instructional practices, shows little or no effect on students' achievement (Becker, 1982; Blankenship, 1985; Marshall, 1984; Pogrow, 1990).

There are many reasons that might explain the limited achievements and mixed outcomes identified in instructional uses of computers. As Mecklenburger (1990) explains, it may be too soon to assess with accuracy the merits of computing in instruction. One of the main factors influencing this situation is that, even though the number of computers in educational institutions is increasing rapidly, the number of computers available is still relatively small. A specific problem to overcome is the contrast between the computer's capacity to interact with one student and the group-based nature of the educational system (Becker, 1982). Although computers are found in classrooms at all levels of education in ever-increasing numbers, it is evident that in order for clear and strong benefits of the use of computers for instruction to be evident, the numbers of computers per student must increase even more.

Other factors have also been identified as contributors to slow progress in the area. Some of these factors are: lack of planning in instructional implementations, inequitable distribution of computers, and inadequacy of available educational software (NTFET, 1986; O'Neil, 1990; Papert, 1987).

Even with all the controversy surrounding instructional uses of educational technology, computers are being used for instructional purposes in many ways, particularly at the primary and secondary levels. Terms such as "computer-assisted instruction", "computer-managed instruction", and "computer-based instruction" have become common-place in schools. Among the most popular uses of

microcomputers in schools are drill-and-practice applications at the elementary level, and programming at both the elementary and secondary levels (Becker, 1983; Becker & Sterling, 1987). Programming is used both as a basic and high-level skills development tool—with programming languages such as LOGO—in elementary education, and as a high-skills development tool and computer literacy tool in secondary education (Becker, 1983; Chan, 1990; NTFET, 1986).

However, by far the most exciting results of instructional uses of computers have been found in implementations that focus on exploiting the potential of computers to support in-classroom activities. These programs usually involve the student with the use of computers and related technologies as tools to achieve program goals (Carter, 1990; O'Neil, 1990).

In higher education, instructional software packages have been used in the past, but have proved to be impractical. However, the shift to desktop computing over the last decade has created a great demand for instructional software. The demand for software packages oriented toward higher education has yet to be fulfilled (NTFET, 1986), however, because as Gilbert and Green (1986a) point out, the instructional needs of higher education are qualitatively different from those of elementary and secondary education, for which the majority of instructional software is designed.

The impact of using computers for instructional purposes has been difficult to measure. Some authors have expressed the need for research specifically aimed at designing adequate measurement tools if we are to use educational technology efficiently for instruction (Becker, 1983; NTFET, 1986). Others maintain that a possible explanation for the limited effect of computers in the instructional process is that no models for applying this technology are available, underlining the need for well-conceived theoretical or research-based teacher-training models and implementation strategies for educating teachers about the instructional uses of microcomputers (Becker, 1983; Jacobs, 1985; Sutphin, 1987).

Instruction about computers. In this mode, the computer is the subject of instruction. The need for this kind of instruction is the result of introducing computer technology to a society not familiar with this technology. Computer literacy, in its many dimensions discussed earlier in this chapter, is the main objective of this role of computers in education.

In the past, instruction about computers was reserved for personnel dedicated to scientific research in the few computer-using institutions that existed. As computers spread to many, diverse applications in educational institutions, the need for teaching personnel and students about computers became greater. With the relatively recent shift from centralized to de-centralized computing, more computing power has been put into the hands of a population unfamiliar with the technology, and the focus of teaching about computing has changed again, this time to personal computing (Blankenship, 1985; Gillespie, 1983).

During the last decade, teaching about computers has become one of the most important uses of computers at all levels of education. Introductory computer courses are popular in elementary and secondary education and their popularity is increasing (Becker, 1984; Mariño Drews, 1988). In higher education, there are various examples of implementations of different university-wide computer literacy courses, such as those dealing with basic knowledge of computing and included in first-year curricula.

The increasing number of computer courses in elementary and secondary education is forcing yet another change in the focus of instruction about computers. For example, as Gilbert & Green (1986a) report, there is a clear increase in the number of freshmen reporting programming experience during the year prior to entering college in the United States, from 27 percent in 1983, to 51 percent in 1985. This trend is making educational institutions shift from the actual instructional focus to a "computer as a tool" approach, at all levels of education.

Productivity

Personal productivity refers to the use of off-the-shelf computer applications—as opposed to custom-programmed applications—to enhance personal productivity. These applications generally include five areas of personal computing: word processing, spreadsheet, graphics, database management, and communications. They can be used in many different areas of work, and are available for practically every personal computer system on the market.

The use of computers as tools for supporting the other two aspects or roles of computers in education is very common, making a clear definition of the boundaries of each aspect difficult. Gilbert & Green (1986a) stated that off-the-shelf applications are often used for instructional purposes; that is, applications are used in the classroom as tools to teach or demonstrate concepts relevant to a specific subject, such as a business course (Collier et al., 1987, Durndell, Macleod & Siann, 1987, Fitzgerald, 1983), a physics course (Gómez Moreno, 1989), or the use of an educational program purchased from a software vendor. Off-the-shelf applications such as communications, databases, and statistical packages are also used as tools for the information aspect of computers in education (Gilbert & Green, 1986a). For the purpose of this thesis, these uses of computers are considered instructional and information applications of computers, respectively, rather that productivity applications.

As Gilbert and Green (1986a) explain, the use of computer applications for personal productivity is relatively recent. In the past, computing services were highly centralized and relied mainly on mainframe computers, generally regarded as inadequate for use as personal productivity tools because of the complicated nature of their operating systems and a lack of general-purpose applications such as the ones mentioned before (Gilbert & Green, 1986a; Gillespie, 1983).

The use of computers as productivity tools is spreading fast in educational institutions. In elementary and secondary education, the use of computers for instructional purposes has been predominant for the past decade (Becker, 1982), but some authors suggest that eventually the use of

computers as tools would prevail in schools (Bork, 1984; Chan, 1990). In higher education in particular, the use of the computer as a productivity tool is widespread in all areas. Word processing is the most-used productivity application, used by students, professors, and faculty members, for all kinds of papers, assignments, reports, memos, and other written documents. Other applications, such as graphics, database, and spreadsheet, although not as popular as word processing, are widely used to enhance productivity in many areas (Gilbert & Green, 1986a).

Characteristics of Educational Computing

Although the status of educational technology is always changing, through a review of the literature it is possible to identify several characteristics and trends that educational computing generally presents. Six characteristics relevant to this study were identified: lack of planning, equity issues, inadequate software, the need for integrating the computer in the curriculum, teacher training, and increased effectiveness of computers in education.

Lack of Planning

The National Task Force on Educational Technology (1986), emphasizes in its recommendations the importance of planning when introducing computing technology in educational institutions by stating that:

> The effective use of technology in education requires careful planning at every level of the educational system. The needs of our rapidly changing society cannot be met, nor can available resources be employed optimally, if technology is allowed to percolate randomly through the school system. It is not intended that the technology be allowed to determine educational goals, but must be used to help achieve them (p. 63).

Lack of planning is one of the most obvious problems affecting educational implementations of computing technology (Brine & Johnson, 1990a; Carter, 1990; Gillespie, 1983; Sybouts & Stevens,

1986). Many educational institutions devote most of their planning time to discussions about what kind of equipment should be bought, instead of discussing other more important matters such as what to do with the computers once they arrive or what educational outcomes are expected from them (Gilbert & Green, 1986a; Gillespie, 1983; Sybouts & Stevens, 1986).

One of the most emphasized planning issues is the need to focus on educational goals, rather than on the potential of computers in education (Brine & Johnson, 1990a; Hasset, 1984; Kay, 1989; Moont, 1984; Scheffler, 1986; Sutphin, 1987). Experts agree that the most appropriate implementations and uses of educational computing can be identified in those cases where careful planning based on educational goals has been undertaken (NTFET, 1986; O'Neil, 1990).

There are many examples of the interest in careful planning for the introduction of computers into educational programs. Authors such as Graham and Karlsson (1987), and Mudd and Wilson (1987) have proposed different approaches to planning for the implementation of educational computing, in the form of strategies or step-by-step plans. These plans or strategies are generally based on personal experience by these authors, however, and models based on sound research are difficult to find.

Inequitable Access to Computing

The introduction of computers in education has raised equity issues. Advocates of the new technology insist that the computer is a great tool for increasing the general level of literacy among children through their involvement with computers in their classrooms (Lapointe & Martínez, 1988). Other authors state, however, that computer technology is being implemented at a much faster rate in wealthier educational institutions, in effect widening the gap between the rich and the poor (NTFET, 1986; O'Neil, 1990). Research shows that low-income students in city schools do not have the same level and quality of computer education as their counterparts in suburban and private schools (Becker & Sterling, 1987; Chadwick, 1983; NTFET, 1986; O'Neil, 1990). Research conducted by the National Assessment of Educa-

tional Progress shows that computer competence is clearly related to computer instruction and to access to computers at home (Lapointe & Martínez, 1988). Lapointe & Martínez state that "Students who have access to computers in school and at home stand a better chance of developing computer skills than do their not-so-advantaged peers" (p. 60).

In higher education, the problem of inequitable distribution of computing technology is also evident, but presents substantially different characteristics than in elementary or secondary institutions. Gilbert and Green (1986a) explain that access to computing technology is often affected by the vendors' preferences. According to them, elite private and large public universities are usually the beneficiaries of gifts and the advantageous pricing that the industry might offer, while state and community colleges that appear less wealthy are overlooked. Gilbert and Green (1986a) state, however, that as the cost of computing equipment continues to decrease, more universities are able to purchase more equipment and establish better relationships with vendors.

Another characteristic unique to higher education is the fact that it is much easier for private institutions to engage in beneficial relationships with vendors than can state and community colleges, which are the ones that serve the majority of students (Gilbert & Green, 1986a). In the United States, for example, state regulations and laws limit these universities' ability to enter into resale agreements, or develop implementation plans in cooperation with only one vendor.

Inadequate Software

The importance of software in education is underlined by the fact that hardware cannot be used to its full potential without effective software, and that software can require a major investment of staff time and money (NACUBO, 1986). While the power and quality of computer hardware continues to improve exponentially, it is clear that educational software has not kept pace.

Bork (1984) explains that although the number of educational software packages continues to

grow, the quality of these packages is generally very low. The reasons for this low quality are varied, but authors tend to agree in that it is much more a consequence of the lack of resources put into the design and programming of good curricular-oriented instructional software on the part of software developers than lack of interest in the field (Bork, 1984; Gilbert & Green, 1986a; NTFET, 1987).

While the number of good-quality instructional applications available is increasing, particularly in elementary and secondary education, the attitude of educational institutions—which keep paying little attention to the quality of instructional software—along with the high development costs of instructional software and uncertain investment returns for the developers, make the future of good instructional software unrealizable in the near future (Bork, 1984; Gilbert & Green, 1986a).

Need for Integrating Computers to the Curriculum

No technology will have the desired effects if its implementation does not include appropriate changes in the curriculum. According to the literature, computer technology is usually implemented around existing curricula in such a manner that students are exposed to the technology in no significant way, with the possible exception of the effects that direct contact with this technology for very limited periods of time can achieve (O'Neil, 1990).

Brine and Johnson (1990a) explain that for a successful implementation of any technology to take place, a careful analysis of the needs should be made. This needs assessment process "emphasizes the goals of the curriculum and not the specific technologies through which the curriculum is intended to be taught" (p. 25). Integration of computers in the curriculum does not mean adjusting the latter to some assumed potential of computers, but rather utilizing the computer's proven potential in those areas of the curriculum where it can be used effectively to achieve the desired objectives. Also, curriculum guidelines and contents must be structured in a way that permits adjustments to changing technology (Sutphin, 1987).

Teacher Training

The introduction of computer technology in any educational setting must be accompanied by staff development and training in the use of this technology. Janssen Reinen and Plomp (1992) explain that "teachers need to learn new roles in order to work effectively with new programs and technologies", and that "staff development and training is one of the factors that determine success of implementing an innovation in educational practice." For educational computing programs to be successful, computers must be integrated into existing curricula (O'Neil, 1990), and if that is to be accomplished, teacher training must be considered a priority.

Experts contend, however, that this has not been the case, that teachers have not been given the support they need to make it so, and that teacher access and use of computing technology is very limited (Mecklenburger, 1990; Janssen Reinen & Plomp, 1992; O'Neil, 1990). Teachers must learn how to use computing tools effectively across the three aspects of educational computing discussed in the previous section. However, as an example of how far this goal still is from reality, a report by the Office of Technology Assessment found that although nearly every school in the United States has at least one computer, half of all teachers have never used one (O'Neil, 1990).

The results of that study follow the same pattern as a series of studies conducted by Stevens (1984) on the perceptions and expectations of teachers, teacher educators, and student teachers in Nebraska. Stevens stated that "educators surveyed perceived that computers would strongly influence classroom instruction and the curriculum ***but not in their classrooms*** [italics added]" (p. 265), indicating that access to technology is not the only problem facing educational computing training programs.

In addition, the data presented by Stevens (1984) strongly suggests that training teachers to teach with computers and about computers is imperative. In this regard Becker (1983) warns that, while teachers must be encouraged to learn about educational technology, development of a critical perspective to computers in education is a must in training programs.

The literature shows clear agreement as to the relevance of teacher training courses and yet some uncertainty as to what the contents of these courses should be. One of the reasons behind this disagreement may lie in the "computer literacy" nature of these courses. Furthermore, many student-teacher courses have been deemed inadequate, putting too much emphasis on programming. Other problems are based on the fact that in many cases training courses currently offered to teachers are taught by computer vendors, who can do an acceptable job of teaching user skills but who do not have the necessary knowledge about instructional techniques or methodology to satisfy the special needs of teachers (Agee, 1985).

Sutphin (1987) proposes a more systematic approach, based on a thorough training strategy developed at Cornell University. The three core components of this training program are conceptual understanding, technical skills, and application skills, supported by other clearly-defined operative components. The first component of Sutphin's program centers on the basic concepts of the use of computers in education, how to teach with them, and use them as management tools. The second may be taught concurrently with the first, and concentrates on learning everything from evaluation and use of educational software to the use of productivity applications and programming at an advanced level. The third emphasizes the actual application of the concepts and skills learned in the first two stages to the teacher's subject area, placing special attention on educational objectives, rather than technical ones. The literature shows other examples of proposed contents for computer literacy courses for teachers; Sutphin's model is mentioned here as an example of a well-conceived training strategy based on related research that focuses on educational goals rather than technological ones.

Increased Effectiveness

There is still great controversy as to whether or not computers are effective tools for education. Judging from the literature, it would seem that many authors' opinions about educational computing

depend to a great extent on what their personal experiences have been. A more detailed analysis of the literature shows that computers have had positive influences in many areas of education, particularly in the areas of information and productivity, as previously defined in this chapter, and not as much in the instructional aspect of education.

Some experts agree that the effectiveness of educational technology has improved significantly. They explain that the availability of computing has been growing, and so has been its acceptance. Furthermore, computing technology has evolved greatly over the last decade, and today's computers provide multimedia capabilities that will probably eliminate many of the limitations that some claim pose the main problem to educational software development (Becker, 1983; Carter, 1990; NTFET, 1986; O'Neil, 1990).

Whether or not computers are or will become accepted globally as effective tools for instruction is unknown, but encouraging results have been obtained by shifting the focus from simple applications, to learning the basics of computers, to curriculum-integrated instructional uses of the technology, particularly in those cases where proper planning has been undertaken and adequate training is evident (NTFET, 1986; O'Neil, 1990).

Computing in Higher Education

Both the roles of computers in education and the characteristics of educational computing discussed in the previous sections apply to elementary, secondary, and higher education. However, higher education presents some unique characteristics related to the use of computing technology that are examined in this section.

First, the introduction of computers in higher education followed a very different path than in basic education. Computers have been used for scientific and research purposes in higher education institutions for forty years, initially in a computing environment that was centralized and offered limited

access to the non-scientific community. The evolution of computer technology brought about changes in higher education computing, and computer use began to spread across all faculties, initiating a trend toward de-centralized campus computing. In the end, both de-centralized and centralized computing are now essential parts of higher education computing, and the challenge seems to be finding the appropriate ways to provide, manage, and support both kinds of computing services (Blankenship, 1985; Dockerill, 1987).

In recent years, these changes have shifted the focus on computers from a centralized view to a view of computers as a universal tools (Gillespie, 1983). Students entering universities are more computer literate than ever before, faculty and administrators are discovering the power of applications such as word processing and spreadsheets, and the demand for computer services has become greater than the supply (Blankenship, 1985; Gillespie, 1983).

A unique characteristic of computers in higher education is the increasing number of university-industry relationships. Since computers started being used in higher education institutions, industry has played a major role in supporting their introduction and use. Some authors emphasize this aspect of higher education computing because historically, universities and industry have shown a very interesting mutual dependency. As Gilbert & Green (1986a) explain, most of the technology sold by vendors has been developed in universities, which in turn cannot afford large-scale implementation and use of the latest technology needed for research and development without the support of vendors—in the form of donations, joint projects, or long-term purchase plans—particularly in difficult economic times (Blankenship, 1985; Gilbert & Green, 1986a; NTFET, 1987).

However, while financial difficulties and problems with the availability of hardware are deemed to be major problems by most authors, others suggest that the biggest problem facing higher education computing is the scarcity of adequate human resources (Graham & Karlsson, 1987). This problem is accentuated because, as the demand for computer-related personnel increases, the number of students

registering for computer-related fields also increases, and universities find themselves competing in the marketplace for human resources to fulfill classroom and research needs (Blankenship, 1985; Graham & Karlsson, 1987).

Attitudes toward Computers

Throughout this study, special attention is paid to certain particular aspects of the introduction of educational computing in Dominican Republic higher education. One of these aspects is the availability and adequacy of human resources, which play a key role in the proper development of such technologies. In particular, the role of professors in the introduction and use of computers is examined, as well as their attitude toward learning and working with this technology.

Many authors agree in that the introduction of computers can only succeed if the recipients of this technology agree that it is worthwhile to learn and use it (Loyd & Gressard, 1984a; Loyd & Loyd, 1985; Pelgrum & Plomp, 1991; Vermette, Orr, & Hall, 1986; Woodrow, 1987). Although these authors concentrate in the uses of computers in elementary and secondary education, there is no reason to believe their conclusions will not hold true for the success of instructional implementations of computers in higher education. Woodrow (1987) states that the need for acceptance and understanding of the new technology is even more important for its success if its introduction requires the acquisition of new knowledge and skills.

Many different factors have been found to affect attitudes toward learning about and working with computers. Loyd and Gressard (1984a) explain that:

> "Three types of attitudes toward computers were considered important enough to have significant effect on student achievement: (a) computer anxiety, consisting of anxiety toward or fear of computers or learning to use computers; (b) computer confidence, related to confidence in the ability to learn about or use computers; and (c) computer liking, meaning enjoyment or liking of computers and using computers." (p. 68)

In general, positive attitudes toward computers have been related to the amount of experience using computers (Loyd & Gressard, 1984a; Loyd & Loyd, 1985), while negative attitudes have been found to correlate with higher levels of fear or anxiety about computers (Bohlin, 1992). Computer anxiety in particular, has been the subject of more attention recently, and Bolhin (1992) explains that several studies show that instruction can, in fact, reduce computer anxiety in most learners. His study also shows that confidence in one's ability to successfully use and cope with computers would be expected to relate to lower anxiety toward them.

Educational Computing in Latin America

Although the underlying concepts of educational computing presented in the previous section apply, in general, to any setting, some characteristics of developing regions affect the way these concepts are used and implemented. This section focuses on educational computing as it is understood and applied in Latin America and the third world. A background on education in developing countries is presented first, concentrating on the Dominican Republic. Second, an analysis of computer literacy as it applies to the region is presented, followed by an examination of the literature on transfer of technology. Finally, three main aspects of the implementation of computing technology—physical, logical, and human resources—and their current status in Latin America are discussed.

Background on Education in Latin America

This study is an attempt to assess the current status of educational computing in higher education in the Dominican Republic, a developing Latin American country. The importance of looking at educational issues in Latin America—and in the Dominican Republic in particular—from a Latin American perspective rather than from the point of view of a developed country, cannot be overemphasized. An understanding of some aspects of education, research, culture, and economy is essential to describe

the environment in which educational computing is evolving in these countries. This section reviews the literature regarding these aspects as they relate to educational computing in Latin American countries.

Problems with Education

The problems affecting education in Latin America are much the same as in most third world countries. Authors tend to agree that the major problems affecting the quality of education negatively in these countries are directly related to social mobilization, inadequate educational resources, growing school populations, and the overwhelming economic crisis they experience (Chadwick, 1986; Gallegos, 1984; Hungwe, 1989; Fuller & Heyneman, 1989).

Gallegos (1984) asserts that social migration from rural to urban areas in many third world countries contributes to the deterioration of education in these countries. He explains that "rural educational problems contribute to a growing national dilemma of limited and marginal educational opportunities in the villages and overcrowded and low-quality education in the cities" (p. 38). The consequential socioeconomic de-stabilization of many families in Latin America may be a major contributor to the declining quality of education, since the home environment has been suggested as having the greatest influence on language development, general learning ability, and motivation for success in school (Gallegos, 1984).

Some authors highlight relatively large allocations of economic resources to education in many third world countries (Gallegos, 1984; Hungwe, 1989). However, recent reports from the World Bank cited in Fuller and Heyneman (1989), testify to the fact that the share of all government spending allocated to education has fallen over the last two decades and continues to do so. The main contributing factor to this situation is the growth of population and enrollment combined with the actual economic crisis experienced by these countries. In addition to that, Fuller and Heyneman (1989) point to the poor allocation of resources as a major problem. In most third world countries, 95 percent of the educational

budget is allocated to teacher salaries, yet very few studies have found that variation in teachers' salaries is related to pupil achievement.

In the Dominican Republic, sources suggest a decline in the quality of education at all levels of education (Crespo, 1990). Lora (1984) described a number of problems—both internal and external to the higher education system—that have been affecting the quality of higher education in the Dominican Republic over the last two decades. A summary of these follows.

External problems. A first problem mentioned by Lora (1984) is the low academic achievement level of those students entering higher education which generates high desertion rates through the first years of university education. It has also forced several universities to institute a remedial one-year period now commonly known as *CU*, short for *Colegio Universitario* (University School). This low level of academic achievement in pre-university levels was evident in the study *The Teaching and Learning of Mathematics in the Dominican Republic* (Luna & González, 1984), and again in the study *Mathematics Achievement in the Dominican Republic: Grade 12* (Crespo, 1990), in which the Mathematics achievement levels of Grade 8 and Grade 12 students, respectively, were found to be well below the international levels obtained through similar studies conducted worldwide. According to Lora (1984), this problem is a consequence of insufficient funding for education, a general growth of the school-age population at all levels, and insufficient or inadequate physical resources.

A second problem is that students finishing secondary education are strongly oriented toward seeking a post-secondary degree before entering the workforce (Lora, 1984). This puts pressure on higher education institutions, many of which have a policy of free admission which affects the quality of their academic labor. According to the summary report *Diagnóstico del Sector Educativo* (Diagnostic of the Educational Sector), approximately 85 percent of secondary school graduates pursued higher education in 1984 (SEEBAC, 1984).

The lack of a national policy on higher education, discussed previously in Chapter 1, is another problem mentioned by Lora (1984). This situation has driven many universities to develop guidelines based on their own assessment of the country's needs or, in many cases, their own financial considerations. This freewill attitude often leads to wasted efforts and resources, market saturation in some fields, professional frustration, and non-satisfaction of the country's needs for human resources.

Two other external problems are identified by Lora (1984): an underestimation of mid-level technical careers, as opposed to more traditional careers such as engineering or medicine, and the enormous pressure exerted on higher education by the increasing demand for this kind of education. The Rector of the PUCMM explained it as follows:

> By 1992 we might find ourselves with a demand of 400,000 university students, a number that will not be possible to serve, and in addition to that, it is questionable if we should dedicate resources to university students in already saturated areas. As an example, Colombia, with 28 million inhabitants, now has less than 400,000 university students (Cited in Lora, 1984, p. 56).

The increasing demand for higher education stems from socio-cultural factors that are not uncommon in Latin American countries. Two of these factors are: the increasing school population that generates an increasing number of students leaving secondary schools, and the fact that higher education is widely regarded as a means of ascending the social and economic ladder (Lora, 1984; Mejía, 1988). Lora (1984) explains that this overwhelming demand for higher education has affected the academic quality of such institutions adversely, because institutions are operating without having adequate basic facilities, qualified professors, and with a policy of free admission.

Internal problems. Lora (1984) identifies four internal problems that affect higher education in the Dominican Republic: lack of human resources, inadequate curricula, lack of research, and lack of financial resources. The lack of qualified human resources has been identified by many authors as a

major problem in third world countries, and one closely related to the very low salaries and lack of working incentives offered by the educational profession (Alvarez et al., 1985; Hungwe, 1989; Marshall, 1984; Palmer, 1986). Many professors are underqualified, many are not education professionals, and most of them work part-time and cannot dedicate sufficient time to the preparation of their classes or other educational activities.

According to Lora (1984), the established curricula are, in many cases, inadequate; most universities lack the planning and research needed to develop adequate curricula that coordinate departmental policy with the perceived needs of the professional market. In addition to that, authors such as Blankenship (1985), Kling (1983), and Magendzo Kolstrein (1987) state that changes to curricula are particularly important when dealing with educational technology. Research is not practiced in many of the universities, mainly because of financial, human, and physical limitations. Finally, the lack of financial resources is categorized by Lora (1984) as a "suprafactor", because it affects all other factors previously discussed.

Research in Latin America

Although educational research has had a slow development in Latin America, a growth in educational research activity since the mid-seventies has been reported by Schiefelbein (1978), Egginton (1983), and Chadwick (1986). In an analysis of reviewers' assessments of all publications on Latin American education included in the *Handbook of Latin American Studies*, Egginton (1983) stated that "publications on Latin American education are far-ranging and disparate" (p. 126). He concludes that while the quality of research in the area has been uneven, some progress is being made.

Chadwick (1986) stated that instructional research efforts in Latin America are still few in number and developmental in nature. The specific area of educational technology has received significant attention over the last few years, but mostly in the form of articles in journals while the number of

research studies is limited. The main approach is the replication of studies done in other countries, basically aimed at determining if findings from other studies apply to Latin American countries as well. According to Chadwick (1986), studies related to technology transfer have been regarded as important because they analyze potential problems associated with importing technology from developed countries, as well as cultural and other factors involved in the process.

The Dominican Republic does not seem to be an exception regarding the need for additional educational research expressed by authors in the field of educational technology (Chadwick, 1986; Egginton, 1983; NTFET, 1986; Schiefelbein, 1978). In a survey conducted in 1988, "fostering and developing research" in Dominican universities was ranked third out of the five most important goals that Dominican universities should commit to in order to achieve their mission in society (Zapata, 1988). Research is not widely practiced, however, and most of it is centered on analysis of the performance of the educational system (Fernández, 1990).

In the Dominican Republic in particular, many universities do not conduct any research activity, a practice that affects academic quality negatively. Reasons behind this are lack of financial support, physical resources, and human resources. But above all there is a lack of long-term policies on research that would otherwise encourage personnel to engage in those kinds of activities (Lora, 1984).

Alemán (1988) estimated the number of educational researchers in the Dominican Republic as 66 during the 1980 to 1985 period. In a recently conducted seminar in Santo Domingo, *Unión Latina*, a French-sponsored organization, estimated the number of researchers in the Dominican Republic to be 300, including independent research agencies based in the country, as well as researchers working for private institutions (Pimienta, 1991). The bulk of the research is conducted by students in the universities, as requisite for their degrees, and most of this work remains unpublished (Fernández, 1990).

The reasons for the slow development of research in Latin American countries are varied. Mariño Drews (1988) suggests that one of the main reasons is the difficulty that researchers encounter in

obtaining updated information, as well as the high cost of processing this information. In this regard, Pimienta (1991) stresses the importance of developing computerized research information networks. While some countries in Latin America have developed national research networks, this is not the case with the majority of countries; and most of these networks lack the necessary facilities—such as computers and adequate communication infrastructure—to make them available regionally.

Several projects are underway which are directly aimed at developing nation-wide or region-wide computerized networks. One such project, the *Red de América Latina y el Caribe*, REDALC (Latin American and Caribbean Network), unveiled during the previously mentioned *Unión Latina* seminar, is intended to assist in the development of a Latin America-wide research network. Another similar project is the InterNet/LACRIP network described by Oeffinger (1987), involving institutions in Brazil, Chile, Costa Rica, Mexico, Uruguay, Venezuela, and the United States. However, most of these projects are in a developmental stage, and no results can be expected for some time (Pimienta, 1991).

Some authors state cautiously that even if these projects are successful, there is no guarantee that the quality of research will improve, given that these information networks are simply tools that, while useful, will not create a tradition for research by themselves. The need will still exist for changes in the basic structures of educational systems in the region so that research is better understood, desired, and supported with adequate resources (Chadwick, 1986; Soto Bello, 1984).

In addition to the problems with access to information, Mariño Drews (1988) mentions the lack of personnel with appropriate preparation in research-oriented activities as an important factor hindering research activity. Both Chadwick (1986) and Fernández (1990) state that the lack of a tradition for research work is a major factor impeding the development of a research culture. Latin American countries seem to view research strictly as a long-term tool in an environment where short-term solutions are most desperately needed. Institutions fail to recognize the importance of local research for future development. One factor not mentioned by many authors is the issue of funding for research in Latin

America. Chadwick (1986) states that lack of funding is the primary restraint on educational technology research in the region.

Cultural and Economic Issues

Among the most significant factors affecting the quality of education in Latin America—and third world countries in general—are the cultural variations found in the different countries of the region, and the prevalent economic crisis they must endure. These two factors permeate every other aspect of education, as discussed in the previous sections.

On the question of economy, the foreign debt—accounting for approximately $145 billion u.s. dollars paid to industrialized countries from 1982 to 1987—is the main cause of the economic collapse of Latin America (Latapí, 1990), and "has decimated governments' capacity to support basic education" (Fuller & Heyneman, 1989, p. 13). The economic crisis is probably the major factor affecting all other aspects of educational development, resulting in an overall decline of the quality of education at all levels. Fuller and Heyneman (1989) observe that unless fundamental economic changes occur, efforts to improve school quality will have little effect, because students' low performance is primarily a consequence of children's impoverished out-of-school settings.

The other factor in the educational development of Latin American countries is the culture. According to Lennon (1988), the outcome of the transmission of knowledge in school depends to a large extent on the cultural characteristics of the students, and special attention must be paid to these characteristics in order to understand these countries' educational settings. Lennon (1988) stresses that the cultural differences among countries are not only the ones usually described as "ethnic", but that those differences deriving from economic and social divisions must also be considered, "for living conditions influence ways of behaving and thinking, as do ethnic characteristics" (p. 414).

The Dominican Republic is not an exception to the economic problems of the region, and

certain characteristics of the country work against quick solutions to those problems (Lora, 1984). First, an explosive population growth that drove Dominican population from 3 million in 1960 to 6 million in 1981, to about 8 million today. Second, a massive migration from rural to urban areas that has created a number of problems in the capital city of Santo Domingo. Third, the Dominican Republic is a country whose economy is basically agricultural, without commercially-exploitable energy resources. By 1984, the foreign debt was approximately 3 billion dollars.

Computer Literacy in the Third World

Although developing countries are well behind their developed counterparts in many aspects of computing, the introduction of computing technology seems as unavoidable in these countries as it has been in developed countries (Galvis, 1987; Marshall, 1984; Palmer, 1986). It is becoming obvious that most people will need at least some knowledge about computers, but the scope of the knowledge needed varies from one environment to another, according to what Mariño Drews (1988) refers to as *cultura computacional* (computing culture). The application of the concepts of computer literacy depends strongly on the cultural, economic, and industrial development of each country and thus will affect developed and developing countries differently. The definitions of computer literacy previously discussed in this chapter may be valid for developed countries in which information technology has achieved wide acceptance. However, this is not necessarily the case in countries that are far behind in computing technology, and in which other social and economic matters have higher priority. Mariño Drews (1988) examined three different areas in which computer literacy should be pursued in developing nations: computer literacy for the workplace, the development of specialists in different areas of computer science, and the implementation of computer literacy in educational institutions.

Computer Literacy in the Workplace

The business community in developing countries has a critical role to play in the development of computing technology (Alvarez et al., 1985; Galvis, 1987). As Alvarez et al. (1985) explain, the business community can significantly influence the development of computing technology. The levels of computer sophistication in some companies are far higher than found in educational systems, and therefore, the business community is increasingly demanding qualified, "computer literate" personnel. This growing demand for qualified personnel and the lack of established means to satisfy it highlights the need for a special kind of computer literacy oriented to the workplace.

Computer literacy efforts for the business community, according to Mariño Drews (1988), should be linked to, but not limited to, the learner's field of work. They should also stress knowledge and understanding of the computer as a tool, in order for the learner to be able to use the computer to its full potential. This approach to computer literacy is not unlike the "individual needs" approach discussed earlier in this chapter. It differs somewhat in that it clearly specifies the need for making the computer a tool that the user comprehends and can use appropriately.

However, the scarcity of computers throughout educational systems in developing countries, makes the goal of widespread computer literacy difficult to achieve at best. Palmer (1986) states that, with the exception of professionals in the areas of computer science or systems analysis, most development of computer literacy has come mainly from the business community itself, in the form of in-house training, or technical computer courses from distributors and independent training institutions. This means that computer education for the business community is almost exclusively under the control of vendors and distributors, making standardization of computer literacy for the business community difficult (Galvis, 1987).

Computer Literacy Specialists

The literature shows that a few computer literacy projects have been implemented by teams of computing technology specialists and educators working together (Cárcamo, León & Aristizábal, 1988; Chadwick, 1986; Galvis, 1988a). Some authors have proposed the training of educators on computing matters as the basic solution to the implementation of computing technology in third world countries (Gilbert & Green, 1986a; Gillespie, 1983). As the field of educational technology matures, however, it is clear that specialized personnel will be needed to take on the task of redesigning educational systems in developing countries to accommodate new technologies and make the best use of computers.

Although some of the individual efforts mentioned above have been successful, recent Latin American authors such as Mariño Drews (1988) and Rueda Fajardo (1988) suggest that interdisciplinary teams will yield the best implementations of educational technology, whether the situation calls for developing native educational computing solutions, or transferring foreign solutions to native educational settings. They warn, however, that having such a team does not ensure that good implementations of educational technology will be made. Other authors discuss additional problems that may affect educational technology interventions negatively in developing countries, such as the inappropriateness of instructional solutions, media, and technology, or the lack of front-end analysis (Chadwick, 1983; Hungwe, 1989; Weston, 1988).

Computer Literacy in Education

Most of the literature on computing literacy in education, particularly that coming from developed countries, reflects on technology as it applies to primary and secondary education. Although there is a notable growing interest in school-level computing in Latin America, the great majority of computing tools are found in post-secondary educational institutions, while they are practically non-existent in primary and secondary schools.

Approaches to educational computing in post-secondary institutions differ significantly from those in primary and secondary levels, and they also differ between developing countries and developed countries. Mariño Drews (1988) explains that the concept of computer literacy changes according to the perceived needs of the learner by the educational institution and the community, and according to the level of development and awareness that this community has about computing technology.

Training in computer literacy in Latin American elementary education occurs almost exclusively at some private institutions. It has been enormously influenced by pressure from the social and industrial sectors, due to the strong perception that knowledge of computer technology leads to better paying jobs (Mariño Drews, 1988; Rojas Cortés, 1988). Programming, where available, has been taught for different purposes, concentrating on developing problem-solving and other basic cognitive skills, based on Seymour Papert's theories of learning with computers (Papert, 1980). In high school education, there is a trend toward teaching students to use general-purpose applications, but programming is still taught primarily with a market-oriented focus, such as for developing skills useful for acquiring better jobs. In both cases, however, the main factor determining the teaching of programming has been a strong perception on the part of parents that acquiring programming skills will prepare their children for an information society (Alvarez et al., 1985; Mariño Drews, 1988).

In higher education, computers are used primarily for administrative and research purposes, and computer literacy remains mainly a career-specific concept, oriented to computer science and other technical programs. It is only recently that some Latin American universities began to implement university-wide computer literacy curricula (Galvis, 1988b).

Transfer of Technology

The topic of transfer of technology as a means of dealing with educational problems in developing countries has been studied extensively in the past decade, particularly in those cases

involving computing technology. Most authors agree that the impact of computers in education is inevitable even in developing countries, and that these countries should be aware of the different issues regarding the import of educational technology (Harvey, 1983; Hungwe, 1989; Marshall, 1984). The dependence of the third world on developed countries is widespread across most sectors of the economy and society, and Alvaro Galvis (1987) points out that foreign dependence is particularly dangerous for the educational sector. As an example of how inadequate the indiscriminate transfer of technology can be, Galvis (1987) depicts the "magical vision" of computers as a panacea for Latin American educational problems as follows:

> A magical vision of educational computing may lead us to great disenchantment, as was the case of the gypsy's story in the book *One Hundred Years of Solitude*. García Márquez tells that the Gypsies used to come to Macondo from time to time, bringing with them the latest discoveries from the wise people of Memphis, that is, the latest technology. One year they arrived with ice, "such great invention of our time". Its arrival was just the occasion for José Arcadio Buendía to find out the meaning of his dreams about a mirror-walled house. Right away he got its deep meaning. He thought that, in the near future, it would be possible to make blocks of ice in great scale, from a day to day material such as water and, by using them, to build the new houses of the village. Macondo would not be a hot place any more, where hinges and knockers were twisted by the heat, but a frigid one! (p. 197).

This kind of vision of the transfer of technology is common in non-technological societies which are accustomed to importing products and finding uses for them, instead of looking at the underlying developing processes of those products and learning from these. In this way, these societies depend on imported technological products, but do not have the technological expertise to build on these technologies (Clayton, 1975; Galvis, 1987). There seems to be a clear consensus regarding this point: educational technology transfer "as is" does not work because of the many differences among educational settings in different countries. The fact that a given technology works in one setting does not necessarily imply that it will also work in another setting.

One of the major concerns that Latin American countries should have about the transfer of technology lies in the cultural implications that this process involves:

> The process of selection and transmission of culture presupposes the formation of a particular conscience... It is not a neutral process, and inevitably leads to certain degree of manipulation of power and social control. (Magendzo Kolstrein, 1987, p.44)

Many other authors, such as Kling (1983), Bowers (1988), and Brine and Johnson (1990b), agree that computing developments, like other social, economic, and technical developments, are not socially neutral, and that every implementation has a certain degree of "politics" associated with it.

Many authors have expressed concern about this ongoing process of importing technology from developed countries. Transfer of technology is very influential in most aspects of the development of third world countries, particularly in Latin America, and is generally regarded as a kind of technological colonialism. The risk of neocolonialism seems to be even greater when this influence affects the cultural development of these countries by conditioning the educational system of these very traditional countries (Alvarez et al., 1985; Araujo de Oliveira, 1989; Correa, 1989; Harvey, 1983; Magendzo Kolstrein, 1987; Marshall, 1984). Gilbert and Green (1986a) and Collier et al. (1987) explain that while changes in other aspects of education—such as curricula—are slow, the rapid development of computing technology and its acceptance by the business community puts pressure on educational institutions to provide upcoming professionals with the knowledge to take advantage of this technology. Furthermore, Galvis (1987) explains that this problem is even greater in developing countries, since educational computing seems to be totally under the control of vendors, producers, and the general public, instead of educators.

Planning is emphasized by many authors as the key to make transfer of technology work. Brine and Johnson (1990a) point out the importance of needs assessment if the introduction of any technology to the educational setting is to be successful. Most problems with the transfer of educational technology have been identified as relating to lack of planning (Weston, 1988), and planning is particularly important

in the case of the introduction of educational computing tools in developing countries (Galvis, 1987; Harvey, 1983). Analysis of local needs should then be a priority before the implementation of any new technology can take place. Differences in culture, language, and educational systems require careful examination of the underlying principles of the educational computing tools available and their possible uses in a specific educational setting (Weston, 1988).

Developing countries appear to hope that the computer will solve all of their educational problems (Galvis, 1987; Hungwe, 1989); however, even if the tools are carefully revised to fit their specific educational system, they still might not work. Marshall (1984) states that no change in educational technology in Latin America will yield the expected results unless major changes—such as changes in wages—take place. Galvis (1987) adds that what is needed when importing educational technology is a major focus on educational goals, rather than on technological goals.

Authors seem to agree that appropriate personnel development when transferring technology is particularly relevant in the case of educational computing, because of the sophisticated and changing nature of the field (Agee, 1985; Helms, 1985; Palmer, 1986; Sutphin, 1987). In order for any technology to be successfully transferred, some training must take place among its intended implementers and users. In the case of computing technology, developing countries, including the Dominican Republic, are lacking in all aspects of computer literacy. Many teachers are unqualified or under-qualified, and training is very difficult at best because of cultural and economic factors (Alvarez et al., 1985; Hungwe, 1989). Hungwe stresses the importance of personnel development stating that, "As things stand, even if quality media and technology is placed in schools, it can only have minimal or no impact on teaching and learning" (p. 22).

Chaudhry and Fakhro (1986) discuss other more practical problems associated with implementing computers in educational programs in third world countries. First, there is a lack of availability of hardware and quality service in places where authorized dealers are few and companies appear and disappear without notice, due to the less-than-favorable economic conditions in most of these countries.

Second, educational software, regardless of its educational quality, is difficult to find. Most of what is available is created and marketed by companies in developed countries, with a specific educational setting and culture in mind, significantly different from third world countries'.

Chaudhry and Fakhro (1986) also describe the obstacles presented by language. Some popular microcomputer business software packages created in developed countries have foreign-language versions, and more often than not, the language does not represent an unsurmountable obstacle for accounting or word processing applications. In education, however, language is extremely important, and while most educational software also comes from developed countries, these do not have foreign-language versions. This means that software must be translated—to Spanish, in Latin America's case—in order to be usable; however, direct translation is not sufficient because it does not overcome the cultural differences that are embedded within the words. Chadwick (1986) stresses these differences in Latin America's case by explaining that "when referring to Latin America one should not envision a homogeneous area but 27 countries with more than 250 million people speaking five different languages, and with highly diverse historical and cultural heritages" (p. 247).

Computing Issues in Latin America

The development of a computing culture requires that some essential resources exist to support a sophisticated technology such as that of computers. A variety of obstacles are evident when implementing computing technology in Latin America, some of which relate to the transfer of technology previously discussed in this chapter. Other pressing problems exist in three main areas of technology implementation—physical resources, logical resources, and human resources. As Alvarez et al. (1985) explain, very little has been written about informatics and small computers in Latin America. Today there is still relatively little literature available, especially in the area of education, but general characteristics of the region can be examined in some detail.

Physical Resources

Physical resources are essential for the implementation of computing technology. Most Latin American countries experience hardware-related problems and obvious underdevelopment in at least one of three key physical resources, namely their electrical power infrastructure, communication infrastructure, and their microelectronic industry.

As previously explained, most of the computing technology in Latin America is imported from developed countries, and many Latin American countries have customs fees applied to imported goods, making the technology more expensive in these countries (Chadwick, 1986). Local support for repair and parts is very difficult to obtain, and particularly difficult to maintain, since major authorized dealers are few and many companies appear and disappear without notice (Chaudhry & Fakhro, 1986). It has been suggested that this problem will eventually become less important thanks to the increasing number of computer companies representatives in most countries (Alvarez et al., 1985).

The lack of compatibility across computing platforms or brands—and even across models of the same brand—has also been stated as a problem. However, this is becoming less relevant as new solutions for networking and communications become available, and multi-platform environment solutions become popular. The problem is that solutions of this kind take too long or fail to reach some Latin American countries, because of the lack of an adequate information infrastructure in many countries. The lack of information seems to be a major problem in Latin America countries, particularly in computing matters, and it is discussed in depth later in this section.

Among the main physical issues to be considered is the problem of inadequate electrical infrastructure, since computing equipment is very sensitive to variations in power supply. As Alvarez et al. (1985) explain, many Latin American countries have serious problems with providing adequate energy service, and voltage variations, brownouts, and blackouts are common. Under acceptable circumstances, the problems of voltage variations or short blackouts can be solved by voltage regulators and uninterrup-

tible or stand-by power supply systems. These systems, which range from affordable to very expensive items by developed countries' standards, represent considerable and sometimes unsurmountable investments in developing countries.

Another physical element needed for the development of computing technology is the availability of an adequate communication infrastructure, essential to support the flow of electronic data. The state of telecommunications infrastructures in Latin America presents many cases of obsoleteness, although a few countries have state-of-the-art equipment and installations. The main problem is usually the age of the telecommunication distribution systems (Pimienta, 1991). This element is becoming increasingly important in computing in an era where distributed systems, networking, remote-access computing, and data processing seem to be the norm.

The development of national microelectronics industries is another physical resource mentioned in the literature in various forms, and Latin American governments have shown some interest in developing a domestic microelectronics industry. The focus of these interests has been on human resource development, capitalization and investment of economic firms, and import restrictions. According to Alvarez et al. (1985), one area of primary concern is the influence of multi-national corporations on the use of information technology and the effects of the control that certain social groups have over this technology, available only to those people with adequate funding.

Human Resources

Another obstacle to the development of computing technology in Latin America, and one that is related to the problems of lack of information (discussed in the next section), is the scarcity of knowledgeable personnel in all areas of computing. Good technical support—one of the major factors involved in computing—is difficult to find in Latin American countries, particularly for the educational community which does not compete favorably in the market against banks or multinational companies

which are usually the main employers of computer professionals (Chaudhry & Fakhro, 1986; Palmer, 1986).

Administrators and decision-makers who do not have this necessary support are potentially ill-informed or not informed at all about the computing issues they are deciding upon, both in business and in education. Hungwe (1989) explains that this imbalance is likely to worsen the rich-poor gap situation in Latin America. He suggests that training the personnel involved with computing in education, for example, will help them acquire the knowledge required "to make choices, to innovate, and to select" (p. 23), and that in turn will help them attain a much better position to understand computing technology and to help define their own computing culture.

This leads into discussing the aspect of educating and training of personnel involved with computing technology. Practically every author in the field considers the problem of personnel training one of upmost priority, especially in the area of education (Alvarez et al., 1985; Galvis, 1987; Hungwe, 1989; Marshall, 1984), but even if adequate personnel are available, training can prove to be a major task, requiring enormous amounts of resources that are just not available. Furthermore, Marshall (1984), explains that for training in computers to make sense in developing areas, there still is a considerable way to go since a great percentage of the teaching population has little or no training in teaching itself.

Logical Resources

Logical resources refer to what the literature suggests as the two main problems that present the biggest obstacles to the development and use of computing technology in Latin American countries: problems with software, and the poor distribution of information regarding information systems and computing technology in general.

Several authors mention that one of the most obvious problems that affects computing in the majority of third world countries is that software packages are mostly available in English, as opposed to Spanish, let alone the native languages and dialects of many different Latin American countries (Alvarez

et al., 1985; Chaudhry & Fakhro, 1986; Palmer, 1986). The unavailability of software in the native languages for educational applications renders most packages unsuitable for use in Latin American countries when considering the cultural nature of education. Whenever possible, Palmer (1986) explains, English-speaking professors spend a considerable amount of time translating the educational material, but these translations are few in number, usually underpaid and overloaded teachers. Furthermore, even when the material is properly translated and adapted, there is no guarantee as to their benefits for educational purposes.

Another problem with software is the cost. Anybody involved in computing technology knows that the real cost of computing lies not in hardware, but in software, maintenance, and support. The cost of software is not as much an issue in educational institutions in developed countries which are favored with reduced pricing from software developers and resellers. Even within this environment, software piracy rates are alarming, and a cause of major concern (DeLoughry, 1987; Gilbert & Green, 1986b). For developing countries, however, software cost is a major factor considering their economic situation, particularly because reduced pricing is generally not available to them.

The second logical resources issue is the general lack of information about computing technology in all areas. Alvarez et al. (1985) explain that this seems to be a normal trend considering that this is a problem affecting developed countries as well. However, the means for distribution of information are very scarce in Latin America. In fact, few systems exist for exchanging information on computing, particularly educational computing (Chadwick, 1983).

Although new efforts with limited—but valuable—international access can be identified, and some countries have well-established information networks, there continues to be a notable lack of availability of information for research or otherwise (Pimienta, 1991). The practical problems with establishing these networks are enormous, including issues of data flow across borders, use of international satellite communication, and organization and administration of the network (Oeffinger, 1987).

CHAPTER 3: METHODOLOGY

Since no similar project has been conducted in the Dominican Republic, this study was designed to gather the most basic data regarding educational computing in this country's higher education institutions. Therefore, the basic goals of the study make it descriptive in nature. Its purpose is to describe educational computing from the point of view of professors, technical staff, and administration. This description includes all physical aspects of educational computing in the Dominican Republic, such as hardware, software, and physical resources available. It also includes the human factors involved in educational computing, such as the disposition of university professors toward computers, experience, knowledge about computers, and human resources available. Certain informal comparisons among local universities will be necessary to describe key factors of the state of educational computing in these universities.

Population And Generalizability of the Study

This sample can be said to be representative of the Dominican higher education community since the majority of Dominican students attend the higher education institutions selected for the sample. Because of the nature of this study, however, it is not the intent to generalize beyond the actual sample selected. The main purpose of this study is not to make a universal claim about computers in education, but rather to describe some of the specific characteristics of Dominican higher education computing.

These descriptions can be useful in identifying interesting patterns of computer usage in Latin American countries, by describing physical and cultural problems that many other countries similar to the Dominican Republic face. Thus, the real value of this study resides not on the population from which the sample was drawn, but on the selected sample itself.

Sampling

The people who participated in the study were professors and administrative personnel from seven of the major universities in the Dominican Republic. The criteria used to determine which were the major universities in the country were quantitative as well as qualitative. The selection was based primarily on student population, the target population of each university, and its location within the country. Factors such as popularity, reputation, and perceived status of each university were also considered when selecting the universities for the study.

A paired selection was made, according to the universities' student enrollment, and their location, so that some level of replication would exist, thereby allowing for a higher level of confidence in the findings. For this purpose, three different types of universities were identified: large universities with student populations of over 15,000 students; mid-size universities with enrollments of about 6,000 to 10,000 students; and small universities with populations of less than 5,000 students.

The universities were also divided into two main groups according to the region where their main campus is located. The first group consisted of universities located in the capital city, Santo Domingo, the largest city in the country, with a population of about 2.3 million. The second group was made up of universities with main campuses in the city of Santiago, the second largest city (Pop. 700,000), and commercial center of the *Cibao* region.

These two regions differ in many ways. The capital city is in the *Distrito Nacional*, a province located on the southern-central coast of the country. Its population is mostly urban, although this region is the most affected by the rural-urban migration problem, which poses many difficulties for education in terms of economic stress and distribution of resources. On the other hand, it might be hypothezised that being closer to the central government and having the greatest demand for education in the country, helps universities within this group.

Santiago is located in the Cibao region, located in the north-central part of the country, the most productive agricultural region. Although not as populated a city as Santo Domingo, the universities located in Santiago serve a large population concentrated in the Cibao region, the most densely populated area of the Dominican Republic.

The selection of professors within each university was made in conjunction with each university's administration. Each administration was asked to select a total of fifty professors from all of the faculties, so that the number of professors selected from each faculty was representative of the actual size of that faculty within the university. This ensures that the data gathered were appropriately weighted to reflect the actual uses of computers in the sampled universities. Within each faculty, administrators were told to distribute the questionnaires among users, and non-users alike, but no specific selection criteria were defined otherwise.

In addition to these professors, two representatives from each university's administration and technical departments were selected to be interviewed. The selection of the interviewees was strictly based upon their knowledge about administrative policies and philosophies of the university, and about the computing technology currently employed at each university.

The Universities

The universities chosen for the study were: the Pontificia Universidad Católica Madre y Maestra/PUCMM, and Universidad Tecnológica de Santiago/UTESA, with their main campuses in the city of Santiago; Universidad Nacional Pedro Henríquez Ureña/UNPHU, Instituto Tecnológico de Santo Domingo/INTEC, Universidad Dominicana Organización y Método/O&M, Universidad Iberoamericana/UNIBE, and Universidad Católica Santo Domingo/USCD, with their main campuses in the capital city.

Another important university is the Universidad Autónoma de Santo Domingo/UASD, the only public university in the country. This university currently serves a student population of about 24,000,

making it one of the largest universities as well. Although attempts were made to include the UASD in this study, a three month long student strike made it impossible to achieve this goal in the limited time available to collect the data for the study. Some brief comments about the selected universities are provided below.

Pontificia Universidad Católica Madre y Maestra (PUCMM)

Founded in September of 1962 by the Catholic community, it was the oldest private university in the Dominican Republic. Unlike any other university, PUCMM operates not under governmental decree, but by a special concordat between the Vatican and the Dominican Republic. Its main campus is in the city of Santiago, second largest city and economic center of the most densely populated area of the country. Its population of 8,000 students and approximately 500 professors make it a mid-sized university. PUCMM is widely regarded as one of the best universities in the country in terms of the quality of education it provides, but also because of its age and because its Catholic heritage appeals to a mostly Catholic community.

Universidad Tecnológica de Santiago (UTESA)

Founded in 1970 in the city of Santiago, UTESA's goal was to provide access to higher education for working-class adults from the Cibao region who had the least access to this kind of education, and could only study at night. Its student population consists mainly of low-income young workers and adults, and currently the majority of students still attend night courses, although the university offers morning, afternoon, night, and Saturday-only programs.

Nowadays, UTESA offers greater choice in technical careers for low-income individuals. Technical courses provided are of relatively short duration and aimed at preparing students rapidly so that they can enter the workforce and possibly continue their studies later. Its population has been growing rapidly,

particularly because of the worsening economic situation which has forced students from other private universities to look for less expensive alternatives. Mainly because of this, UTESA is currently one of the largest universities in terms of student population, with an enrollment of about 30,000 students spread across their five campuses across the country. The total number of professors is about 700 to 800, of which about 300 work at the Santiago campus.

Universidad Nacional Pedro Henríquez Ureña (UNPHU)

Founded by the *Fundación Universitaria* in April of 1966, UNPHU was the third private university in the Dominican Republic, after the PUCMM (1962), and O&M (1966). It has two main campuses located in Santo Domingo. Other campuses are located in the cities of La Vega and San Juan de la Maguana. Its student enrollment is about 8,000 and the total number of professors is about 650, which makes it a mid-sized university. According to its Academic Vice-Rector, UNPHU's main functions are education, research, and social or community work, and its primary objective is to achieve academic excellence. This university is also very well regarded in the country.

Instituto Tecnológico de Santo Domingo (INTEC)

The INTEC was founded in June of 1972, and has its only campus in Santo Domingo. It is a small university with an enrollment of approximately 2,000 to 2,500 students, and approximately 250 professors. Its main educational focus is engineering and social sciences, and this focus appropriately represents the university's technical vision with emphasis on humanistic education of its students.

According to its Administrative Vice-Rector, INTEC was founded as an option for individuals who wanted to attend a higher education institution that was religiously and politically neutral. This university is known for pioneering aggressive educational programs designed be completed in relatively small amounts of time compared to other universities, because of their 12- or 13-trimester format without sum-

mer vacation breaks. This format appeals to individuals who want an undergraduate degree in a short period of time, but do not want to settle for a technical degree.

Universidad Dominicana Organización y Método (O&M)

This university was founded in 1966 to supply the rapidly increasing demand for higher education in the mid-sixties. Its main purpose was to provide low-income individuals with career training so that they could, in a short time, join the workforce and develop themselves as professionals in the areas of accounting, administration, and other areas in which Dominican Republic was rapidly developing following an era of dictatorship.

Currently, O&M is one of the largest private universities in the country with a student enrollment of about 18,000 students and approximately 600 professors. Its main campus is located in Santo Domingo, and other campuses are located in Santiago, Puerto Plata, San José de Ocoa, and La Romana.

Universidad Iberoamericana (UNIBE)

One of the newest universities in this study, UNIBE was founded in January of 1982. It is the smallest university in the study, and its only campus is located in Santo Domingo. It has a student enrollment of approximately 2,000, with about 240 professors in 14 different programs. The main focus of UNIBE has been in careers such as law, business administration, odontology, and marketing, but it is expanding rapidly to other areas of great demand, such as computer science. This university is known mainly as an élite university, very expensive compared to others in this study, but very well-equipped. It is affiliated with a teaching hospital for its medical school.

Universidad Católica Santo Domingo (USCD)

This is the newest university of those included in this study, founded in December of 1982 by the Catholic community in Santo Domingo. It has a student population of approximately 2,600, served by about 200 professors. This university is still developing several of its programs, and concentrates in programs such as administration, advertising, tourism, and the arts. Along with UNIBE, this university seems to be gaining rapid popularity in Santo Domingo, maybe because it is one of the few universities offering programs in areas such as diplomacy, for which it is well-known.

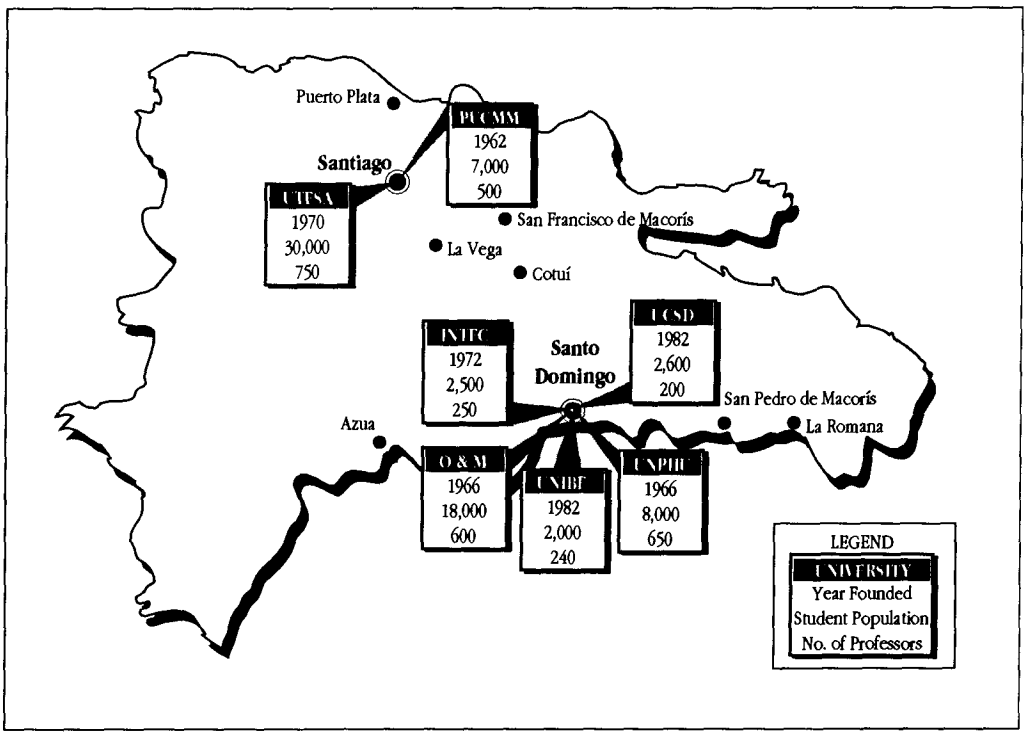


Figure 2. Location and other basic information about the selected universities

Data Collection

A sample of professors was selected by each university's administration, according to specific instructions from the researcher. From each faculty a number of subjects was selected proportional to the size of that faculty within the university. The total number of professors in each university's sample varies somewhat according to total response rate and size of the university; but the sample size was an average of 28 professors per university, for a total of 194 professors.

Participating professors completed a questionnaire, and administrative and technical personnel from each university were interviewed. Fifty questionnaires were given to each university's administration, to be distributed to professors from each faculty through their own internal mailing system. They completed these questionnaires regarding usage or non-usage of computers, problems with the use of computers (users), reasons for not using computers (non-users), knowledge about computers and their applications in higher education, and opinions and attitudes toward computers. After the questionnaires were completed, these were returned to the administration, and then to the researcher.

The data for the technical and administrative parts of the study were gathered through personal interviews, rather than through written questionnaires. The reason for this approach is that the kind of information needed about administrative policies and technical resources of the university was usually available through only one or two key individuals representing their university in those areas of interest. For example, an Administrative Vice-Rector of a university was most likely to have all the information needed for this study about the history and evolution of the university and its general policies regarding educational computing. In the same manner, the individual in charge of computing, or the computing centre, was able to answer most questions regarding the number of computers, type of computers, their location, and their general form of use.

Questionnaire development

The professors' questionnaire used in this study is based on questionnaires used in the "Computers in Education" study conducted by the International Association for the Evaluation of Educational Achievement/IEA in 1988 (Pelgrum & Plomp, 1991).

The questions drawn from these questionnaires were modified to create two new questionnaires to be piloted in a Dominican university, with the goal of developing an appropriate tool for gathering the data. Two pilot questionnaires were developed, one for administrative personnel, and one for professors. Changes were made to the new questionnaires after piloting, so that the questions would be tailored to the researcher's need to collect data about availability of computing technology, physical and human support, and professors' disposition toward educational computing. Some of the information gathered during the pilot study was of critical value in controlling factors such as the length of the questionnaire and type of questions. The pilot study also provided information on the overall level of knowledge about educational computing among respondents, which permitted the development of questions within that perceived range of knowledge, making them simpler and shorter, in many cases.

The questionnaire included items dealing with the attitudes of professors toward computers, and these were a subset of the computer attitude scale developed by Brenda Loyd, University of Virginia (Loyd, personal communication, December 18, 1990). The original scale consisted of forty items divided into four sub-scales: anxiety, confidence, liking, and usefulness. Measuring the attitude of professors toward computers was only a part of the overall study, so it was decided to use a subset of this scale, in order to keep the questionnaire as brief as possible. Three questions from each sub-scale were selected, taking into consideration the validity of their content for this population, the psychometric properties of the questions (Loyd & Gressard, 1984b), and how appropriate a translation could be made. A total of 12 attitude questions were incorporated into the questionnaire, three for each of the sub-scales mentioned above.

Finally, the format of the questionnaire itself was developed over a two-month period, with active participation from David Robitaille, David Bateson, and Marcia Johnson at the University of British Columbia. Those questions which appeared to be biased, unclear, or which might have drawn confusing or inaccurate information were revised, and changed accordingly before establishing the final questionnaire format. Both the original questionnaire, and a translated version can be found in Appendices A and B, respectively.

Interviews

Two interview schedules were developed. It was decided that key informant interviews and not questionnaires would be used in this part of the study for several reasons. First, as previously explained, the kind of questions to be asked could be answered by only a few people at each university—those in charge of the technical and computing staff and equipment (for the technical questions), and some top administrative personnel (for the administrative questions). Second, because of the first reason, a questionnaire would not be sufficient nor accurate enough to gather the needed information. Thus, considering the small number of people involved, interviews presented a much more practical and efficient approach to gathering information on technical and administrative issues. As for the development of the questions themselves, input from the pilot study was invaluable in designing the interview schedules.

The interviews themselves were of approximately 30 minutes in length, and mostly informal. The schedules presented a guide of the major topics to cover during the interviews, but interviewees were encouraged to discuss any particular aspects of computing that they felt were important in their case. This approach was very positive in that interesting discussions of topics not included in the schedule were held, but it had the effect of making the outcomes of the interviews somewhat dissimilar among universities, making them more difficult to analyze and compare. Most of the interviews were audiotaped, although two of them were recorded with notes, according to the interviewees' preference.

It was decided that the information gathered through these interviews would be used as the main source of information for the administrative point of view about computing, and only as a secondary source of information about actual uses of computers in these universities. Also, due to the rapidly changing nature of technology, information about technical issues such as the number and type of computers used, for example, is important only as a "snapshot" of the status of these technologies in Dominican universities in the early 1990s. More emphasis, however, has been given to deciding what the universities are seeking during the next few years in terms of computing in education, rather than on analyzing the number or type of equipment being used now.

The interview schedules for both the administrative and technical interviews can be found in Appendices C and D, respectively.

Pilot Study

The pilot study was conducted during the three-month period from April to June, 1990. The main goal of the pilot study was to test the basic methodology and tools to be used and, at the same time, collect basic information to help refine the final questionnaires for the present study. It was done at one of the major universities in the Dominican Republic, the *Pontificia Universidad Católica Madre y Maestra* (PUCMM), located in the city of Santiago.

There were several decisions to be made in the selection of the sample. First, the university in which the pilot study was conducted, the PUCMM, was arbitrarily selected because it provided several advantages, namely its location and the fact that it was a familiar university environment for the researcher—a key advantage considering the relatively short period of time available to complete the pilot study.

The second step was to choose the actual subjects for the study, which called for a sample of professors, as well as a sample of administrative personnel. After consulting some professors at the university, it was decided that the subjects would be selected arbitrarily, at the discretion of the faculty

deans. The faculty deans were asked to select a number of users and non-users of computing technology within their faculty. They were also asked to select some professors that they knew as being promoters of the use of computer technology and some professors they knew as being against the use of computers. This method was ideal since it provided the researcher with extreme cases to test the reaction of professors to the questions posed, and the range and limits of awareness of computer technology among professors.

After being granted permission from the administration of the PUCMM to conduct the pilot study, questionnaires were distributed to 49 professors in four faculties (Engineering; Sciences and Humanities; Health Sciences; Social Sciences and Administration), and an additional nine given to individuals in administrative departments. The return rate was very high. Thirty completed questionnaires from professors (80% response rate) and six from the administrative employees (67% response rate) were returned. This was probably due to the researchers' proximity to the university which allowed constant follow-up during several visits to the campus.

To gather additional information about the institutional approach to computer technology, key administrative, academic, technical, and research personnel were interviewed. These interviews were short (about 30-45 minutes) and their purpose was to test the appropriateness of the interviews for gathering the desired information from the administration (the length of the interview in particular) and to test some of the actual questions to be asked during the interviews in the present study.

In general, the methodology followed in the main study was similar to the one used in the pilot study, with one major difference: in the pilot study, questionnaires were distributed personally to every professor selected. This was possible only during the pilot study and it was an effective way to ensure a good response rate. During the main study this was not possible, however, so the distribution method previously described was used.

Analysis And Reporting

The characteristics of this study are consistent with those of a case study, in which multiple cases were used and the method of data collection was a survey using interviews and questionnaires as instruments. The study is mainly descriptive, since its main concern is to describe certain variables that are considered to have important influence on the status of educational computing—such as the availability and quality of the physical, human, and logical resources—as well as the uses of computers by professors in the surveyed universities.

For the analysis and interpretation of the data, a combination of approaches was used. The main technique used is described as a type of "Pattern-Matching" technique, referred to by Yin (1988) as "Explanation Building". In this technique, a cross-case analysis of a set of variables—those defined by the literature as being important in educational computing—is conducted with the data gathered from each university. In other words, those variables which are thought to determine or affect educational computing in higher education are examined in each university, and common patterns are identified, and explained, whenever possible. Every university represents a case in the study, and the goal is to draw basic conclusions about the status of educational computing, based on common patterns found across universities.

The first step after data collection was to organize the data in a way that facilitated analysis. Interviews were transcribed and appropriately indexed, so that specific parts of it could be retrieved effortlessly. The questionnaires were coded, and the data entered in a custom-designed Hypercard™ stack that allowed semi-automated data entry, and some re-coding done after the data had been entered. These data were then exported to the SYSTAT statistical program (Apple Macintosh version 5.1), with which most relevant analyses were performed.

The second step in the analysis of the data was to develop a descriptive framework in which the responses to the questions in the interviews and the questionnaires were grouped into meaningful sets

which would help to answer each focus question. This framework corresponds to the actual structure of Chapter 4, where the results are reported. Each set consisted of data from questions from both the interviews and the questionnaires that are relevant to one aspect of the study.

For each data set, questionnaire data were analyzed mainly through the tabulation of frequencies across universities, as well as other straightforward forms of analysis. In this manner, the differences and commonalities among universities were exposed, and patterns identified. In each case, the available information was cross-checked and interpreted using information gathered through the interviews, so that specific situations could be explained.

The analysis of the attitudes of professors toward learning and working with computers required several additional tasks. The reduced scale was tested for reliability, so an analysis of reliability using the LERTAP program (Nelson, 1974). In addition to that, the dimensionality of the reduced scale—which was supposed to contain four different sub-scales—was threatened by the small number of items chosen for each sub-scale (3 items per sub-scale), so a factor analysis was performed using SYSTAT.

Most of the results are reported in graphical form, which are particularly helpful for identifying commonalities and differences between universities at a glance. Also, extensive use of three-dimensional graphs is made, mainly because of their ability to represent several variables across universities in a single graph. The analysis of these variables would otherwise require multiple two-dimensional graphs, and this would make it more difficult to understand the overall view being presented.

Since this study focuses on general patterns of interest across the universities studied, rather than on specific details, exact values are usually not reported on the graphs and only rounded values are used in the tables. However, complete tables for each of the graphs are included in Appendix E.

CHAPTER 4: RESULTS

This chapter is concerned with answering the two research questions that give shape to this study. It is divided into three main sections. The first section presents a profile of the professors who returned their questionnaires, and each of the other two sections addresses one of the research questions. In each of these last two sections, the major components of the answer to that particular question are identified, and the relevant data available to explain each component are reported. Data from both the professors' questionnaires and the administrative and technical interviews are presented and examined. In most cases interview data and observations are used to support, further explain, or clarify some conclusions drawn from the questionnaires.

Profile of the Respondents

The data reported in this chapter come from the technical and administrative interviews, and the professors' questionnaires. This section provides some insight about the professors who responded to the questionnaires, both users and non-users of computers. This information provides background for the reader to better understand and interpret the data presented in the reminder of this chapter.

A total of 194 out of 350 questionnaires (55%) were returned by professors from all academic faculties or departments; the response rate ranges from a low of 36% (n=18) at UNPHU to a high of 76% (n=38) at INTEC. Table 1 shows the frequency and response rate for each university.

Table 1
Questionnaire response rates by university

Universities	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA	TOTAL
No. of Eligible Professors	50	50	50	50	50	50	50	350
No. of Returns	38	35	25	28	26	18	24	194
Return Rate (%)	76	70	50	56	52	36	48	55

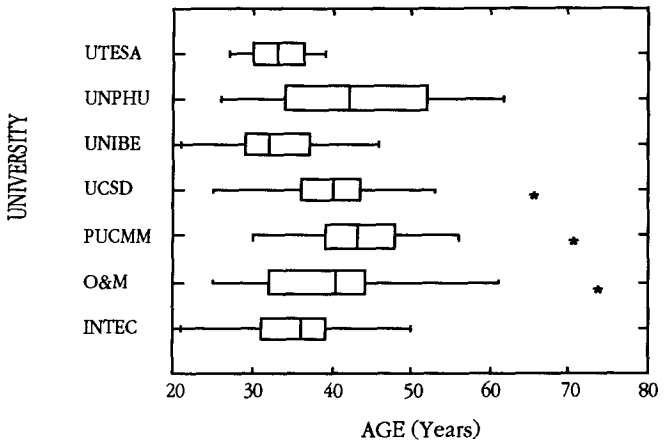


Figure 3. Distribution of the age of professors across universities.

The average age of respondents was 38 years, with 50% of all respondents falling between 32 and 43 years old. As shown in Figure 3, the distribution of ages was fairly similar across universities. About 69% of the respondents were male, and 28% female, while the remaining 3% declined to answer this question.

The average number of years of experience in the field of education was 11 years (see Figure 4). However, it is a common practice in Dominican universities to have professors that are not necessarily educators, but professionals in other areas who teach as a second job.

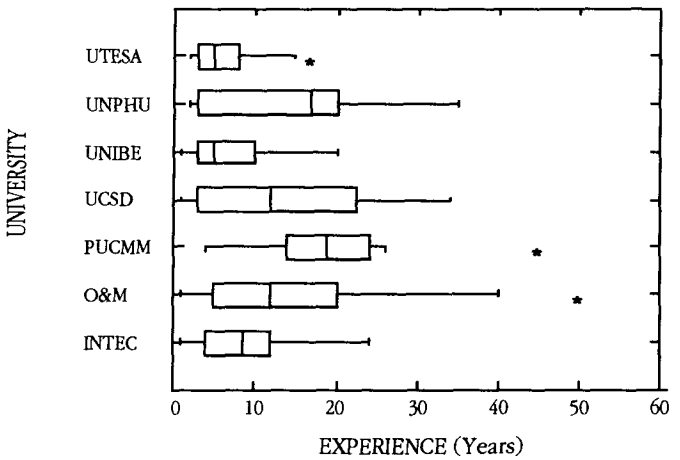


Figure 4. Distribution of the experience of professors in the field of education across universities.

Most professors surveyed (60%) had an undergraduate degree, but not necessarily in education. About half as many professors (28%) had a master's-level degree, and about 9% of all professors had a doctoral degree. A few professors (3%) did not have a complete undergraduate degree. Figure 5 shows that this pattern applied to most universities. The majority of professors from PUCMM had master's degrees.

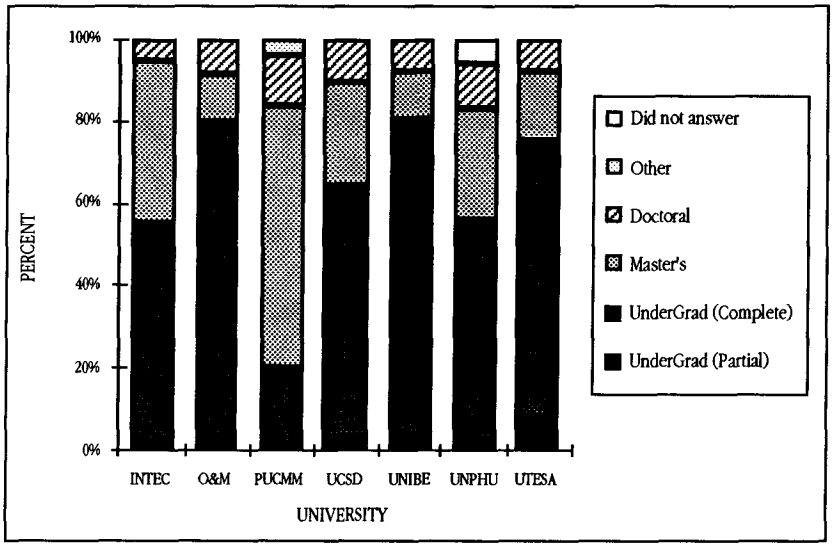


Figure 5. Distribution of the highest degrees held by surveyed professors across universities.

Computer usage varied significantly among universities, with an average of 43% of all respondents being computer users. At INTEC, for example, 74% of respondents used computers, while in other universities such as UCSD or UTESA the percentage of computer users was as low as 21% and 25%, respectively. Table 3, and Figure 6 show the distribution of users and non-users across universities.

Table 2

Distribution of users and non-users of computers by university

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA	TOTAL	N
Non-users (%)	26	63	48	79	65	50	75	57	110
Users (%)	74	37	52	21	35	50	25	43	84
N	38	35	25	28	26	18	24		194

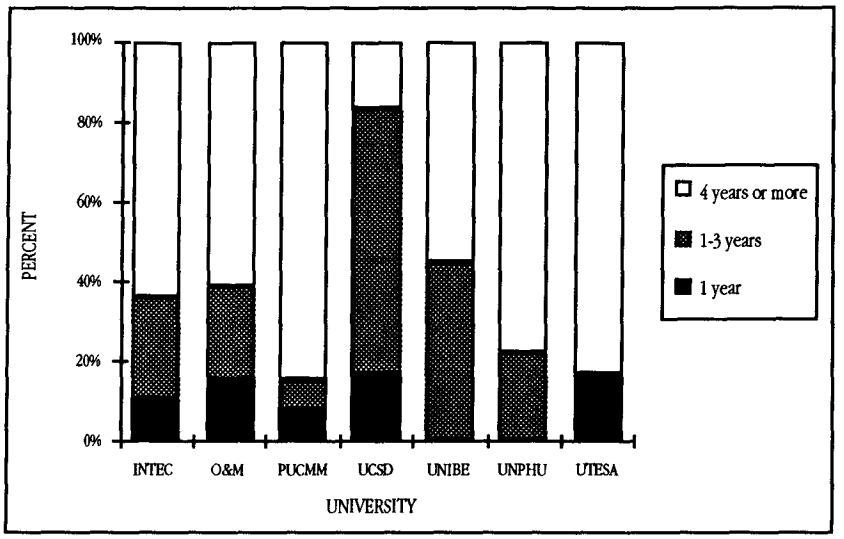


Figure 7. Computing experience of computer users across universities.

Professors were also asked in what year they had used computers for the first time, and if they had used a computer for the first time at the university as a student, at the university as a professor, at home, or somewhere else. As depicted in Figure 8, most professors used a computer for the first time during the 1980s, which is not surprising. Possible exceptions are PUCMM and UNPHU which showed the most number of experienced users. As to where they had used computers for the first time, about 10%

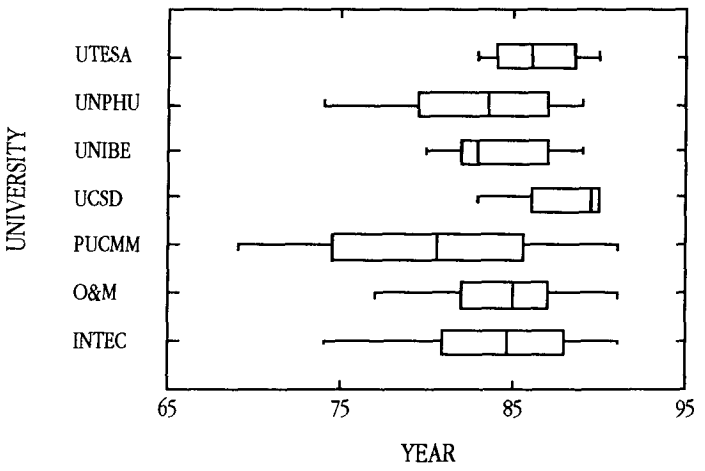


Figure 8. Year in which computer-using professors started using computers, by university.

said they had used them for the first time at home. Only 2% of the computer users said they used computers for the first time at the university as professors. All those who had used computers for the first time as professors at their university were from PUCMM.

About 43% of the computer-using professors indicated they had first used a computer "somewhere else", and 42% said that they had used a computer for the first time as university students. Further analysis revealed that "somewhere else" in most cases meant at work (44%) or at a technical training institution (28%), while some said it was at a friend's house (11%) or while studying at a foreign university (11%). These results are summarized in Figure 9.

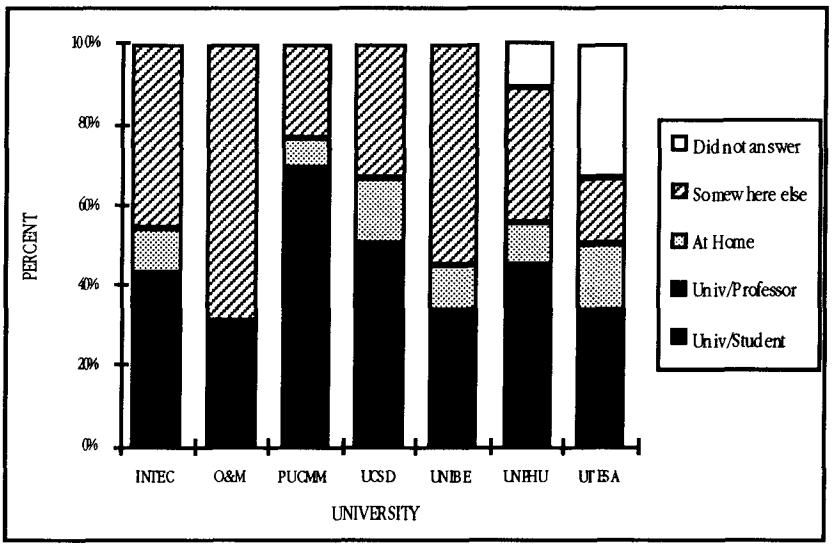


Figure 9. Places in which professors learned about computers.

A second area of interest was the knowledge that professors had about everyday computing issues and tasks. Item 9 on the professors' questionnaire was a list of ten statements concerning basic tasks and concepts in educational computing (For presentation purposes, these statements are labeled here as K1 through K10.) The first two statements were of a conceptual nature: "I know several uses of computers" and "I know some advantages of using computers in education". The next five statements

dealt with more technical topics, such as: "I know several criteria to judge printers", "I know what a modem is", and "I know different kinds of computers: MS-DOS, Apple II, Macintosh, UNIX". The last three items referred to basic tasks that even a novice user would likely be familiar with: "I know how to copy a file from one disk to another disk", "I know how to edit a document with a word processor", and "I know how to create a data file on a computer".

An unexpectedly large number of professors indicated that they were actually familiar with most of the concepts, technical issues, and tasks presented. Figure 10 shows the percentage of YES and NO responses. Two things are interesting from this chart. First, while the percentage of YES responses on the technical issues (K3 to K7) was, as expected, lower than on the other statements, all percentages were higher than expected (for a more detailed table, see Appendix E). It seems obvious that the computer experience of these professors had a lot to do with these results. The second interesting point relates to statement K1: "I know some advantages of using computers in education". Professors appeared quite confident about knowing some benefits of using computers in education, even though the literature in educational computing shows great controversy about several aspects of the use of computers in education.

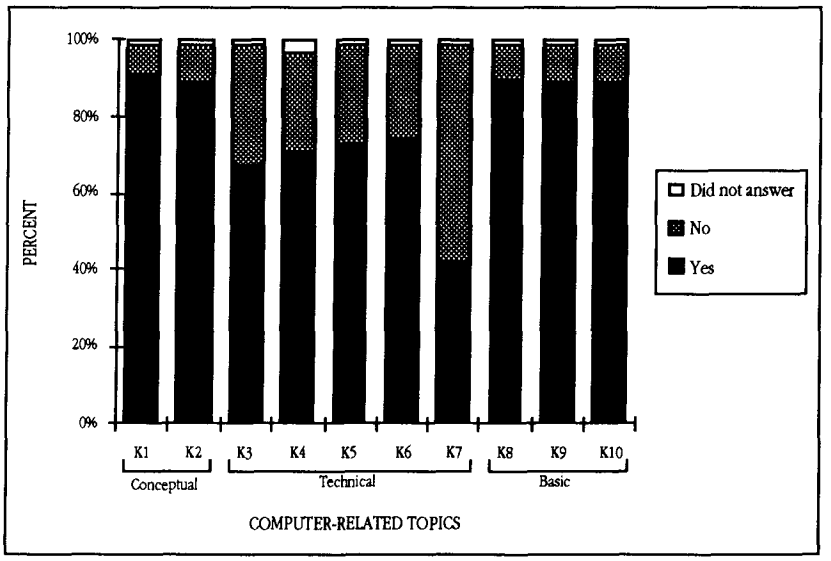


Figure 10. Percentage of YES and NO responses to knowledge questions about computers.

The Status of Educational Computing in Dominican Universities

To assess the current status of educational computing it is important to identify those characteristics that give shape to, or condition educational computing. This section has been divided into several sub-sections, each of which concerns an important aspect of educational computing. The first sub-section contains a description of the organization of the computing environment in which professors and students use computers. The other three sub-sections contain descriptions the availability, and adequacy of the physical, human, and logical resources in the surveyed universities. Each section concentrates on the areas of most interest, such as hardware and software available in each university, computing policies, training, and motivational programs in place.

The Computing Environment

The environment in which university professors and students make use of computing technology is determined by many different factors, often related to a university's policies, and approach to computing. In order to examine some of these factors from each universtity's particular perspective, a number of questions were included in the technical and administrative interviews that were conducted with officials from each university. The answers to these questions and observations made during the interviews and visits to the universities are reported and examined in this section.

Organization of Computing Services

The first factor of interest is related to the general organization of computing within the participating universities. A technical and an administrative representative from each university was asked to explain the role of the computing centre(s) in relation to the administrative and academic functions of the university.

Two distinct approaches to computing were evident from the interviews. In the first approach, there was one department in charge of administrative computing, which reported to the administration, while academic computing was controlled by the department of computer science or informatics (see Approach A, Figure 11). In the second approach, one computing department was in charge of all academic and administrative computing, which depends upon the administration, and whose academic operations were controlled by the computer science or informatics department (see Approach B, Figure 11).

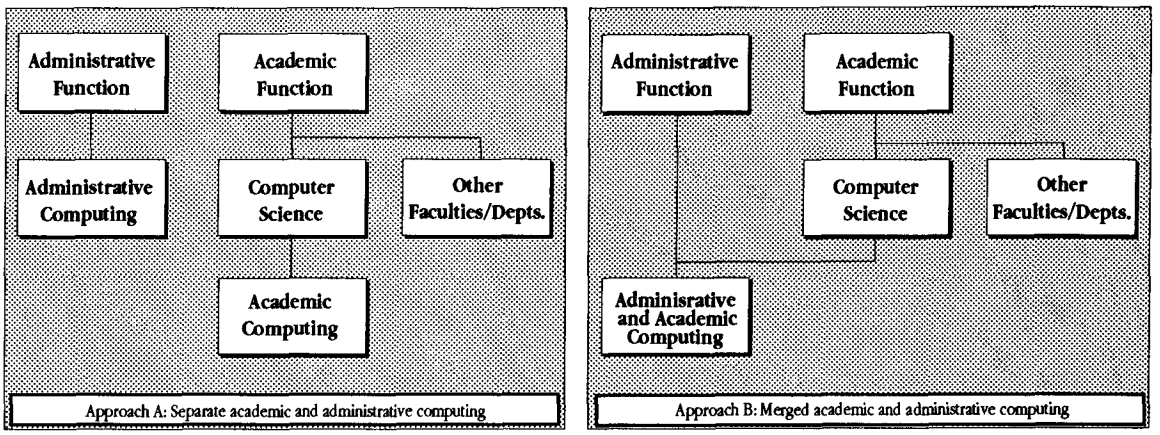


Figure 11. Organizational approaches to computing used by the surveyed universities.

Only O&M reported having a distributed administrative computing environment based on microcomputers, while the rest of the universities relied upon centralized computing systems, and the use of terminals across administrative departments. Some use of microcomputers in administrative departments was reported, but there was no extensive use of them for administrative purposes, except at O&M where only microcomputers were used. In the academic area, the use of microcomputers was more extensive, however, and all universities had academic laboratories set up with microcomputers. In addition to that, all universities except O&M had a centralized computing system based on a minicomputer for academic uses.

Importance of Computing

Interviewees were asked how long their universities had been using computers for administrative and academic tasks, and what they thought the advantages and disadvantages of computing were. Also, both technical and administrative personnel were asked what had been the trend of investment in computing over the last few years at their universities.

Three universities, PUCMM, UNPHU, and O&M, reported having used computers since before 1975, while the other universities started using computers during the 1980s, first as administration tools, and eventually spreading to academic uses. Most universities reported making greater investments in computing and, although no specific numbers were available, interviewees said that their universities were definitely committed to computing, and that investment in computing matters has been increasing significantly over the last few years. Testifying to the validity of these comments are a number of computing-related projects in progress at many of the universities. For example, INTEC was redesigning most administrative systems, UCSD and IBM had a joint multimedia project related to the celebration of the 500th anniversary of the voyage of Columbus, and UNPHU was expanding its computing environment, with the help of local and international agencies.

The advantages of computing cited by the interviewees related for the most part to benefits of computing in administration. Comments such as, "Our services have become much more efficient, faster, and much more reliable" (Vice-rector, O&M), and "To obtain the data on time, so that there is no delay in administrative processes" (Vice-rector, UNPHU) were common among administrative personnel. When asked about the educational benefits of computing, however, the responses were not as clear. Two of the responses are characteristic:

> 1. In this country, and in this university, we use the computer for instruction specifically in the area of informatics. I am personally trying to motivate a project to use computers in other areas, not only in heath sciences or informatics. (Vice-rector, UTESA)

> 2. I think that academic personnel should use computers to develop students' capabilities, and involve them in the teaching-learning process. That is, to enhance students' learning conditions with the computer. (Vice-rector, INTEC)

These two interviewees emphasized the need for a change to use computers in other academic areas, but the majority of respondents did not mention any educational advantages of computing other than their use in informatics or computer science.

The disadvantages of computing mentioned during the interviews were mostly related to a lack of resources to support computing, particularly economic and human resources. The following are representative of that view:

> 1. I think that the greatest problem of computing is human resources, because it is a resource that since it is in great demand, and the university pays so little, it does not have permanency or stability in the university. The other thing is that the systems analyst (or computer scientist) does not know the academic processes, and that makes the situation that much more difficult. (Vice-rector, INTEC)

> 2. [The main problem with computing is] resources. You know that to implement an ambitious program costs a lot of money ... and usually these institutions have economic limitations ... (Vice-rector, UTESA)

The main concern among interviewees was over the lack of economic resources to set up, support, and maintain computing facilities in the universities. In general, it appeared much easier for respondents to come up with advantages than with disadvantages of computing. One respondent even played down the disadvantages of computing, indicating that the advantages heavily outweighed the possible disadvantages of computing, which were limited to technical problems.

Physical Resources

The most visible aspect of educational computing in higher education institutions are the physical resources needed to support it, and as such, those resources are an important focus of this study.

Data about physical resources were gathered through both the technical interviews, and the questionnaire. The technical interviews provided detailed information about current hardware and software technology being used, as well as information regarding laboratories, the universities' energy infrastructure, and other physical facilities in place at each university. Questionnaire responses provided data about professors' perceptions of the availability and quality of these and other physical resources.

Hardware Technology

The types of computers available in Dominican universities fall mainly into two categories: minicomputers and microcomputers. Minicomputing technology is used for both administrative and academic computing, while microcomputing laboratories are used mainly for academic purposes. The typical trend for all universities has been to move away from old minicomputing systems, such as the IBM S/34 or IBM S/36, to newer minicomputing technology capable of running UNIX systems and applications. However, three universities (UTESA, PUCMM, and UCSD) still use older minicomputing technology, either by itself, as in the case of UTESA, or alongside newer technology, as in the case of PUCMM and UCSD.

Microcomputing is used primarily for academic computing. All universities have microcomputing laboratories dedicated to students, and most universities have some microcomputers in several administrative and academic departments. The predominant microcomputing technology in use is PC/MS-DOS, although other technologies, such as Apple II, and Apple Macintosh computers are present in smaller numbers. A peculiar case is that of O&M, which concentrates specifically on microcomputing for both academic and administrative purposes. The rationale for this was explained by the Vice-rector of Science and Tropical Technology of O&M:

> We think that, in the Dominican Republic, for each mainframe or minicomputer, there are hundreds or thousands of microcomputers. If we think about the work force, for each person needed to work on mainframes or minicomputers, there will be a need for 20 or 30 people that know how to work with microcomputers. (Vice-Rector, O&M)

Software Technology

The software-related questions included in the technical interview examined two different software categories: operating systems, and application software. The system software used for minicomputing is tightly related to the kind of computer in use, and again the trend here is to switch to a standard operating system such as UNIX. Universities that had older minicomputing systems were using these systems' native operating systems. In microcomputing, the de-facto standard is MS-DOS, which is in use across administrative and academic departments.

Administrative application software is developed in-house at all universities, using programming languages such as RPG and COBOL. There is a trend toward newer technology in this area, and four out of the seven universities either already have re-developed, or are re-developing, their administrative systems to run on database systems such as Informix's 4GL, and Oracle. Microcomputer application software for administration is also developed in-house using similar tools, such as the popular dbase database for MS-DOS computers, and programming languages such as Pascal or Basic. However, most microcomputer applications used in administrative departments are off-the-shelf multipurpose applications, such as word processors, and spreadsheets.

Educational application software was generally limited to the tools used in computer science courses or continuing education courses. Computer science tools, such as languages, databases, and tutorials, were available for both minicomputer and microcomputer systems. Microcomputer applications, such as spreadsheets, word processors, and databases were used for continuing education courses and for microcomputer courses for non-computer science students. There were no instructional applications, or computer-aided instruction (CAI) tools found in this study. Only two interviewees indicated that some instructional uses of computers were being carried out regularly by some professors. Table 3 summarizes the data presented in the last two sections regarding availability of hardware and software technology.

Table 3

Summary of the type of hardware and software available in the universities surveyed

University	Type of Hardware Available			
	Administrative Use		Academic Use	
	Mini	Micro	Mini	Micro
INTEC	UX	PC	UX	PC
O&M	—	PC	—	PC,A2
PUCMM	S3,UX	PC,Mac	S3,UX	PC
UCSD	S3,UX	PC	S3,UX	PC
UNIBE	UX	PC	UX	PC,Mac
UNPHU	UX	—	UX	PC
UTESA	S3	PC	S3	PC

	Type of Software Available							
	Administrative Use				Academic Use			
	Mini		Micro		Mini		Micro	
	O/S	Apps	O/S	Apps	O/S	Apps	O/S	Apps
INTEC	UNIX	IH	MS	WP,SS	UNIX	P1,ST	MS	DB,P2,SS,WP
O&M	—	—	MS	DB,IH,SS,P2	—	—	MS,A2	P2,SS,WP
PUCMM	S3x,UNIX	IH	MS,MF	DB,SS,WP	S3x,UNIX	DB,P1	MS	DB,P2,SS,WP
UCSD	S3x	IH	MS	IH	S3x,UNIX	IH,P1	MS	DB,SS,WP
UNIBE	UNIX	IH	MS	DB,SS,WS	UNIX	DB,P1	MS,MF	DB,SS,WP
UNPHU	UNIX	IH	—	—	UNIX	DB,P1,ST	MS	AC,DB,SS,WP
UTESA	S3x	IH	—	—	S3x	P1	MS	P2,SS,WP

Hardware codes:

A2 = Apple II-compatible computer.
Mac = Apple Macintosh computer.
PC = IBM or IBM-compatible personal computer.
S3 = IBM System 34, or 36 minicomputer.
UX = Minicomputer that runs the UNIX™ operating system.

Operating System codes:

A2 = Apple II-compatible operating system.
MF = Macintosh Finder™ operating system.
MS = Microsoft Disk Operating System (MS-DOS).
S3x = IBM System 34 or 36 operating system.
UNIX = AT&T UNIX™ operating system.

Application codes:

AC = Accounting packages.
DB = Database programs, such as dbase III, Oracle, 4GL.
IH = Custom applications developed in-house.
P1 = Minicomputer programming languages: RPG, COBOL, C.
P2 = Microcomputer programming languages: PASCAL, C.
SS = Spreadsheets: Lotus 123, Borland Quattro.
ST = Statistical packages.
WP = Word processors: WordStar, WordPerfect

Adequacy of Hardware and Software

Computer-using professors (about 43% of the total) in each university were asked several questions (questions 6, 8-1, and 10-1 through 10-10 on the questionnaire) about the adequacy and availability of the hardware and software to them. Non-users of computers (57% overall) were only asked two questions (questions 12-7, 12-10), on the assumption that they would not be as well informed about these topics as computers users.

Hardware availability. About 36% of the computer-using professors said they had computers available to them only at the university, 19% had computers available only at home, and 33% said they had computers available to them both at home and at the university. Additionally, about 12% said they had computers available to them somewhere else other than at home or at the university, most probably at work. As is shown in Figure 12, however, there were notable differences among universities. While 100% of computer users at PUCMM reported having computers available to them at the university, less than

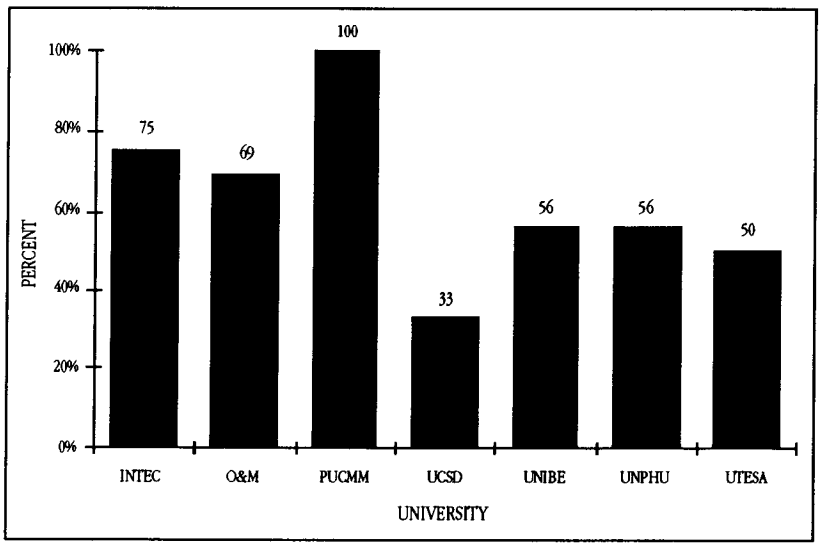


Figure 12. Percentage of computer users who said they had computers available at their universities.

56% said so at UCSD, UNIBE, UNPHU, and UTESA. This indicates that many computer users actually do not have computers available to them at the university, but only at work or at home.

Professors were asked how adequate the number of computers was at their universities, and also if the number of computers presented a problem to them when they used computers at the university. When asked how adequate the number of computers available to them was (question 8-1), 51% rated this resource "inadequate" or "very inadequate", while 38% rated it "adequate" or "very adequate". Figure 13 shows professors' responses to question 8-1.

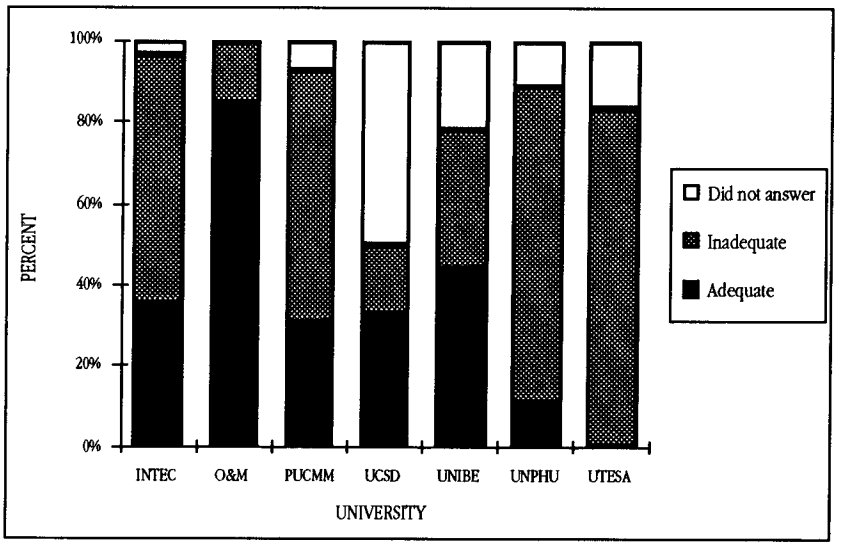


Figure 13. Percentage of users who said the number of computers was adequate.

Some differences among universities are evident. Computer-using professors at O&M seemed to be the most satisfied with the number of computers in their university (about 85% said the number of computers was adequate), but less than 40% of computer-using professors at INTEC, PUCMM, UCSD, and UNIBE, and less than 10% in UNPHU and UTESA expressed satisfaction with this resource.

A number of professors (11% overall) did not answer these questions, particularly those from

UCSD, UNIBE, UNPHU, and UTESA. This was true for a number of questions. One can only speculate about the reason for this, but some professors indicated not having computers available for their use at their university, but possibly somewhere else (see Figure 12), thus are not able to assess some of the computing-related resources available at their university. For the purposes of reporting it is of interest not to omit these cases, however questionable they are, because of the number of non-respondents varies across universities, and omitting them will significantly vary the proportions depicted in some of the figures.

Computer-using professors were presented with a number of possible problems which they might encounter while using computers at the university. When asked if one of these problems was, that the number of computers was insufficient (question 10-1), approximately the same response as in question 8-1 was obtained: 57% said it was a problem, 35% said it was not a problem. The other hardware-related problems listed were: "The number of peripherals is insufficient", "Maintenance of available equipment is deficient", "Limitations of current equipment (obsolete, slow, low quality, insufficient memory)", and "The supply of energy (electricity) is inadequate". The problem "The supply of energy (electricity) is inadequate" was left out of this discussion because, although is a problem that affects hardware directly, it is not inherent in the hardware. Other physical resources, such as energy supply, will be discussed later on in this chapter.

Figure 14 shows a graph of the percentage of computer-using professors who selected these as problems they experienced while using computers at their university. The problem that was most frequently selected overall was "The number of peripherals is insufficient" (38% overall), followed by "Maintenance of available equipment is deficient" (33%), and "Limitations of current equipment" (26%). Since Figure 14 also shows the percentage of responses by university, it is relatively simple to analyze the data at the university level. Computer users at UTESA, for example, were the ones who most frequently selected these as being problems they experience at the university.

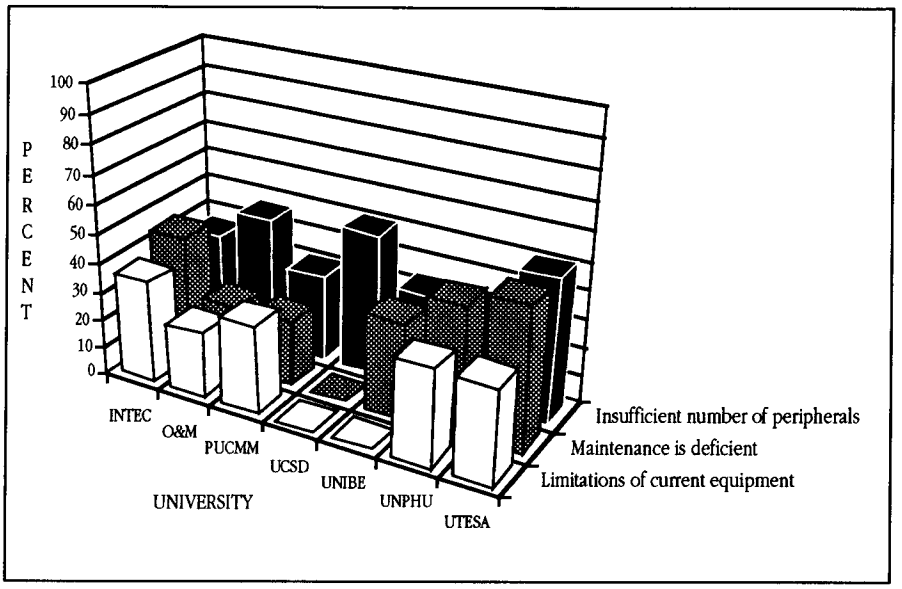


Figure 14. Percentage of computer users who experienced hardware-related problems.

Non-users were given a number of possible reasons for not using computers, among which "The number of computers is insufficient", and "Computers are not accessible enough to professors" (questions 12-7, and 12-10) were the only two directly related to hardware. Professors who did not use computers were asked to mark those options which they considered to be reasons not to use computers.

While only about 15% of non-users said that an insufficient number of computers was a reason for not using computers, the majority (52%) indicated that the inaccessibility of the available computers was indeed a reason for them not to use computers. Non-users from all universities showed a similar pattern of response to this question. Figure 15 shows the percentage of non-users that chose those options in each university.

Software Availability. Computer-using professors were asked if any of the following were problems they experienced while using computers at the university: "There are not enough applications (programs) available for public use", "The available applications are very difficult to use", "The manuals

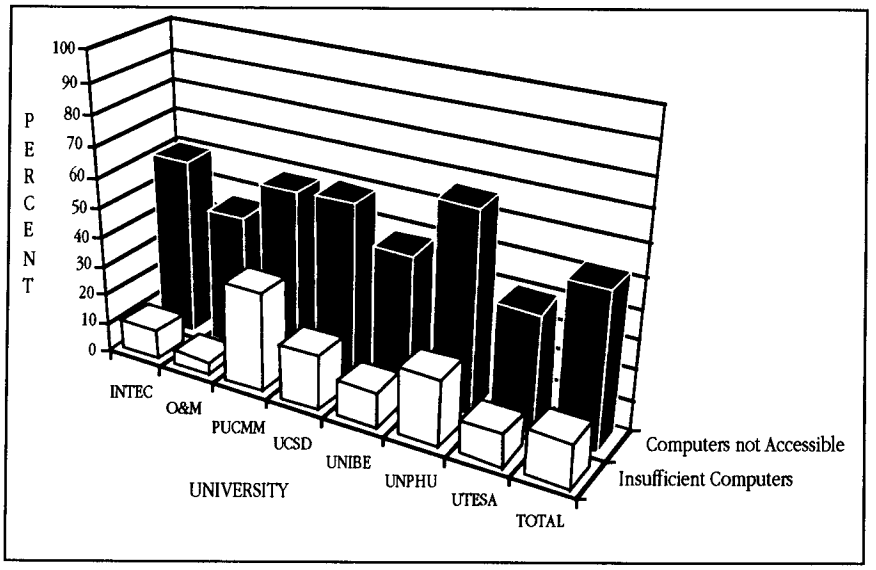


Figure 15. Percentage of non-users who did not use computers because of hardware-related reasons.

and support materials are incomplete or inexistent", "There is no information about the different applications or their quality", "The applications are in English, and there are no Spanish versions available" (questions 10-6 through 10-10).

Figure 16 shows the percentage of computer users who selected these as problems they experienced when using computers at their university. The problem that was selected by the largest number of users in all universities (45% overall) was that no manuals or support materials were available for the applications they used. A possible explanation for this is the widespread use of unauthorized copies of application software in the country which leads to a lack of manuals and support materials.

Professors from PUCMM and UNIBE selected the "no information on applications" problem, and professors from INTEC and O&M selected the "not enough applications" problem more frequently than professors from other universities. In relation to the other problems, responses appeared to follow similar patterns. A unique response came from UNIBE, were 44% of computer-using professors expressed concern about the limited number of applications in Spanish available.

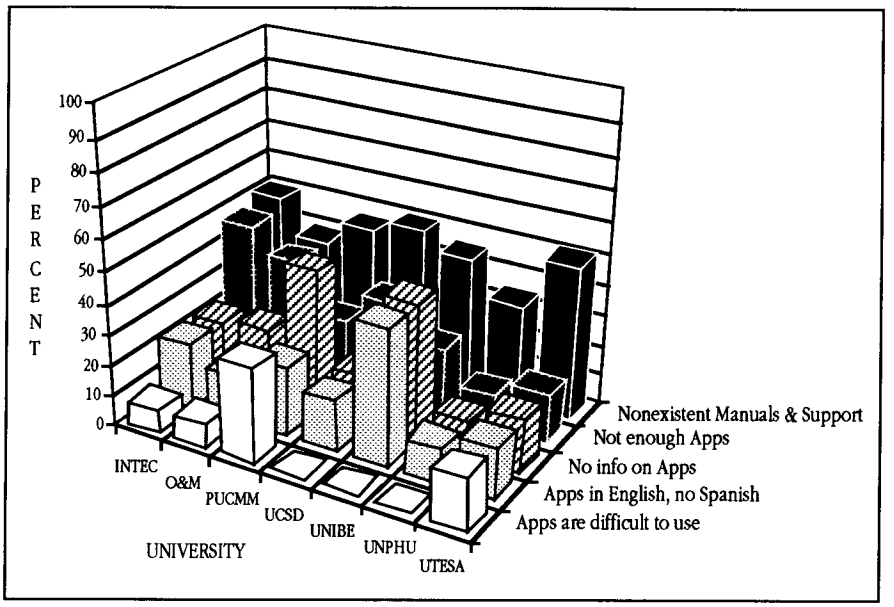


Figure 16. Percentage of computer users who experienced software-related problems.

Other Physical Resources

Although computing hardware and software are the two major physical components of educational computing, the availability and quality of other physical resources may be equally important. Both the interviews and the questionnaires included specific questions regarding the computing laboratories' setup, availability, and services provided. They also included questions about the universities' electrical infrastructure (currently a major issue in the Dominican Republic), and other facilities they provided for professors and students.

Computer laboratories. The computing services provided by universities can heavily influence those who actually use the computers and how they use them. This section explores the services offered by the universities through their computing laboratories. According to the technical interviews, all of the

universities had a multi-purpose computing facility for students, and professors. Also, most universities had an administrative computing centre, usually separate from the academic facility, that provided computing services to administrative departments through terminals.

Although some universities had more than one location for academic computing, only O&M had a three-laboratory setup, each for a specific purpose. All other universities either had all computers (minicomputers and microcomputers) in a single location, or had one or two locations which provided mixed services. The usual operating hours for these laboratories were from 7-9 AM to 8-10 PM. In all cases there was a person in charge of the facility, usually an advanced student, computer technologist, or a systems operator, in the case of minicomputing facilities. This person's job was usually nothing more than to supervise the use of the equipment, and control printing and other shared resources; although, in a few instances, they also provided some technical assistance to users.

Services provided by these computing laboratories differed across universities. These services were usually provided either on a first-come, first-served basis, or on demand, requiring booking prior to coming to the laboratory. There was no remote access to computers available in any university, although UNIBE was planning to make administrative functions available to certain officials through modems.

Laboratories in most universities provided three basic services. First, the computer laboratories served as the place where hands-on computer courses could be held. Second, the computer laboratories provided the students with the software they needed to carry out course-related activities. Third, the laboratories were open to all students who wanted to use computers for university-related work.

While laboratories in all universities provided these three basic services, two universities provided two other additional services. In the computer laboratories at INTEC, O&M, and UNPHU, for example, there were personnel specifically assigned to help users (students or professors) with technical problems or with questions regarding the hardware or software they were using. These *monitores* (monitors), as they were called, were usually experienced or advanced students who earned credit or money for their work

at the laboratories. Furthermore, unlike any other university, laboratories in INTEC were also responsible for preparing workshops on the use of computers for both professors and students.

Table 4

Setup, and services offered in computer laboratories in the universities surveyed.

University	Labs	Hours	Access	Supervision				Services offered					
				P	S	T	O	C	P	T	S	W	X
INTEC	Educ	9-21	First-come, first served	•		•		•	•	•	•	•	
	Admin	9-21					•	•	•		•		
UTESA	Educ	8-22	Booking		•		•	•	•		•		
	Admin	8-20					•			•	•		
O&M	Educ I	7-22	First-come, first served		•		•	•	•		•		
	Educ II	7-22	First-come, first served		•		•	•	•		•		
	Educ III		Booking	•				•					•
UNIBE	Educ	8-22	First-come, first served	•			•	•	•		•		
	Admin	8-18								•	•		
UCSD	Educ/Admin	8-20		•			•	•	•		•		
UNPHU	Educ	9-22	Booking	•		•	•	•	•	•	•		
	Admin	8-22								•	•	•	
PUCMM	Educ I	8-22	Booking	•			•	•	•		•		
	Educ II	8-22	Booking	•			•	•	•		•		
	Admin	8-18								•	•		

Supervision codes:

P = Professors supervise their students in the lab.
S = A student "monitor" that helps users.
T = A computer science technician that helps users.
O = A systems' operator (usually for mini systems).

Services Offered codes:

C = Classes.
P = Practice or Homework.
T = Technical Support for specific software, etc.
S = Software available, and software development.
W = Workshops.
X = Special Uses, such as project development, research, etc.

In all cases, the academic laboratories were originally set up for computer science students to carry out their coursework-related exercises. Nowadays, computing services are offered to all students and professors, although in practice the use of computers is limited mostly to students, and then almost uniquely to those in areas of computer science and engineering. The interviewees indicated that computer usage on the part of professors was in no way institutionalized. Of all the universities, only INTEC was implementing a university-wide computer literacy plan to get all professors involved with computers. But INTEC's case was the exception, and when asked if professors showed interest in using the computing services, and how much they used them, some of the following comments were common:

> 1. [Professors' use of computers is] actually very limited, and that is not recorded. It is very informal, that is, some professors use computers for their teaching purposes, to prepare classes, or examples for students, but very few hours. The amount of time is really insignificant. The use of computers by professors is not institutionalized. (Vice-Rector, O&M)

> 2. Well, that depends more on what the professor thinks or interprets that the computer can do for him, up to what point he thinks it might be beneficial, because informatics professors who are conscious about the use of computers as tools do express their interest....But I still think that professors need to be taught more about what they can gain through the use of computers, regardless of the area they are in. (Director of informatics, UNPHU)

Computer users were asked to rate the adequacy of the location of the computers in their universities. Overall, about 50% of the computer users appeared satisfied with the location of the computers in their universities, while 28% said it was inadequate (see Figure 17). As discussed previously, however, the adequacy of the number of computers and their availability were questionable, both from the point of view of computer users, and non-users (see Figures 12, 13, 14, and 15).

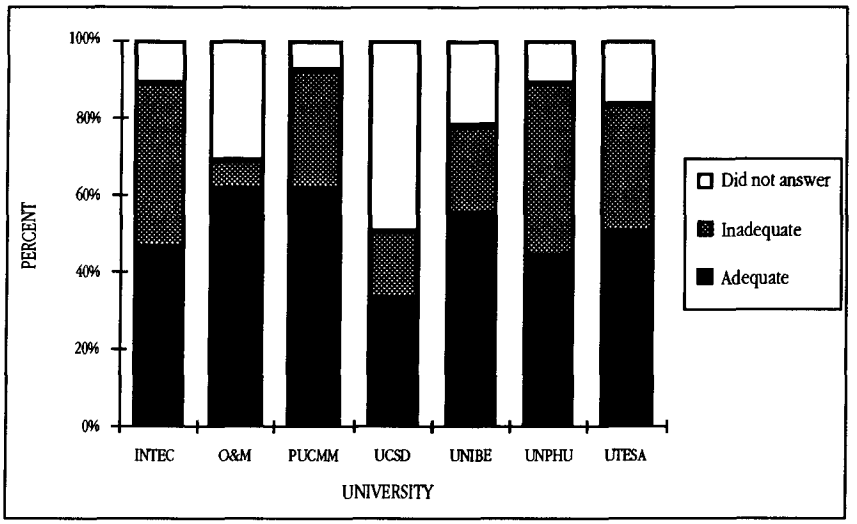


Figure 17. Percentage of users who said the location of computers was adequate.

Electrical power infrastructure. A major issue in the Dominican Republic is the deficiency of the country's electrical power infrastructure, which affects every aspect of Dominican life. Over the last three years, the quantity and quality of the energy supplied by the public power company has been so deficient that unpredictable voltage and multiple-hour blackouts have become a daily routine.

Since public energy supply is so untrustworthy, universities have been forced to become self-sufficient in electrical power generation. Six of the seven universities surveyed (INTEC, O&M, UTESA, UCSD, UNPHU, and PUCMM) currently own one or more power generators. The remaining university, UNIBE, is in the process of purchasing its own generator also. Most universities have additional protection for computing equipment in the form of different kinds of UPS (uninterruptible power supplies) and voltage regulators.

Interviewees from all universities said that the supply of electricity was good, but only because of the use of generators. It is common practice for Dominican universities to ration power consumption, because the public service is so poor that generators often have to run continuously. When asked about this subject, the following comments were common among interviewees:

1. Yes, it is mandatory to have a generator. We have three generators that supply power to the whole campus ... Although we do not have energy problems, we do have a policy of ration during periods of frequent blackouts. (Director of Administrative Computing Centre, INTEC)

2. The electricity [problem] has been a very influential factor, particularly on the laboratory hardware; that is, we have suffered a lot because of high or low voltages at a given time. Thank God we have the emergency generators that allow us to provide students with service during normal academic hours ... [Power-related problems] have cost me up to a month without adequate service for the students. (Director of Informatics, UNPHU)

Computer users were asked to rate the adequacy of the supply of electricity, and if it represented a problem while using computers at the university (questions 8-2, and 10-5, respectively). Non-users were asked if the lack of energy was a reason for not using computers (question 12-8). Overall, professors seem to agree with university officials in that the availability of electrical power is adequate at their universities. About 50% of the computer users rated the supply of energy as "adequate" or "very adequate"; 30% rated it as "inadequate" or "very inadequate"; and about 20% did not mark any answer for this question.

As shown in Figure 18, computer users from PUCMM seem to be the most satisfied with the supply of energy, followed by professors in INTEC, O&M, UNIBE, and UNPHU. Users from UTESA, however, rated the resource negatively. There was the unusually high rate of non-responses at UCSD described previously. Responses to question 10-5 (whether or not the lack of energy is a problem while using computers at the university) yielded percentages similar to those in Figure 18, and indicated that the majority of users in UCSD were also satisfied with the supply or energy.

Responses from the non-users indicated that the lack of energy was not considered a major impediment for using computers. Only about 20% of the non-users said that the lack of electricity was a reason for them not to use computers. However, the fact that universities have power generators does not ensure that universities are totally self-sufficient in that aspect. One of the interviewees explained:

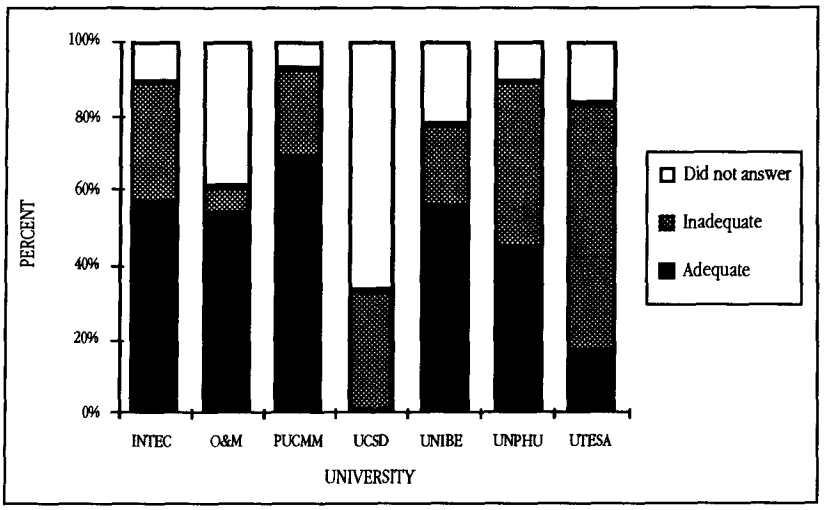


Figure 18. Percentage of users who said the supply of electricity was adequate.

> In previous instances we have had problems [with the supply of energy], but not because of the university, but because there was a fuel crisis in the Dominican Republic and we were unable to obtain sufficient fuel for the generators. (Director of Administrative Computing Centre, UNPHU)

The crisis this interviewee was referring to happened in summer of 1990, when the government was unable to come up with sufficient funds to purchase the necessary supply of crude oil to keep the country running. As a result, the country was brought to a stand-still, and even those institutions which had generators were not able to operate properly.

Human Resources

This study paid very close attention to the human element of educational computing, perhaps its most critical component. Several questions were included in both the interviews and the questionnaires to gather data about the availability and experience of the technical staff for computing. Universities' policies on training, support, and incentives to the user were examined, as well as professors' perception of the availability and quality of services and support received.

Training Issues

In general, computer training in Dominican universities is very limited; and at most universities there is no established mechanism to provide such a service, although the basic computing infrastructure needed is there. In most cases, administrative computing centres offered training to personnel for specific computer applications or for tasks they are required to perform. These training sessions, however, are very limited in scope, and usually serve the sole purpose of allowing individuals to learn how to use a specific menu-driven application in a terminal, or word-processing program in a microcomputer, and they do not provide the user with basic concepts of computers, or tools for them to build upon their new knowledge.

One exception to this rule is UNPHU, where the administrative computing centre provides regularly scheduled computer awareness seminars, in which basic concepts of computing are discussed, and end-user questions and concerns are answered. The Director of this computing centre explains:

> I feel that this has helped a lot, and has been very beneficial, because the attitudes of the users are different when they understand what a computing centre is ... We meet in an auditorium and hold seminars, and we allow them to ask questions and that allows us to teach the users, but it also allows us to draw conclusions as to what problems may exist that we do not know about. (Director of Administrative Computing Centre, UNPHU)

However, while administrative training is somewhat common, professor training is close to non-existent. Some universities provide training on demand to interested groups of individuals who request such a course. Others provide continuing education courses which professors can register in. The following comments are representative of interviewees' responses when asked what kind of computer training, if any, was provided for professors:

> 1. No, this has not been systematic ... we are thinking about offering courses and institutionalizing [computer training]; for example, the use of computers in general ... (Vide Rector, O&M)

2. Not officially. There is nothing official that says that a new professor is going to be given computer training. It is not like that. Here we offer continuing education courses and, in some cases, professors will register in courses that interest them ... On certain occasions we have prepared special courses for groups of professors ... but only because they asked for it. (Director Academic Computing Centre, UNIBE)

Of all the universities surveyed, only INTEC had a comprehensive, university-wide computer literacy course aimed at making professors aware of the computing resources available to them, and to encourage them to use computers across the curriculum:

> Recently, we designed a computer literacy project for professors. We are doing it so that professors use computers, because in the curriculum reform we have included as mandatory an emphasis on computers in all areas. For the students to become involved with computers, professors must also be involved, because otherwise professors do not encourage them [to use computers]. (Vice-rector, INTEC)

To find out more about how professors had learned about computers, several questions about professors' perception of the training offered at their university were included in the questionnaires (questions 4, 10-18, 12-3, 12-11, 16, 17, and 18). As shown in Figure 19, about 87% of the computer users

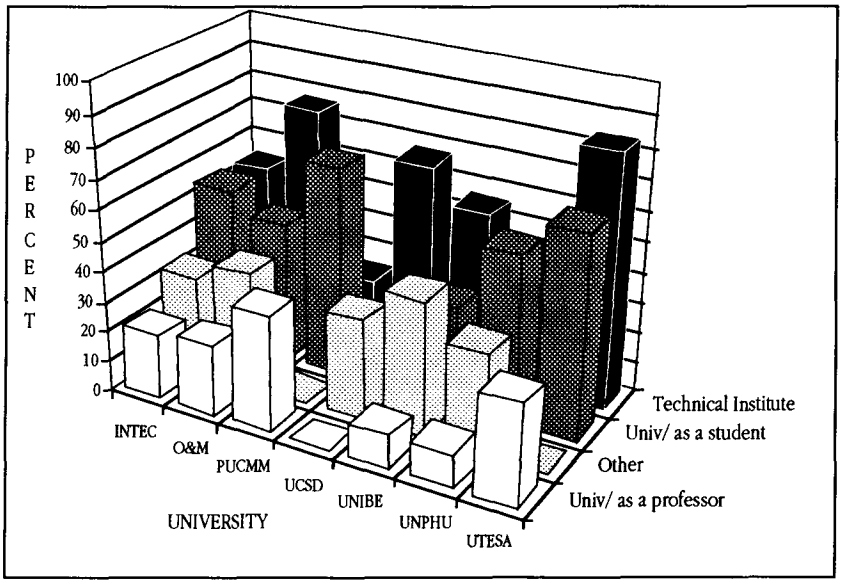


Figure 19. Percentage of computer users who obtained computer training by different means.

said they received some sort of training, but mostly as students or outside of the university. A minority of professors (21%) received training in courses taken as professors at their university. Overall, about 52% said they received training in a technical institution outside the university, and 51% of computer users said they received basic training as students.

Half of the computer users indicated that there were not enough training opportunities for professors (question 10-18). About 60% of non-users said that the support to learn how to use computers was nonexistent (question 12-3), or that there was not enough training opportunity for professors (question 12-11), or both. Figure 20 shows the percentage of professors who said that there was not enough training opportunity, by university.

This graph shows that users in PUCMM and INTEC seemed to be the most satisfied ones, but a large majority of non-users in these two universities were dissatisfied with their universities' efforts to train them. Professors in the other universities showed similar patterns of response.

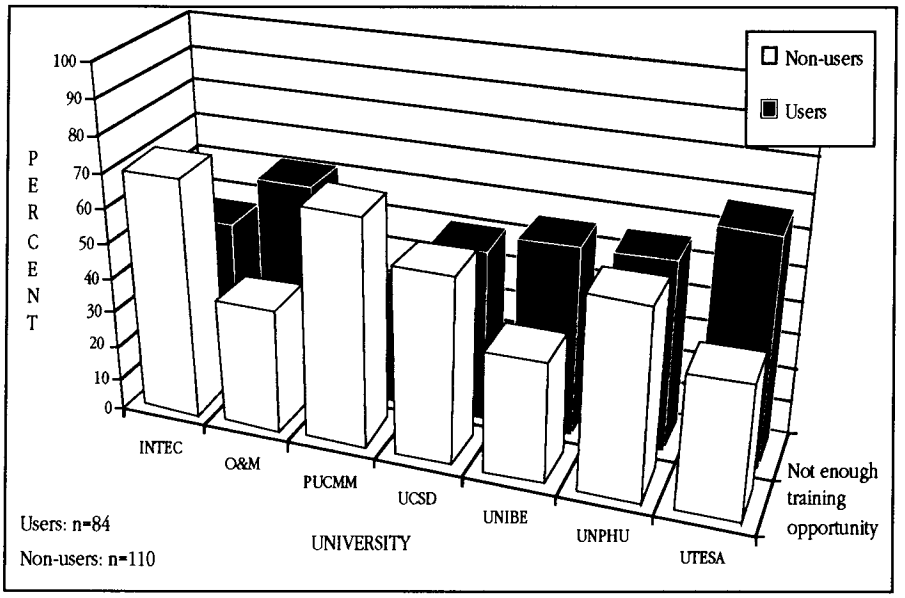


Figure 20. Percentage of professors who thought there was not enough training opportunity.

According to informants from each university, only INTEC, UNIBE, and UNPHU have offered their professors in-house training programs in computing exclusively for them. Professors in these universities were asked whether they had taken any of these courses, what they learned about, and how they would rate them (questions 16, 17, and 18).

Only 15% of professors indicated that they had participated in one of the training courses offered by their university, while 54% indicated that, although they knew that some courses were being offered, they had never participated in any of them. An interesting fact to point out is that 29% of the respondents said that no courses had been offered to them. This means either that the courses were offered to a specific group of professors and were not available to these, or that these professors simply did not know about these courses, pointing to a possible communication problem (see Figure 21).

From the three universities that had offered computer training courses for professors, those who took computer courses (this includes users and some non-users) were asked to indicate which topics they had learned about in these courses (question 17). Question 17 was divided into five content areas

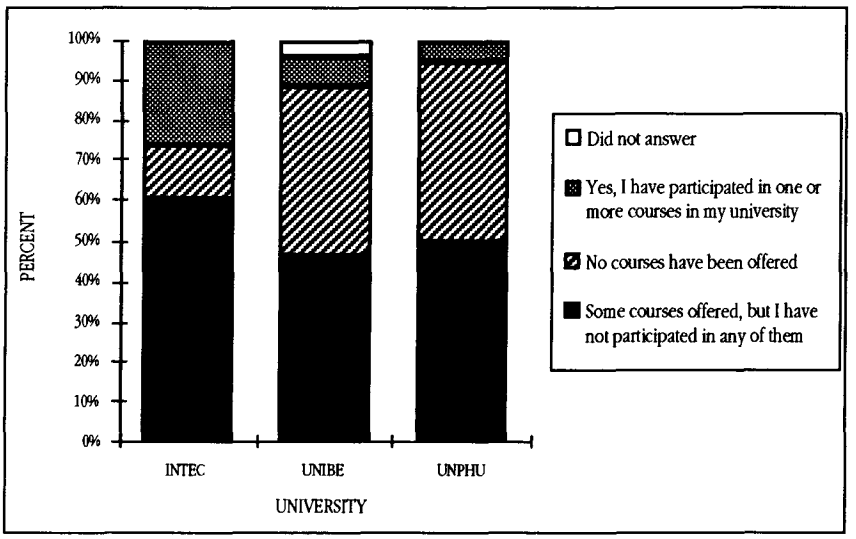


Figure 21. Percentage of professors who were aware of, and given training courses at their university.

into which most computer courses topics may fall: Computers and Society (4 topics), Applications (14 topics), Problem Analysis and Programming (5 topics), Hardware and Software Principles (3 topics), and Instructional and Pedagogical Issues (6 topics). Professors marked those topics which had been included in the courses they had taken.

Figure 22 shows the percentage of professors who selected each topic as having been taught in the courses they took. These courses put much more emphasis on history/importance of computing, programming, hardware and software principles, and certain popular applications, rather than on other aspects of computing which the literature suggests might be better-suited for professors. For example, very few professors received any kind of training in educational applications, educational use of typical applications, or pedagogical issues. In fact, topics under "pedagogical issues" were by far the least marked ones, as the figure suggests.

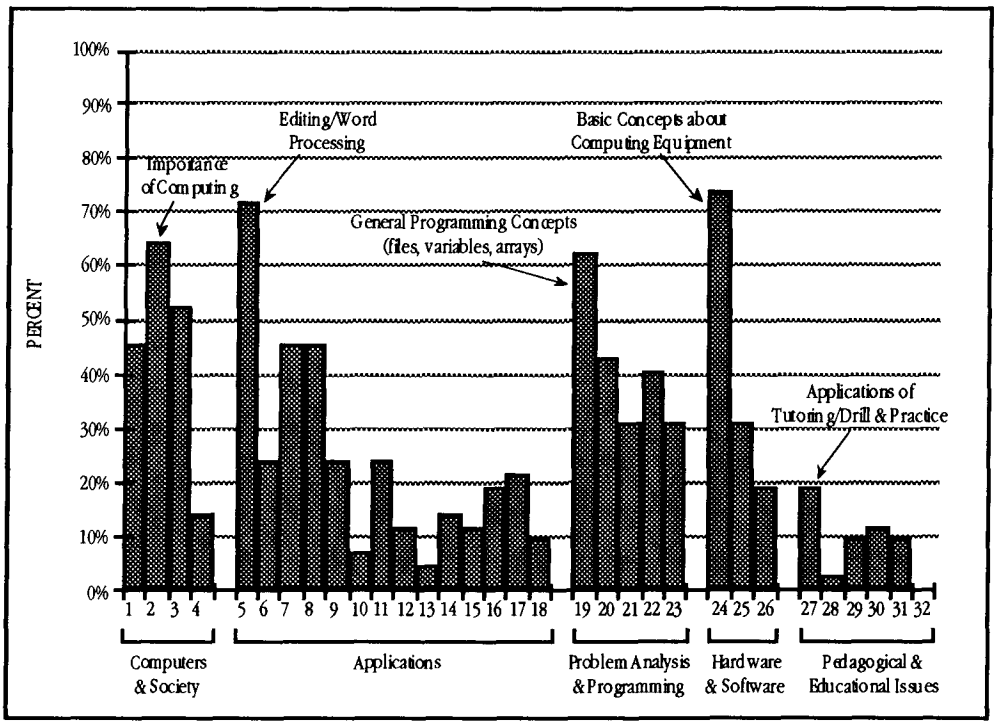


Figure 22. Percentage of professors who said these topics were taught in training courses.

Further examination of these responses from each university reveals that the pattern of responses was similar in all three universities. According to professors, INTEC concentrates its training in programming more than any other university. Of these three universities, UNPHU is the one whose courses included the most education-specific contents. Topics such as tutoring languages, educational/recreational games, as well as some instructional and pedagogical issues, appear to have been discussed more frequently in UNPHU's courses than in the other two universities, although not by a large margin.

Both users and non-users who took one or more of these training courses were asked to rate the overall quality of the courses, as well as their pedagogical and technical aspects (question 18). As shown in Figure 23, the most varied responses came from INTEC, perhaps because the actual number of responses was higher there (n=21) than in the other two universities (n=10, and n=8, respectively). Overall, most professors rated the courses as "Good", but 60% of professors from INTEC rated their courses as "Average" or lower, while about 80% of professors in the other two universities rated the courses as satisfactory.

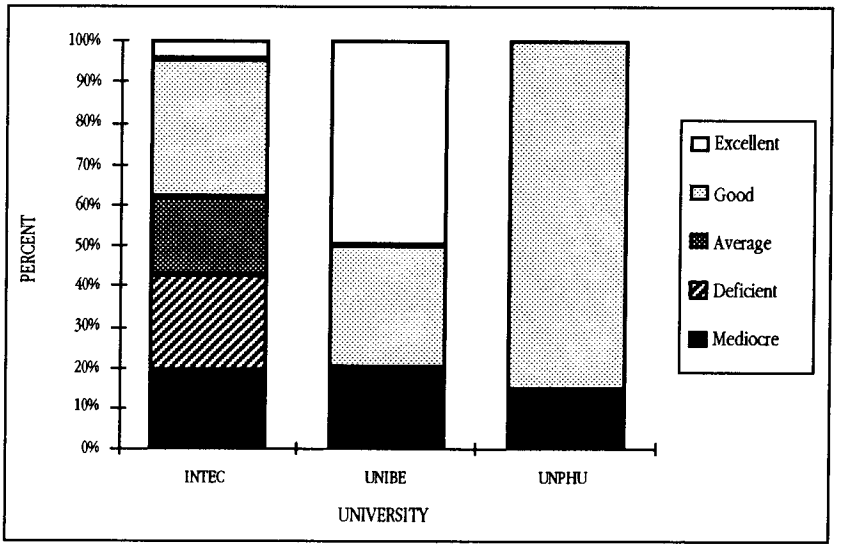


Figure 23. Professors rating of the training courses received in their university.

Support Staff

Some universities had personnel specifically assigned to provide assistance to computer users in their laboratories. The staff usually consisted of one person in charge of the laboratories, and one or more assistants. The person in charge generally held at least a technical degree in computer science or informatics from that university and, in some cases, was also a computer science professor. The assistants and monitors were usually advanced computer science students.

Although the availability and experience of the support staff was judged to be adequate by most interviewees, one interviewee expressed concern about the fact that the best candidates did not remain in the university because of the university's inability to pay as well as business. This condition not only affected professors or technical personnel, but students as well, as testified to by the following comments:

> 1. We are trying to reinforce our computing staff but, as you well know, the university cannot compete in salaries with the [business] market. But we are looking for a mechanism to compensate for the differential in salaries, and we are thinking very seriously to turning this computing centre into a professional services entity [for the public]. (Director of Administrative Computing Centre, INTEC)

> 2. The "monitores" (monitors) are advanced students who are selected by their own professors. These students attend classes and do not pay, and have a very small salary. They learn a lot, in fact, we have problems with that because these students do not last long. They learn all the software, all the tricks, and they quickly leave. (Vice-Rector, O&M)

Computer-using professors were asked to rate the adequacy of the availability of technical personnel in their university, as well as their experience (questions 8-5, and 8-6, respectively). As shown in Figure 24, less than half (44% overall) of the computer users were satisfied with the availability of technical personnel; professors in O&M appear to be the most satisfied ones with this resource. Figure 25 shows that computer users were only slightly more satisfied with the experience of the technical personnel that is available.

Computer users were also asked if the lack of technical support to operate or maintain the equipment was a problem they experienced while using computers at the university (question 10-16). Overall, the vast majority of computer users said this was not a problem, although a good percentage of professors from UNPHU and UTESA did mark this option (see Figure 26).

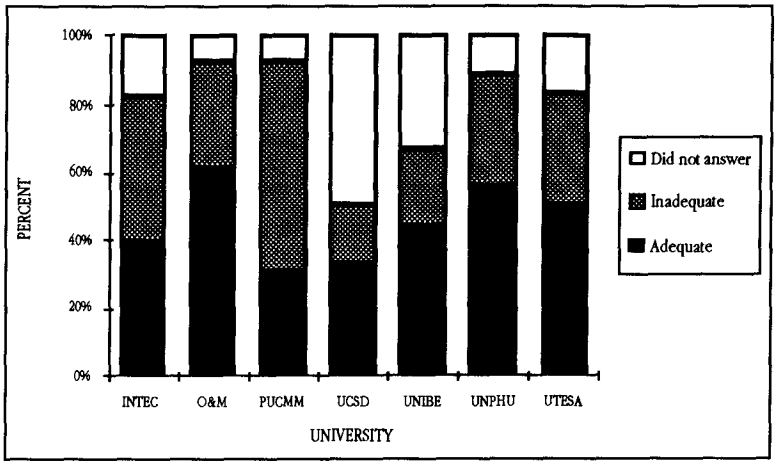


Figure 24. Percentage of users who said the availability of technical personnel was adequate.

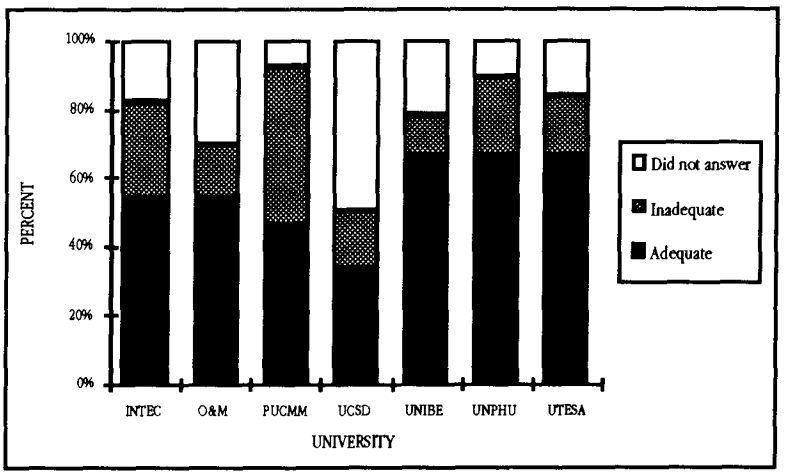


Figure 25. Percentage of users who said the experience of technical personnel was adequate.

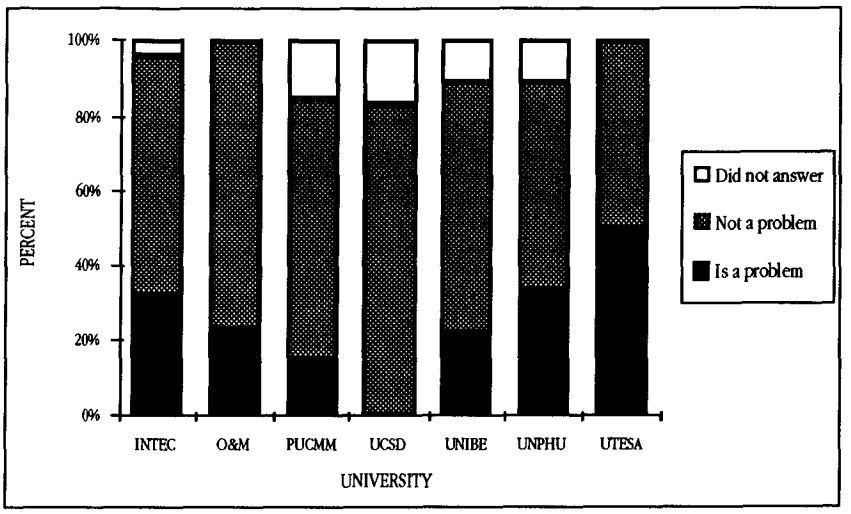


Figure 26. Percentage of professors who thought poor maintenance of equipment was a problem.

Logical Resources

Throughout this study, logical resources are factors that affect the development and use of computing technology in educational institutions, but are not inherent to the problems discussed in the previous two sections, although are closely related to them. Among those, the availability of information, language-related issues, and administrative support and motivation, play a very important role in the development of educational computing, and thus are examined in this section.

The questionnaires included questions for gathering data about information (questions 5, 8-7, 10-9), language (10-10, 11, 12-6), and administrative support (10-15, 12-9), while the interviews looked at these areas from the universities' point of view. Observation, informal inquiries, and the researcher's personal experiences helped put these data into context.

Availability of Information

Educational computing is a dynamic field where the distribution of information about new developments might be critical for the implementation and use of its related technologies. While training and even mere exposure to the field surely conveys some of this information to administrative personnel, students, and professors, these are not efficient information sources in Dominican universities for at least two major reasons. First, as reported previously, the availability of training is limited. Second, professors' exposure to computing technologies is even more limited. A review of information policies of the surveyed universities reveals that there is no established mechanism to distribute information about computing, let alone educational computing, among administrative personnel, students, or professors in any of the surveyed universities.

In most universities there is no way of distributing any information about computing; in others, such as INTEC, and UNIBE, the distribution of information is left to departmental newsletters, mostly limited to announcing the arrival of books to the library, or the discussion of computer science topics. Information on computing, or educational computing for that matter, is basically left to interested individuals to look for, but sources are limited. Not all universities have subscriptions to computing magazines, for example, and most of these are in English, making them even less useable. Testifying to these facts, computer-using professors indicated that they keep up-to-date in computing technology mainly through friends or colleagues, and magazines, while a very small number of professors said their university provided them with this information.

Figure 27 shows the percentages of computer-using professors who selected the different possible sources of information as being the ones they used to keep up-to-date (question 4). It is very clear that the main source of information for the professors is word of mouth (69% overall selected this option), followed by computer magazines (selected by 46%), and that the universities do not appear to provide

this information (9% overall selected this option). All response patterns were quite similar, except for UNPHU, where there was a very low response rate to this question.

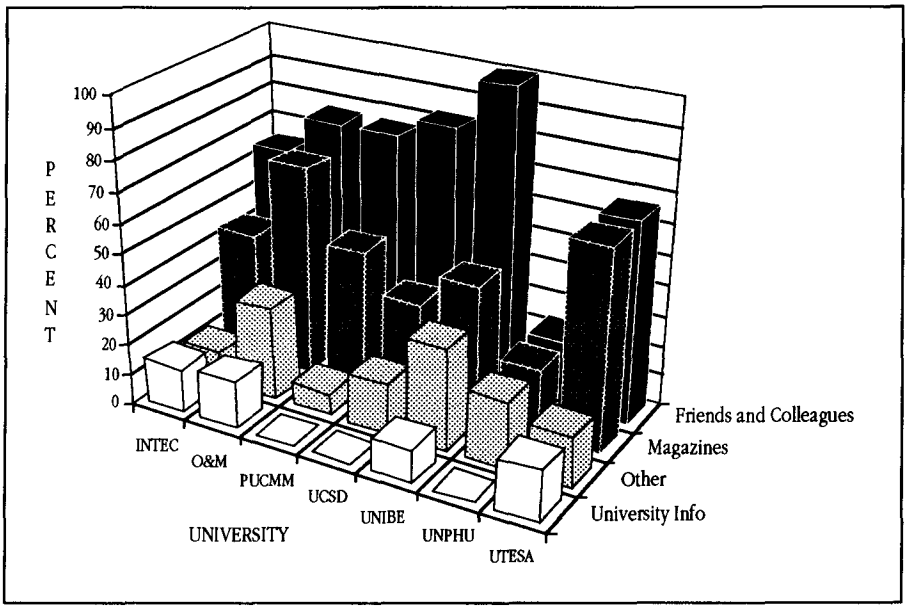


Figure 27. Sources of information for computer users who keep up-to-date in computing.

Computer users were also asked to rate the adequacy of the general information on computers as a resource available at their university (question 8-7). Figure 28 shows that computer-using professors were split in this issue. Overall, 39% of them said this resource was inadequate, while 38% said it was adequate (27% did not answer the question). Most users at INTEC, UNPHU, and UTESA who answered this question rated this resource as inadequate. The opposite was true for the other universities.

An interesting result pointed out previously also suggests that distribution of information within universities is deficient. About 29% of professors who answered question 16 (Figure 21) expressed that they did not know there had been computer courses available for professors, even though these courses had been offered by their universities. Further investigation suggests that the distribution of information is more efficient among computer users, and that non-users have less chance to get this information.

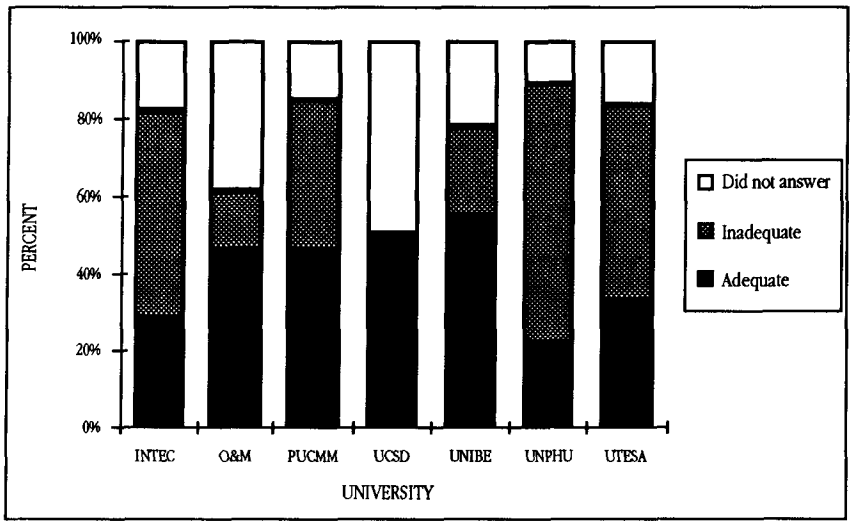


Figure 28. Percentage of professors who thought availability of information was adequate.

As an example, Figure 29 shows the absolute number of users and non-users that answered question 16, on the availability of training courses. It is evident that non-users are less aware of training courses being offered in their universities, since more non-users than users said that no courses had been offered to them in their universities.

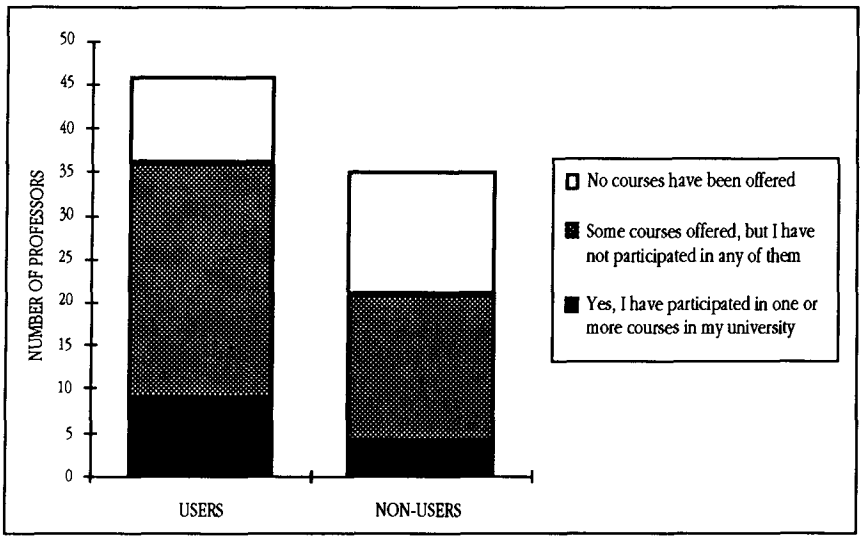


Figure 29. Number of users and non-users that were aware of, and participated in training courses.

Language Problems

One of the first problems that comes to mind when discussing the implementation and use of computing technologies in Latin America relates to the cultural aspects embedded within these technologies. One of these aspects is the fact that most new developments in all areas of educational computing take place in developed countries in languages other than Spanish.

The majority of software used in Dominican universities is available only in English, except for the administrative software that is developed in-house. Three-fourths of the computer users indicated that less than 10% of the applications they used were in Spanish, and about half of those said that none of the applications they used were in Spanish (see Figure 30).

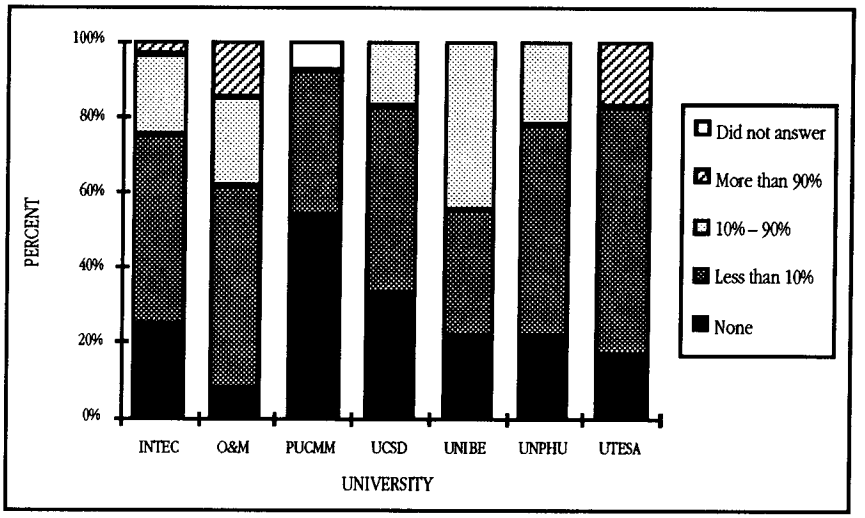


Figure 30. Percentage of the applications used by professors that are in Spanish.

Surprisingly, this did not seem to be a problem for professors. Computer users were asked if the fact that applications were in English was a problem they faced when using computers (question 10-10), and non-users were asked if this was a considered a reason for not using computers (question 6). Only

21% of computer users selected this as a problem, and only 5% of the non-users considered it a reason for not using computers.

Administrative Support and Motivation

A major factor in implementing a good educational computing program in a higher education institution is the level of support and motivation that the administration provides. In a sense, administrative support is a critical resource, as well as a provider of resources, such as those discussed throughout this chapter. According to the administrative interviews, all Dominican universities seem to support continuing computing developments, and most administrators interviewed expressed the importance that their universities place on computing, not only for administrative functions, but for educational purposes as well.

Administration support for computing in Dominican universities is most evident in the form of efforts to improve their physical computing infrastructure within their modest economic conditions. Other components of educational computing, however, seem to have been seriously neglected. For example, with the possible exception of INTEC, educational computing support efforts in the form of established training policies, or educational programs for professors, and personnel are not evident in Dominican universities, despite an obvious need for training that is recognized by some of the interviewees, and evidence that such programs can be highly beneficial:

> 1. It is not going to be enough that they [students] take an "Introduction to informatics" course ... For the students to become involved with computers, professors must also be involved. (Vice-rector, INTEC)

> 2. I still think that professors need to be taught more about how much they can gain through the use of computers, regardless of the area they are in. (Director of informatics, UNPHU)

> 3. I feel that this [computer education seminars] has helped a lot, and has been very beneficial, because the attitudes of the users are different when they understand what a computing centre is. (Director of Administrative Computing Centre, UNPHU)

Other sources of motivation have worked somewhat better. Most universities either have, or were planning to implement programs that allowed professors to purchase computing equipment with financial support to pay for them through the university, taking advantage of import duty exemptions that the government provides for educational computing equipment. Such plans have met with mixed success at different universities, and are at risk of disappearing, as the Vice-rector of O&M explains:

> Universities, by law, are exempted [from import duties] when importing certain equipment. Right now, since six months ago, these privileges have been revoked. Universities are paying import duties like everyone else who wants to import computing equipment.

A number of questions about motivational aspects were included in the questionnaires, to get a perspective about what professors thought about the support available at their university. Computer users were asked if the following were problems with computing at their university: "There is not enough administrative support", "There is not enough financial support", There is not enough interest on the part of professors", and "There is not enough interest on the part of students" (questions 10-19 through 10-22).

As Figure 31 shows, a major concern in most universities was the lack of financial support, which is a predominant problem in the Dominican Republic, and particularly so in crowded and under-budgeted educational institutions, such as UTESA. Overall, 46% of the computer users selected this problem, while 39% said there was not enough administrative support, and 36% said that there was not enough time to learn about computing. This does not mean that there was a consensus as to what the major problems are, however. Different options were selected more frequently than others in different universities. For example, professors from O&M selected the "Not enough time to learn about computing" option more often, professors from UNIBE selected the "Not enough professor interest" more often, and professors from UNPHU selected the "Not enough administrative support" more frequently than any other.

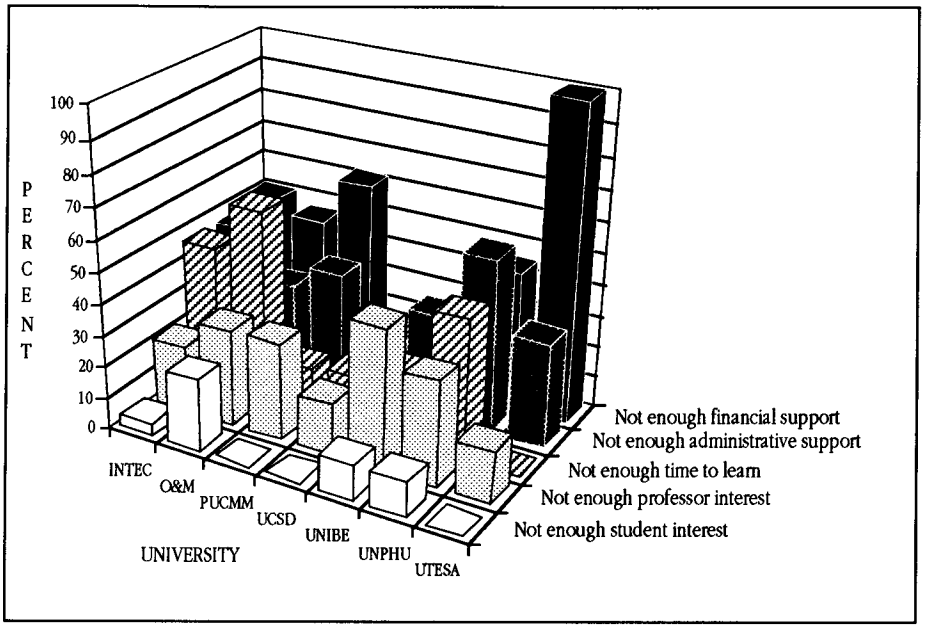


Figure 31. Percentage of computes users who experienced administrative/organizational problems.

Non-users were asked whether the following were reasons for not using computers: "I do not have time to learn about computers", "I am not interested in learning how to use computers", "There is insufficient guidance/experience to help professors use computers", "There is not enough administrative support", and "There is not enough financial support" (see Figure 32).

Overall, the number of non-users who selected these reasons for not using computers was moderate, averaging 31 out of 110 (not taking into account the expected low frequency of selection of the "Not interested in learning about computers" option). Non-users selected more frequently the "I do not have time to learn about computers" (34%), and both the lack of financial support, and the lack of guidance/experience to help professors use computers (32% for both).

Again, professors in different universities answered differently, although it is difficult to identify any specific response pattern. The major concern in INTEC, UCSD, and UNPHU, seemed to be the lack of financial support. Professors in O&M, UTESA, and to a lesser extent, UNIBE, seemed to be more concerned

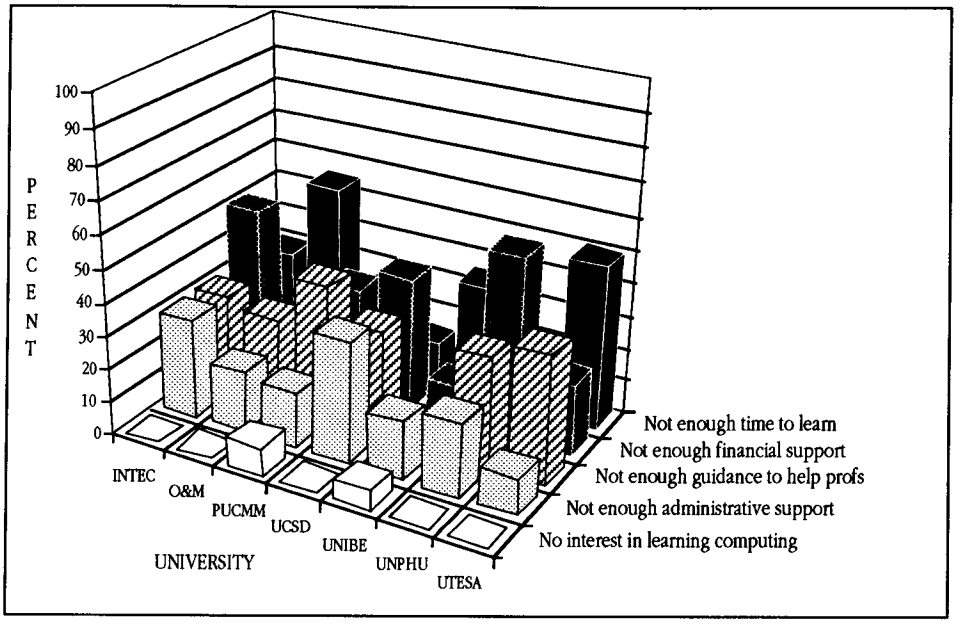


Figure 32. Percentage of non-users who thought these were reasons for not using computers.

about the limited time available for learning about computers; and professors from PUCMM, UNPHU, and UTESA expressed concern about the lack of guidance and experience to help professors use computers. One point that can be made is that those universities with the greater number of students (and the largest student to teacher ratio) were those in which more professors thought lack of time was a reason for not being able to learn about computers.

The Use of Computers in Dominican Universities

One important aspect of educational computing that this study is concerned with is the actual use of computers in Dominican universities. Like the previous section, this one is divided into two sub-sections that address the major aspects of the use of computers in universities: the roles of computers in higher education, and attitudes toward computers. First, there is extensive literature on the subject of roles of computers in higher education, and it is of interest to see to what extent these definitions apply to

Dominican universities, by examining the reported use of computers by administrative personnel and professors. Second, an analysis of the attitudes toward computing may provide some insight into why computers are used the way they are in Dominican universities.

The Roles of Computers in Dominican Universities

According to the analysis of the literature presented in Chapter 2, computers play three distinct roles in educational institutions, in the areas of information, instruction, and productivity. This section examines these three aspects of the use of computers in Dominican universities through the data gathered from the interviews and questionnaires. Then, a more detailed analysis of the applications used by Dominican professors is presented.

Use of Computers for Information Management

There are several uses of computers that fall into the category of information management: the use of computers for administrative services, support for research and library systems, and the use of electronic mail throughout campus. The literature suggests that computers are usually introduced first in higher education institutions for information management purposes, and Dominican universities appear to be no exception. While the greatest use of computers in Dominican universities was found to be in the area of management of information, most of this use was concentrated on administrative systems, while the use of computers in other areas of information management was very limited.

All universities surveyed used computers for the management of administrative information, such as student registration, accounting, and payroll. Administrative computing in these universities is mostly a centralized process, however, where administrative departments send their data to the computing centre (either manually or via terminals) where the data are processed. A few administrative tasks were handled independently by some departments in PUCMM, INTEC, and UNIBE, using microcomputers. As

an example, the uses of computers for administrative tasks in INTEC was described by its Vice-rector as follows:

> The services offered by the Computing Centre are vital for the control of academic systems. All academic control of the students is done by the Computing Centre, although the Registration Department does not entrust everything to them. The current trend is to decentralize. All accounting, for example, is to be done by the Accounting Department, with advice from the Computing Centre....Here in the Rector's Office, we have our own PCs, and we do our own work with them.

The use of computers for the support of research activities was explicitly reported only at INTEC and PUCMM, as part of the major functions of the computing centre. In both cases, the computing centre provided data entry services as well as data processing services to interested parties. The access to these services, however, was mostly limited to specific departments, or projects, and it was not readily available for students or professors, for example. Also, only one university (INTEC) reported using computers to assist in the management of library information, although other universities also seemed interested in this use of computers. The lack of support for research activities is probably part of a major problem that this area is facing in the Dominican Republic and Latin America, and that was described in Chapter 2. The Vice-Rector of O&M explains:

> In our country, the aspect of research in universities is something that has been talked about a lot. This area does not have the prominence that it should have, mainly because of the lack or economic resources, something all institutions of this kind suffer from, since we are not in a position that we can say we have a budget of so many millions [of pesos] to dedicate to research; we are not in such a position, not O&M, nor any other university in the country.

The use of electronic mail was not implemented in any of the universities at any level, except for rare cases in which some departments or educational projects had access to international electronic mail services. This is the case despite the fact that five out of the seven universities in this study had the inherent capability of electronic mail in their (UNIX) systems. The real reasons why electronic mail is not

implemented in these universities are unknown, but two possibilities come to mind. First, the fact that administrative computer systems are, in many cases, physically centralized (i.e. computers and terminals are located within one or two rooms), rendering electronic mail useless since the computing power is not really in the hands of administrative personnel, but computer operators. Second, there is reason to believe that computer users are simply not educated about the benefits of electronic mail (only 8 professors reported receiving any instruction about telecommunication, electronic mail, and computer networking).

Use of Computers for Instruction

There are two major aspects of the instructional use of computers which can been identified: the use of computers for instruction (or instruction with computers), and instruction about computers. Dominican universities have been using computers to teach about computers ever since computers were first introduced to them. However, there appears to be almost no knowledge about how to use computers as an instructional tool in subjects other than computer literacy.

A major point about computers and instruction that became evident through the interviews, and throughout the development of this study, is that the use of computers in Dominican universities was highly, if not uniquely, tied to the field of computer science. All universities in this study offered a computer science program, and the use of computers for instructional purposes was, in most cases, limited only to this field.

Instruction with computers. There are different ways in which computers can be used for teaching, some of which were mentioned in Chapter 2. Among those, for example, computer software can be used in the classroom to teach certain concepts in many subjects, and to help students visualize certain physics or chemistry concepts with the help of graphics and animation. In other cases, computers can be used as tools that help professors deliver the instructional material, such as when used with

projection devices. Computers can also help with classroom management tasks, such as keeping grades and preparing exams.

In Dominican universities, the use of computers in this manner was found to be practically unknown. Computer use was mostly limited to the fields of computer science, and engineering, in which case the computer was not being used as a tool for instruction, but rather as the subject of instruction (this kind of use is discussed in the next section).

In some instances, computers were used outside the computer science field, as electronic tools for teaching specific courses; such was the case for the field of architecture, where computer-aided design (CAD) programs were taught to students, or in accounting, where some professors taught students how to use some off-the-shelf accounting package. However, since for most students in these areas, this was their first, and possibly only exposure to computers, a good portion of these courses was dedicated to teaching students how to use the computer, or specific characteristics of the application programs they would use.

Only INTEC had plans to implement a computer-aided instruction (CAI) program with the establishment of a CAI laboratory, and the acquisition, or development of CAI software:

> There are plans ... [to set up] a computer-aided instruction laboratory, with CAI applications. Right now there is nothing in relation to tools of that kind....Those kinds of [software] packages do not exist here....There are plans to develop such software. (Director of Computing Centre, INTEC).

Computer users in all universities were asked to mark whether or not the following were problems that they experienced when using computers for the classroom: "There is not enough help to supervise students who use computers", "There are problems when trying to integrate computers to the curriculum", "Professors lack the necessary knowledge to use computers for educational purposes", "There is insufficient guidance/experience to help professors use computers".

As Figure 33 suggests, the most frequently selected problems were the lack of guidance to help professors use computers (48% overall), and professors' lack of knowledge about how to use computers for educational purposes (45% overall). Professors from INTEC, UNIBE, UNPHU, and UTESA felt the strongest about the first one, while professors from PUCMM selected the latter more often. The problem that was selected the least was related to the integration of computers to the curriculum (26% overall). This is interesting, since half of the professors who selected this option as a problem were from INTEC. In fact, many professors from INTEC found that all of these were problems they experienced with the use of computers for the classroom. The reason for this might well be that INTEC is the only university currently implementing a university-wide computer-usage program, in which professors are being strongly encouraged to integrate computers in all areas of study. Thus, professors in INTEC are apparently experiencing problems that professors in other universities are not, possibly because of a lack of exposure to computers.

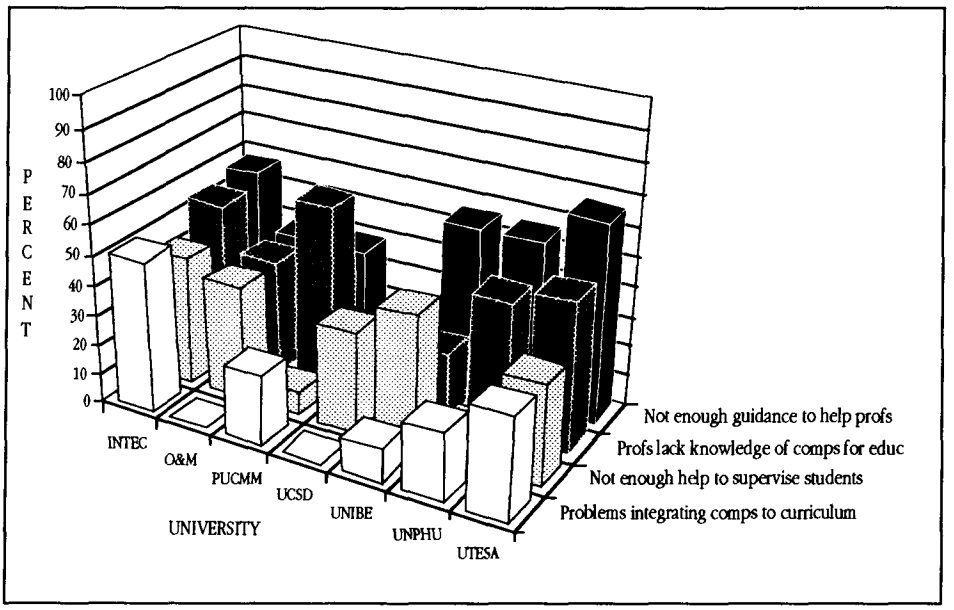


Figure 33. Percentage of computes users who experienced problems using computers for instruction.

Instruction about computers. Of the two types of uses of computers for instructional purposes, instruction about computers was by far the most popular in Dominican universities. As was evident from the analysis of the organization of computing services reported previously in this chapter, all universities had laboratories for the use of computer science students. These laboratories were also used in some instances to teach computer literacy to other students, professors, and administrative personnel.

As mentioned in the introduction to this section, the use of computers for instruction in the Dominican Republic appeared to be uniquely tied to the area of computer science. For example, when discussing the role of computing in the university, the Vice-rector of INTEC explained: "We also have a computer laboratory because we have the career of computer science." The director of the educational computing centre at O&M also confirmed that use of the computing resources was restricted almost exclusively by computer science students. Computer laboratories in all universities were used by these students mainly for programming courses, (such as BASIC, RPG, COBOL, PASCAL, or C) or to learn a specific software package (such as Lotus 1-2-3, dbase, Oracle, etc.), and to practice the concepts taught in more advanced courses.

On the other hand, the use of computers by students of fields other than computer science, although limited, has been slowly expanding. All universities have been implementing computer literacy courses for all students over the last few years, or at least offered computer education courses through their continuing education programs. The Administrative Vice-rector or PUCMM, for example, said that the current trend was to view the computer as a useful "tool", in all areas of specialization. Other interviewees agreed with this view:

> 1. In this country, and in this university, we use computers for instruction specifically in the area of informatics. I am personally trying to motivate a project to use computers in other areas, not only in heath sciences or informatics. (Vice-rector, UTESA)

2. O&M has as a priority to develop the area of computer science, in the academic area, in research, as well as in instruction—meaning continued education, in this case. We think that it is very important to develop the field [of computer science], not only for computer science students, but for all areas of study because we think that [computers] are a very useful tool for any activity. (Vice-rector, O&M)

3. In general, we have students from Hotelería [Hotel Management/Tourism], Banca [Commerce/Banking], and Law, who take an "Introduction to the computer" course, where they use computers, but oriented toward their need; for example, law students learn text processing, banking students learn spreadsheets, and so on. (Director, Educational Computing Centre, UCSD)

As it currently stands, however, most of these courses concentrate on teaching how to use a specific type of computer, or software package. Experience shows that these courses are also of a highly technical nature, covering many hardware aspects, and dedicating a lot of time to operating system commands, usually MS-DOS. Most universities offered continuing education programs for professors, and for the general public. A unique case is this respect is that of PUCMM, which created a semi-independent institution called Centro de Estudios y Servicios Empresariales/CESYSE (Centre for Business Studies and Services), through which many kinds of computer literacy courses were offered.

Use of Computers for Productivity

The data gathered about the use of applications by professors—reported in the next section—gives an indication that the use of application software by Dominican professors followed the same pattern as reported by others in the literature, that is, the use of applications such as word processing, spreadsheets, and database managers, was quite common. These data do not show, however, how these applications were being used, other than whether they were used for personal or educational matters. Even so, the data on the information and instructional uses of computers reported previously, as well as informal observations made in the universities, suggest that applications such as word processors,

spreadsheets, and graphics, were mostly used for productivity purposes (office work), while databases, statistics programs, and programming languages were mostly used as tools for supporting the information or instructional aspects of higher education computing.

The use of computers for personal productivity seemed to be limited mostly by the lack of availability of computers, rather than lack of understanding of the benefits of off-the-shelf software for personal productivity. Most universities have personal computers for secretarial and, in some cases, executive use, but in very limited numbers. For example, INTEC reported having "one or two" personal computers in each of their four academic faculties, as well as four other personal computers in administrative departments; there was no report of this kind of use of personal computers in UTESA; other universities reported relatively more availability of computers throughout administrative and academic departments.

It is obvious that economic constraints affect this use of computers significantly, since universities seemed to attach more importance to the use of computers for information, and instruction, than to the use of them as tools to enhance the productivity of any one individual. For example, the Administrative Vice-rector of PUCMM indicated that the priority areas of investment in computing were, in order: big computing systems (multiuser hosts), microcomputers laboratories (more powerful, and efficient microcomputers), computer terminals, the acquisition of application software, the acquisition of productivity tools (software/hardware), and computers for individual classes.

Professors Uses of Computers

Item 7 in the questionnaire presented a list of applications that might be used by professors in an educational setting. Professors were asked to indicate whether or not they used each application, how frequently they used them, as well as whether they used these applications for personal matters, educational matters, or both.

Overall, the use of applications by Dominican professors seemed to conform to what the litera-

ture shows as the norm. The use of word processing applications was by far the most popular use of computers, followed by spreadsheets, graphics, and database managers (see Figure 34). Overall, about 83% of professors indicated that they used word processing applications, 64% said they used spreadsheets, 56% used databases and graphics applications, and 50% used the BASIC programming language. The rest of the applications were used by fewer than half of the professors.

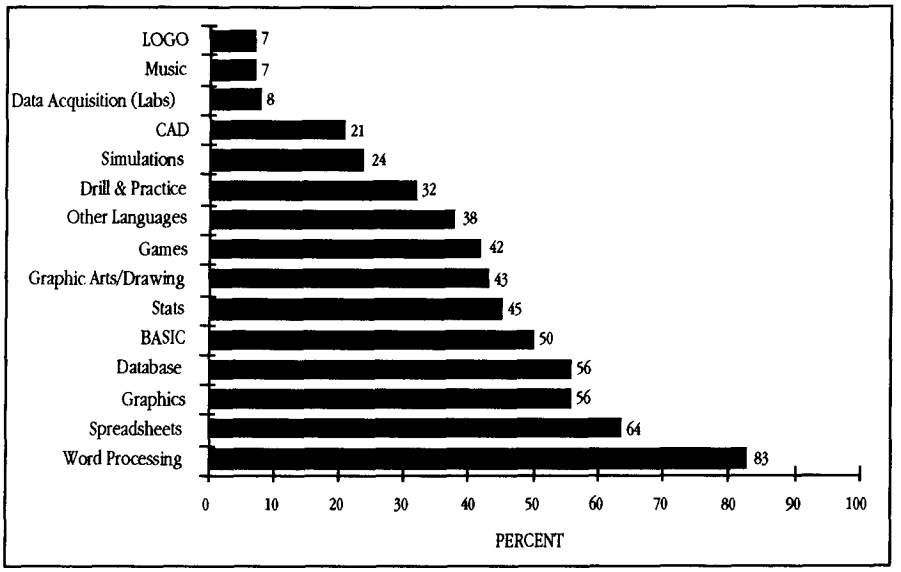


Figure 34. Percentage of professors who use each kind of computer application.

A surprising result here is that the use of the BASIC programming language seemed to be very popular, since half of the professors indicated they used this application. Some possible explanations for this are that the use of BASIC is reminiscent of the kind of technical training that seemed most popular in the country, that BASIC has always had the reputation for being the easiest programming language to learn, and that most microcomputers come with some version of BASIC for the novice to use.

The data about the number of professors who said they used specific applications do not yield sufficient information about how much these applications are actually being used. For this reason,

professors were asked to indicate how often they used each application, by marking whether they used them "Rarely", "Sometimes", "Often", or "Always" ("Never" means that they did not use this application).

Again, word processing, spreadsheets, graphics, and databases were ranked as the most frequently used applications. As Figure 35 reveals, however, that the use of "other languages" (such as COBOL, RPG, PASCAL, or C) and the use of drill and practice applications are, in fact, used more frequently than are BASIC, statistical packages, graphic arts/drawing, and games.

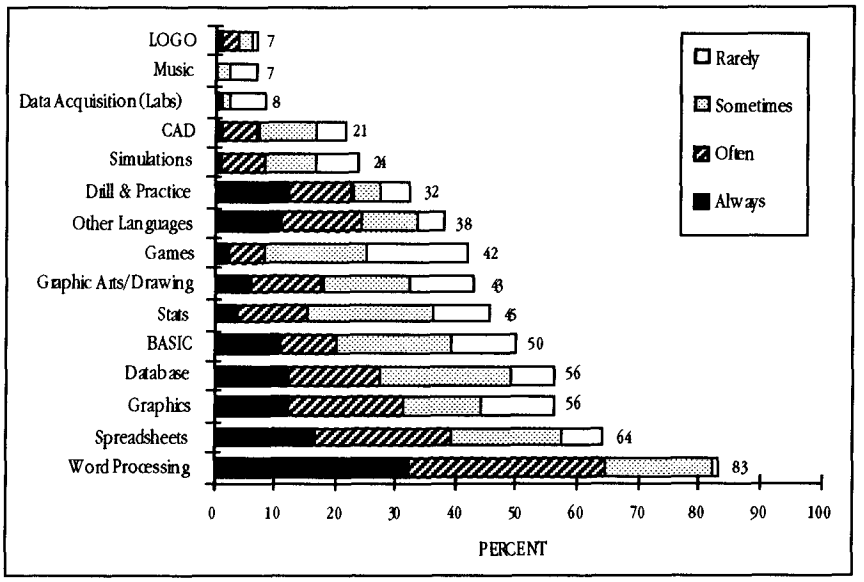


Figure 35. Frequency with which professors who use each kind of computer application.

The obvious explanation for the more frequent use of other languages, and drill and practice programs is that these are the kind of packages that were used for teaching programming and other computer-related subjects to computer computer science and engineering students, as well as students from other fields. Thus, professors who used these packages probably used them in computer courses on a daily basis.

Further examination of the responses to this question reveals that professors used these applications, in general, mostly for personal use, or for both personal and educational matters. As shown in Figure 36, except for word processing, spreadsheets, other languages, and drill and practice applications, professors main use of applications was personal.

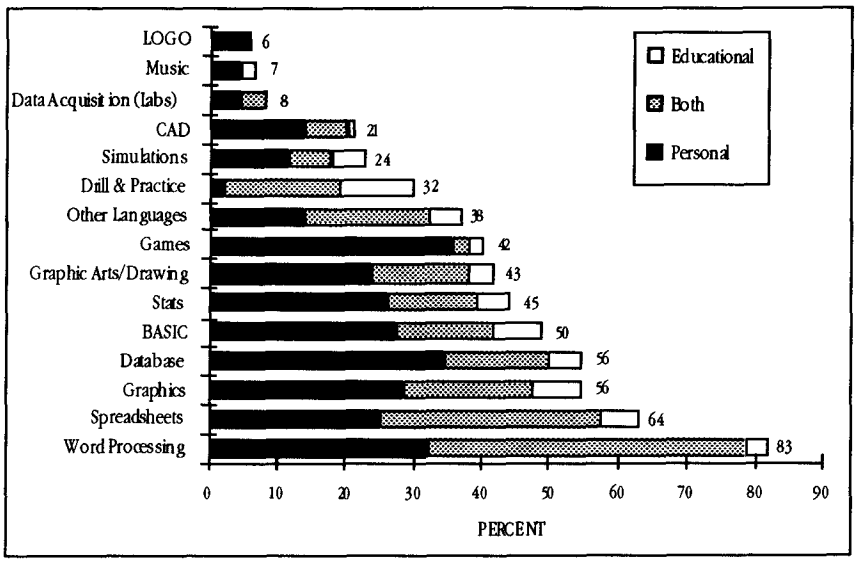


Figure 36. Percentage of professors who use applications for personal, educational use, or both.

For most applications, a good number of professors indicated that they used these applications both for personal, as well as educational purposes. The use of computers for purely educational purposes was rare, except in cases where the use of applications for other personal purposes makes little sense, such as in the case of the "drill and practice" applications.

Professors' Attitudes toward Computers

The scale used to measure professors' attitudes toward computers was a subset of a computer attitude scale developed by Brenda Loyd, of the University of Virginia (Loyd, 1986). The original scale

consisted of forty items, divided into four sub-scales: computer confidence, anxiety, liking, and usefulness.

Since the study of professors' attitudes toward computers is but a small part of this study, it was decided that a subset of the original scale was to be used, so a total of twelve items were extracted from it, three from each one of the sub-scales. An analysis of the reliability of the items in the new scale was conducted to ensure that the stability of the test was not significantly affected by the reduced number of items, or translation of these from English to Spanish.

Table 5

Reliability of the modified computer attitude scale (LERTAP output).

LERTAP 2.0 TOTAL TEST STATISTICS

TEST No. 1 Professors' Attitudes Toward Learning and Working with Computers

Number of individuals	= 194.00	Number of items	= 12.00
Mean	= 40.55	Highest score	= 48.00
Standard deviation	= 8.20	Lowest score	= 0.00

Source of variance	D.F.	S.S.	M.S.
Individuals	193.00	1081.50	5.60
Items	11.00	154.71	14.06
Residual	2123.00	913.63	0.43
Total	2327.00	2149.85	0.92

Hoyt estimate of reliability	= 0.92
Standard error of measurement	= 2.18
No. Subtests with non-zero wt	= 4.00
Cronbach's α for composite	= 0.92

As Table 5 shows, the attitude test was found to be highly reliable, with a Hoyt estimate of reliability of 0.92. Additionally, a principal components factor analysis was performed on this scale to investigate its dimensionality, threatened by the small number of items selected for each sub-scale. The analysis produced a one factor solution using the rule of eigenvalues greater than one.

These results (see Table 6) show that this scale is, in fact, unidimensional with a large proportion of the variance accounted for by a single factor. Because of this, the analysis of the four sub-scales was dropped, and professors attitudes were examined only through the total scale score.

Table 6

Principal components factorial analysis results (SYSTAT output).

SYSTAT 5.1 PRINCIPAL COMPONENTS ANALYSIS				
LATENT ROOTS (EIGENVALUES)				
	1	2	3	4
	2.681	0.518	0.425	0.376
COMPONENT LOADINGS				
	1	2	3	4
Confidence Subscale	0.829	0.265	0.350	0.347
Liking Subscale	0.830	-0.127	-0.492	0.231
Anxiety Subscale	0.824	0.377	-0.080	-0.414
Usefulness Subscale	0.791	-0.538	0.233	-0.174
VARIANCE EXPLAINED BY COMPONENTS				
	1	2	3	4
	2.681	0.518	0.425	0.376
PERCENT OF TOTAL VARIANCE EXPLAINED				
	1	2	3	4
	67.034	12.951	10.620	9.395

Professors' responses to the modified computer attitude scale (question 13) were coded and scored appropriately (Loyd, personal communication, December 18, 1990). Higher scores mean more positive attitudes toward learning and working with computers. Professors' attitude toward computers appear to be very high, with a total mean score of 29 points, out of a possible maximum of 36 points.

Scores across universities were fairly consistent, with the least positive total scores (average of 27.7 to 29.4) found in UTESA, O&M, UCSD, and UNPHU, and the highest (average of 31.0 to 31.4) in PUCMM, UNIBE,

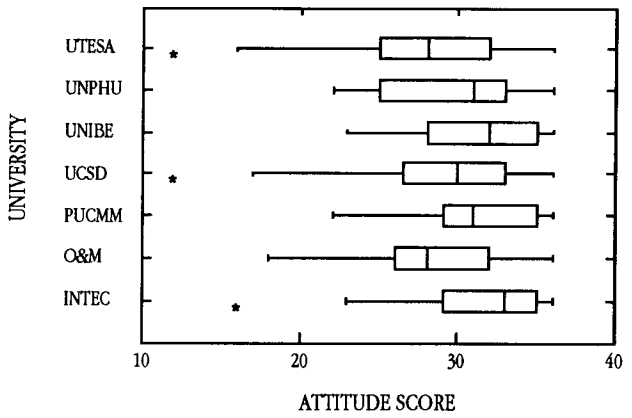


Figure 37. Distribution of professors' attitudes toward computers across universities.

and INTEC, in that order. As illustrated in the boxplot in Figure 37, the ranges of scores is relatively wide, particularly in UTESA, UCSD, and O&M.

This highly positive attitude toward the use of computers was evident during the interviews, and also in the questionnaires. Professors' answers to question 23 in their questionnaire (reported later in this section) show that professors—users and non-users alike—hold high regard for all aspects of computing, and that they feel more should be done to give them access to computing. Attitudes of users and non-users show an unexpectedly small difference, and many non-users show attitude scores as high as those of computer users (see Figure 38).

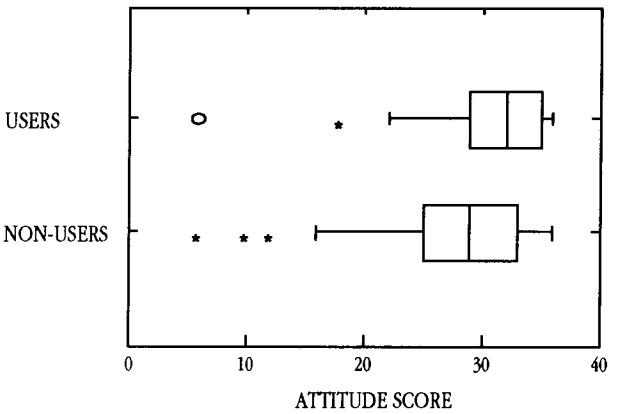


Figure 38. Distribution of attitudes toward computers for computer users and non-users.

Figure 39 suggests the same is true for all universities. In fact, with the exception of UTESA, and UNIBE, attitudes of non-users are almost equal to those of users, with the only difference that non-users show greater range of scores.

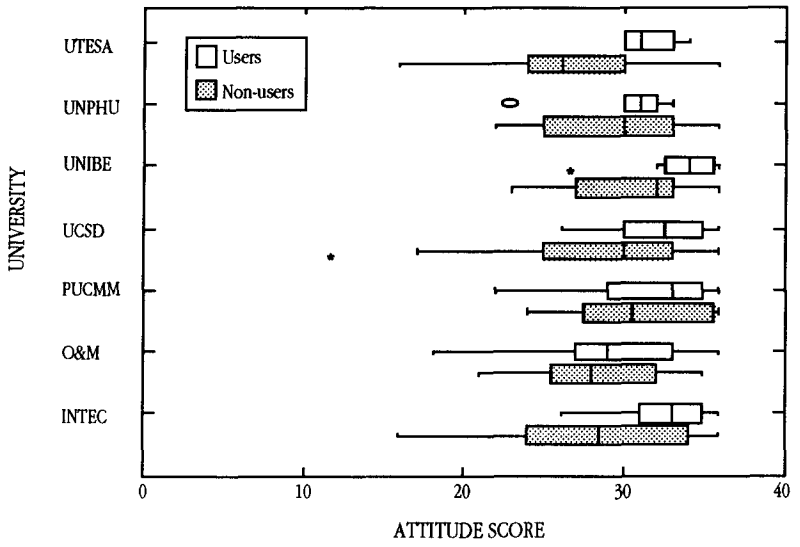


Figure 39. Distribution of professors' attitudes toward computers across universities.

Question 23 in the questionnaire was an open-ended "comment" space, in which professors were encouraged to comment about any aspect of the study, or educational computing in general. Surprisingly, about 26% of professors wrote some kind of comment, mostly about computing technology, its importance, and many of the problems that educational computing faces in the Dominican Republic.

The different responses to question 23 were coded and tabulated. By far the most common comment had to do with the importance of computing. Other comments related to how computers should be integrated into classrooms, and the need for information, training, and of providing professors with access to computing technology. Also, professors pointed to different current or potential problems of integrating computing into education, such as cost, deficient electrical infrastructure of the country, and de-humanization of the teaching-learning process.

Some of the comments were chosen to exemplify the kind of attitude these professors presented toward computing, as well as some of the problems the appeared concerned about:

1. It is interesting that the use of computers reaches education, but only as a valuable medium (which it is) and not as a substitute of the professor, because the professor-student relationship is of vital importance in the teaching-learning process.

2. The use of computers in education (like any other type of advanced technology) is very limited because of its cost. I think the use of computers in education would be a great advancement on our educational system.

3. Universities should offer courses on pedagogical uses of informatics. The majority of courses that are available in and out of the country are too expensive for professors to pay for.

4. Computers constitute a valuable tool in the learning process. It allows the student to concentrate in the use of different techniques, rather than the calculation process.

Overall, professors comments appear to confirm many of the issues discussed throughout this study. One computer science professor with experience from different universities, enumerated some of the different problems professors face with the following remarks, among others:

1. Dominican universities do not have a policy of dedicating resources and efforts to training their teaching staff or it is simply not obvious if this is so. The universities in which I have worked [three different ones] do not offer training courses to their teaching staff.

2. Magazines are expensive, salaries are low. That forces professors into a situation where they cannot keep up to date with developed countries' technology and markets.

3. [Computing resources mentioned in question 8] are usually adequate for the students, but not so for professors.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

The main goal of this study was to describe and assess the current status of educational computing in higher education in the Dominican Republic. To achieve this goal, a survey was conducted among administrative and technical personnel, as well as professors from seven major universities in the country.

Two major aspects of educational computing in the Dominican Republic were investigated and described. First, a description was made of the availability and perceived quality of the physical, human, and logical resources for computing, which the literature shows as the essential elements of educational computing. Second, the roles that computers play in the areas of information, instruction, and productivity were examined, according to their use by administrative personnel and professors, and the attitudes of professors toward learning and working with computers.

In the following sections, these two aspects of educational computing are discussed, and conclusions are drawn based on the information gathered through the survey, as well as the available literature on the subject. Then, several possible ways to improve the development of educational computing in higher education are proposed, in the form of general recommendations that focus on the particular needs of the Dominican Republic, and available resources. Finally, limitations of this study, and suggestions for further research are presented.

The Status of Educational Computing in Dominican Universities

The field of educational computing includes all applications of computers in education, and their role in educational technology including planning and organizational strategies. Dominican universities seem to have developed a narrow vision of educational computing and the implementation of computing technology has been geared almost exclusively to the areas of administration and computer science.

Even in these areas, implementations of policies, strategies, and planning are either vague, or non-existent.

Control over academic computing is either completely under, or heavily influenced by, the departments of computer science, regardless of the kind of organizational approach used in each university. This is problematic since, because of this, the educational benefits of computing are limited by those departments' view of educational computing. Interviewees from the administration also seemed to imply that educational computing is uniquely tied to computer science. For example, one university official said that, "We have a computing laboratory ***because*** [italics added] we offer the career of computer science." Another one said that the computing centre, "Also serves as laboratory for ***computer science*** [italics added] students." When asked about the role of computers in education, one administrator started by saying, "We have a school of informatics."

On the other hand, some progress has been made, and Dominican universities appear to be at a turning point in their understanding of computing technology and its implications for higher education. Computer integration and training programs such as those at INTEC, for example, are encouraging first steps toward comprehensive educational computing implementations. Well-intentioned—if not so well informed, or supported—ideas were also evident throughout the interviews.

The fact remains, however, that the economic limitations of Dominican universities permeate every aspect of educational computing, making progress difficult. This is made clear in the following discussion on the different components of educational computing—physical, human, and logical resources—and their current status in the country.

Physical Resources

For Dominican universities the most expensive resources are the physical resources. Computing hardware is very expensive, costing at least twice as much as it would in developed countries. Problems

with the supply of electricity from the government have caused, and are still causing major problems and expense, both in the form of the need to acquire and maintain generators, as well as damage caused to electronic equipment because of the poor quality of the electricity that is available. Moreover, the country is totally dependent on imported oil to run the nation's electrical generators and the universities' own generators.

These realities have created a vision of computers as "precious hardware", rather than as productivity tools: a vision that seems to be changing slowly. Universities are starting to move away from centralized-only computing, toward more decentralized environments in which more computing power is placed in the hands of individuals. For example, the current trend in minicomputing technology is to move away from once-popular vendor-specific environments, such as IBM S/34 and S/36 minicomputers, to open systems that run UNIX, and allow for extensive inter-connectivity options and the development of multi-vendor, multi-platform environments. In the microcomputer area, however, less progress is evident. First and second generation IBM-compatible computers running MS-DOS are the only kind available in significant numbers, little networking is supported, and newer computer technologies are non-existent. The concept of "workgroup computing" is still unknown.

Microcomputing resources are probably most important for the integration of computing into the educational system, because these are the least expensive and the ones that professors and students from all areas would use the most. Microcomputer-based environments such as that at O&M are cost effective, and professors in this study seem to agree with this fact.

On the software side, the most significant problem seems to be the shortage of manuals and support materials. Although not formally explored in this study, the only feasible explanation for this situation is the widespread use of unauthorized copies of application software in the country. Also, there seems to be no educational software available, and this explains why computers are not used for instructional purposes at all.

Computer laboratories in all universities are, in theory, dedicated to students and professors from all areas. In practice, however, very few non-computer science students or professors use the services provided by these laboratories, and there are no incentives for them to do so. Users and non-users alike said that the computers were not available to them, and very few new computer users were found in this study. Part of this is due to the limited number of computers, but better use could be made of the available computing resources, to enable professors—users and non-users alike—to have more access to computing.

Human Resources

The literature shows that development of human resources is important for the introduction and integration of new technologies into educational systems, but this aspect of educational computing has been neglected in Dominican higher education. Dominican universities put a lot of effort into upgrading their physical computing resources, but little is being done to upgrade professors' knowledge of computing or to dedicate computing staff to educational computing matters.

Of all the universities surveyed, only INTEC was in the process of establishing an official policy of encouraging and training professors university-wide. None of the universities had a formal educational computing program covering the major points outlined in this study. A number of reasons could be cited for the lack of policies and implementation of continuing education programs in educational computing. Among those would be the limited number of computers available, the vision of computing as a tool exclusive to computer science, general lack of knowledge about the need and potential of educational computing, and economic limitations. However, it may be that none of these reasons are as important as the fact that there are very few educational computing specialists in these universities to lead them through the changes necessary to implement successful educational computing programs. In consequence, educational computing is implemented without appropriate consideration of major issues.

Training programs for professors and administrative personnel are available in only a few universities, and professors have only limited access to them. These training programs are highly technical and present a business-like approach to computing, rather than focusing on aspects of computing that are more appropriate to an educational environment such as the uses of computers for information, instruction, and productivity. Even so, training programs and seminars seem to have had a positive impact on professors and administrative personnel who have had access to them, and many people in the universities seemed to be aware of this, and would like to see more of them.

Logical Resources

Even though resources like information, and administrative support and motivation are probably the least expensive compared to the cost of computing hardware or software, these resources appear to be in very limited supply. Professors, especially non-users, indicated that they did not receive enough support, motivation, or information about computing to become involved with this technology.

The unavailability of information is also evident at the managerial level, accentuated by a lack of educational computing specialists. Software documentation, support materials, and other information sources are in short supply, and are usually in English. The language was not deemed to be a problem by professors, even though the overwhelming majority of applications available are in English. However, it may be hypothesized that this is due to the experience shown by computer users in this study, and the little educational use of computers. As computers are integrated into the educational process, professors will probably find the language issue to be of more importance.

Representatives of all universities in this study believed that computing was important, but concrete motivational or support programs in the form of continuing education for professors or staff development do not exist, except in a few cases with limited scope. Again, there is evidence to suggest that universities want their professors to become more involved with computing, but only time will tell if

they are willing to back these claims with proper planning and economic support for a comprehensive educational computing implementation.

Characteristics of Educational Computing in the Dominican Republic

Most of the major characteristics of educational computing in developed countries, according to the literature, can also be found in Dominican universities. These characteristics are: lack of planning, inequitable access to computing, inadequate software, need for integrating computers to the curriculum, and need for training. A brief discussion of each one of these follows.

Lack of Planning

The literature shows that poor planning is one of the most obvious problems affecting educational implementations of computing technology (Brine & Johnson, 1990a; Carter, 1990; Gillespie, 1983; Sybouts & Stevens, 1986). In Dominican universities planning for educational computing implementations centers mostly around the kind of computing equipment to be acquired, rather than in the educational goals that want to be achieved and other important factors involved in these implementations.

None of the universities surveyed had any specific authority or department dedicated to educational computing. Thus, planning that takes into account all aspects of educational computing is nonexistent. However, universities today are beginning to realize this need, and some of them have committees or departments in charge of computing for education.

Inequitable Access to Computing

Inequitable access to computers has been referred to as a cause of widening differences between the rich and the poor (NTFET, 1986; O'Neil, 1990). Within the Dominican context, this inequity is

obvious, and universities with lower budgets and larger numbers of students, such as UTESA and O&M, lack the economic resources to compete technologically with small, élite universities such as UNIBE. Thus, students from these universities are not likely to have the same amount or quality of exposure to computing as students from universities with better resources and experience.

Inadequate Software

The literature refers to the lack of good educational software when discussing the inadequacy of software in higher education (Bork, 1984; Gilbert & Green, 1986a; NTFET, 1987). In the Dominican Republic, the case could be titled "no software", rather than just "inadequate". The only educational software available to Dominican higher education are tutorials for certain applications, hardware, and perhaps some computer science techniques. Other applications of software in education are generally limited to training sessions in which the use of off-the-shelf applications is taught to students.

While educational institutions in developed countries have many potential sources of free or very inexpensive educational software—through INTERNET, for example—available to them, that is not the case for Dominican universities, and similar sources are not available at the regional or national level. Even if the universities had access to these sources, then language and cultural issues must be addressed before educational software can be used effectively. Most universities develop their own administrative software, but very few locally developed educational software packages were found.

Need for Integrating Computers to the Curriculum

For educational computing programs to be successful, changes must take place in the curriculum to accommodate the use of new technologies where the use of these technologies is deemed to be appropriate or beneficial (Brine and Johnson, 1990a; Sutphin, 1987). In this study, professors from INTEC were the only ones who indicated that there was indeed a need for integrating the computer into the

curriculum, perhaps because they are the only ones being encouraged to use computing technology university-wide.

Dominican universities have yet to reach the point where computers are used in subject areas other than computer science, in which integration of the computer is a given. This study could be a useful tool in anticipating problems that can affect the proper development of computing in these other areas. For example, professors point to the need for guidance on how to use computers as well as to their lack of knowledge about how to use computers appropriately in the classroom. These and other problems are evidence that, as computers begin to be used in non-computer science environments, more and more curriculum integration and support for professors will be needed.

Need for Training

The point made about integration of the computer into the curriculum, and the evident need for guidance and training underlined by professors and administrative personnel in this study, raises the issue of training. It appears that training for professors and personnel in Dominican universities is limited, but not only in computing matters. Many professors are not so by profession, and many of them have had to resort to multiple jobs in order to sustain themselves. Universities are experiencing a lack of qualified personnel in all areas, so training in computing might not seem a priority to most of them.

Training courses in Dominican universities, where available, seem to suffer from the same problems that many other computing training programs show. Most courses are taught by computer vendors or computer science personnel. The courses are too technical, focus too much on programming, or are only useful for professors to learn basic user skills. None of the programs apparently satisfy professors' needs or help them learn how to use computers effectively in the three areas of educational computing discussed in this study: information, instruction, and productivity.

Uses of Computers in Dominican Universities

The uses of computers in educational institutions can be classified into three major areas: *Information*, or the use of computers for the management of administrative information, as well as research and electronic mail; *productivity*, when computers are used in combination with off-the-shelf application software to enhance the productivity of administrative personnel or professors; and *instruction*, when computers are used to teach about computers or to help in the teaching of other subjects. A discussion of the results of this study regarding the use of computers in these three areas is presented in this section, followed by a brief summary of the attitudes toward learning about, and working with computers on the part of professors.

Roles of Computers in Dominican Universities

Results of this study show that Dominican universities are well-developed in the use of computers for the management of administrative information, even when compared to universities in developed countries, but much less developed in other areas of computer use. In the areas of instruction, and productivity, as well as some aspects of information, they appear less developed.

The use of computers for research is limited to data processing and statistical analyses, but access to national or international information sources in electronic form, or even electronic access to library catalogues is not available. Recent developments, such as the establishment of the REDID (Red Dominicana para la Investigación y Desarrollo/Dominican Network for Research and Development) may provide Dominican universities with access to the INTERNET, in which case computers should prove to be much more useful for research purposes.

The use of computers in the area of productivity appears to be hindered by economic limitations that imposes severe restrictions on the idea of providing individuals with expensive tools such as

computers. However, some use is evident, particularly in executive and secretarial positions throughout the universities, and it seems to be only a matter of time before the use of computers as productivity tools is widespread. Heavy use of computers for instruction is obvious in the computer science area, and some use is made in engineering, and computer literacy courses university-wide. Computer use is fairly common for teaching about computers, while instruction with computers is practically nonexistent.

The results of this study indicate that the areas in which the use of computers is most developed are those in which computers are used in ways similar to uses in the business environment. The business community has had a great impact on the development of computing in the country, and has heavily influenced computer implementations in higher education. The areas of management and technical computer literacy are the most developed areas because these are practices that have been common to the business community for many years. For example, it is evident that training and computer literacy courses in universities have a business-like approach to computing, and that reflects the way in which computers are used in the business community.

Professors Attitudes toward Computers

The attitudes of Dominican professors and administrative personnel are generally highly positive. Even though universities face many problems that limit their development in educational computing, university officials are very much in favor of change toward more widespread use of computers, and seem to regard computers as very important tools for the development of any individual in society today. The results of the attitude scale indicate that professors who use computers, as well as those who do not use them, hold high regard for these tools and related technologies, even with the limited exposure they have had to them.

This positive attitude is encouraging, but might also be misleading. Computer users in this study seem to have had enough experience with computers so that factors such as computer anxiety or first-

time-user frustrations do not exist anymore, and so their attitude scores are high. Also, non-users show so little exposure to information about computers, that their reactions might be more positive than they would be if they had more knowledge about them. Furthermore, it was shown that computer courses given to professors (both users and non-users) put a lot of emphasis o n topics such as the importance of computing and impact of the applications of the computer, topics which may make computing sound much easier to implement than it really is. Whatever the case, it would seem appropriate to be encouraged, but cautious, about professors' attitudes toward computers in Dominican universities.

Recommendations

For educational computing implementations in higher education to be successful, development in three areas—physical, human, and logical—is of major importance. In Dominican universities, development is restricted by factors that are in many cases beyond the universities' immediate control. Restricting factors include the poor economic situation, problems with the electrical infrastructure of the country, and unfavorable import restrictions on computing technology, among others. Despite these negative factors, and some evident progress, the results of this study show that there is a lot of room for improvement in these three areas in current educational computing implementations.

Based on these results, and on the constraints that have been identified, three general improvements are proposed. First, Dominican universities must develop their own local educational computing policies which take into account the different aspects of educational computing reviewed in this study in order to make the most of the physical and human resources available to them. Second, Dominican universities must understand and address the current issues of availability and quality of human resources for educational computing that have been underlined throughout this study. Third, new technologies must be introduced, and the use of available technologies must be optimized.

Development of Local Educational Computing Policies

Dominican universities must realize that educational computing encompasses more than the use of computers for administration and computer science. Comprehensive planning and policies for the application of computers in the areas of information, instruction, and productivity should be established. These policies, particularly those which refer to the acquisition, local development, and use of software in the area of instruction, should take into careful consideration the technology transfer issues outlined in the literature. Also, economic limitations sometimes allow the business community to influence the computing culture of these universities. Universities must cease to be trend followers, and become trend setters in the applications of computing technology in a culturally-appropriate manner.

Improving Availability and Quality of Human Resources

These changes cannot take place within the current organizational environments without significantly enhancing the human element of educational computing. Specialists are needed to guide Dominican universities through appropriate planning and implementation of educational computing. Although it is not likely that these specialists can be found in the Dominican Republic, it is not unreasonable to assume that universities can import this kind of expertise, preferably by providing local prospects with training abroad, until the country can produce its own specialists. If this is to be done, careful attention to technology transfer issues is warranted, however.

Training of administrative personnel and teaching staff is mandatory. Dominican universities must understand that the most important element in educational computing is that of the human resources. This study shows that while administrative personnel receive a certain amount of training, universities seem not to understand the importance of providing professors with appropriate knowledge about computing, or about how to integrate computing into the educational setting, not only for the delivery of instruction, but for class management, research, and communication.

Establishing appropriate training programs is perhaps the most inexpensive of the propositions made here, and can be done with available computing resources. One important recommendation is that universities shift the focus of the training courses from their highly technical contents, to an emphasis on instructional and pedagogical aspects of computing.

Optimization of Available Physical Resources

The continuous enhancement of the available physical infrastructure is a logical step required to keep pace with new computing developments. However, this is a very expensive proposition, considering the economic constraints of Dominican universities. Until import restrictions are eased and the Dominican government understands the importance of computing for the development of the country, solutions of this kind will be very difficult to implement.

For Dominican universities, then, it is more important to optimize the use of currently available technologies by exploiting the capabilities of these technologies to their maximum. Hardware technology appears to be underutilized in many areas, such as, for example, communications (electronic mail, research, and so on). At the same time, universities should keep improving their computing infrastructure with the introduction of new technologies, as far as their economic condition permits.

Limitations

This study has several limitations that need to be considered. First of all, it is both a descriptive and explanatory case study in which characteristics of educational computing in seven of the almost thirty Dominican universities were examined, and commonalities and differences explained. The fact that only certain Dominican universities participated in this study makes generalizability of the results difficult. However, the purpose of this study is not to make universal claims about educational computing in higher education, but rather to provide enough contextual information and descriptive evidence

for readers to make their own generalizations to other higher education settings.

The main problem encountered while conducting the study was the inability to include the Universidad Autónoma de Santo Domingo/UASD, the only public university and one of the biggest ones in the country in terms of student population. The reason for this omission was a general student strike that closed down the university for about three months. The importance of this university in terms of student population is decreasing rapidly, however. Its current population represents about sixteen percent of the total student population attending higher education institutions in the country, compared to about fifty percent in the universities studied.

Suggestions for Further Study

Educational computing is a very young field in which very few studies are available in Latin America. The results of this study point to three general areas in which research would be most desirable: curriculum development, professors' uses of computers, and the development of computing in elementary and secondary education.

In the area of curriculum development, it would be of interest to study different approaches for teaching computer literacy to professors. This study shows that training programs in the Dominican Republic are very few and highly technical, and that there is a need for context-sensitive courses that are suitable for the needs of professors. Also, Dominican universities are just starting to establish university-wide computer literacy courses. It would be interesting to look into the development of those courses as well and ways in which non-computer science students learn computing best.

The use of computers by professors in the universities surveyed was analyzed on the basis of the types of applications they had available and used. This kind of analysis gives only a general picture of the use of computers by professors, since the literature shows that one application can be used for various different purposes. It would be of interest to find out how professors are actually using compu-

ters, and determine where the use of computers could be improved or optimized by looking into their actual needs and potential uses of computers in their specific areas.

Finally, this study concentrated on higher education because there is very little computing carried on in elementary and secondary schools in the Dominican Republic. However, development in these areas has already begun in many Latin American countries and in some private schools in the Dominican Republic. Studies similar to this one at those levels of education are necessary to support appropriate planning and implementation for further development of educational computing.

REFERENCES

AECT: Association for Educational Communications and Technology (1977). *Educational technology: definition and glossary of terms.* Washington: AECT.

Agee, Roy (1985). Are we really training computer teachers? *T.H.E. Journal, 12*(7), 96-99.

Alemán, José Luis, Dr. (1988). *Población y educación. Tendencias recientes y urgencias futuras.* [Population and education. Recent trends and future urgencies]. Unpublished manuscript, Pontificia Universidad Católica Madre y Maestra, Santiago, Dominican Republic.

Alvarez, José, Smiley, Steven M., & Rohrmann, Francisco (1985). Informatics and small computers in Latin America. *Journal of the American Society for Information Science, 36*(4), 259-267.

Araujo de Oliveira, Joao Batista (1989). ¿La tecnología puede hacer progresar la educación? [Can technology help education progress?]. *Carta de Tecnología Educativa, 5*(3), 1-4.

Becker, Henry Jay (1983). School uses of microcomputers: Report 1 from a national survey. *The Journal of Computers in Mathematics and Science Teaching, 3*(1), 29-33.

Becker, Henry Jay (1982). Roles for microcomputers in the 1980s. *NASSP Bulletin, 66*(455), 47-52.

Becker, Henry Jay, & Sterling, Carleton W. (1987). Equity in school computer use: national data and neglected considerations. *Journal of Educational Computing Research, 3*(3), 289-311.

Blankenship, Lloyd V. (1985). An amateur's view of the information revolution in academe. *CAUSE/EFFECT, 8*(5), 18-23.

Bohlin, Roy M. (1992). *Correlates of computer anxiety and confidence: Some personal factors for college students.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, California, April 20-24, 1992.

Bork, Alfred (1984). Computer education today and some possible futures. *Phi Delta Kappan, 66*(4), 239-243.

Bowers, C. A. (1988). *The cultural dimensions of educational computing: Understanding the non-neutrality of technology.* New York: Teachers' College Press.

Brine, John W., & Johnson, E. Marcia (1990a). The role of needs assessment in educational computing. *Perspectives in Education*, Fall, 25-26.

Brine, John W., & Johnson, E. Marcia (1990b). The cultural context of educational computing. *Perspectives in Education*, Fall, 23-24.

Calfee, R. (1985). Computer literacy and book literacy: Parallels and contrasts. *Educational Researcher, 14*(5), 8-13.

Cárcamo S., María Teresa, León Bohórquez, Guillermo, & Aristizábal, Elvia Cecilia (1988). Plan piloto en informática educativa Colegio de Nuestra Señora del Pilar, Bucaramanga. [Pilot plan in educational computing Colegio Nuestra Señora del Pilar, Bucaramanga]. *Boletín de Informática Educativa, 1*(1), 49-52.

Carter, Donna J. (1990). What have educators learned about computers? *ACSD Update, 32*(9), 1.

Chadwick, Clifton B. (1983). Los actuales desafíos para la tecnología educativa. [Current challenges of educational technology]. *Revista de Tecnología Educativa, 8*(2), 99-109.

Chadwick, Clifton B. (1986). Instructional technology research in Latin America. *Educational Communication and Technology, 34*(4), 247-254.

Chan, Lyn (1990, November). Issue: Computers in education: Boon or Bust? *ACSD Update, 32*(9), 7.

Chaudhry, Farouk I., & Fakhro, Samir Q. (1986). Computer education in Bahrain's secondary schools (A pilot project). *Computers in Education, 10*(4), 439-443.

Clayton, J. S., (1975). *La transferencia de tecnología. [The transfer of technology].* Bogotá, Colombia: Universidad Pedagógica Nacional de Colombia.

Collier, Henry W., McGowan, Carl B., & Ryan, William T. (1987). Microcomputers: A successful approach to teaching business courses. *Computers and Education, 11*(2), 143-148.

Correa, Carlos María (1989). Informatics in Latin America: Promises and realities. *Information Technology for Development, 4*(1), 11-30.

Crespo, Sandra (1990). *Mathematics achievement in the Dominican Republic: Grade 12.* Unpublished master's thesis, University of British Columbia, Vancouver.

DeLoughry, Thomas (1987). Widespread piracy by students frustrates developers of computer software. *The Chronicle of Higher Education, 33*(48), pp. 1, 31-32.

Dockerill, John (1987). Institutional management of information technology: A centralised approach. *International Journal of Institutional Management in Higher Education, 11*(2), 208-220.

Durndell, A., Macleod, H., & Siann, G. (1987). A survey of attitudes to, knowledge about, and experience of computers. *Computers and Education, 11*(3), 167-175.

Dwyer, Thomas (1980). Some thoughts on computers and greatness in teaching. In R. Taylor (Ed.), *The Computer in the School: Tutor, Tool Tutee* (pp. 113-118). New York: Teachers College Press.

Egginton, Everett (1983). Educational research in Latin America: A twelve-year perspective. *Comparative Education Review, 27*(1), 1983.

Esteniou M., Javier (1987). La transformación cultural del Estado contemporáneo frente a las nuevas tecnologías de información: Análisis del caso mexicano. [The cultural transformation of the contemporary State against new information technologies]. *Revista de Tecnología Educativa, 10*(1), 15-31.

Farrel, P. (1984). Computer literacy. What does it mean?. *Journal of Physical Education and Recreation*, 55, 54-55.

Fary, B. A. (1984). Computer literacy for staff development. *AEDS Journal*, (16), 1-8.

Fernández (1990). Dominican Republic. In N. T. Postlethwaite (Ed.), *The Encyclopedia of Comparative Education and National Systems of Education*. Oxford: Pergamon Press.

Fitzgerald, Dolores (1983). Small college business program focuses on computers in decision making. *T.H.E. Journal*, 11 (3), 109-115.

Fonseca, Clotilde, & Schaffer, Marilyn (1990). ¿Por qué LOGO? Una respuesta de Costa Rica. [Why LOGO? An answer from Costa Rica]. *Boletín de Informática Educativa, 3*(1), 19-30.

Fuller, Bruce, & Heyneman, Stephen P. (1989). Third world school quality: Current colapse, future potential. *Educational Researcher, 18*(2), 12-19.

Gallegos M., Arnold (1984). Educational technology in Latin America: The cultural dynamics. *Educational Technology, 24*(3), 38-42.

Galvis P., Alvaro H. (1987). Educational computing technology transfer: Towards a non-magical approach. *Computers and Education, 11*(3), 197-204.

Galvis P., Alvaro H. (1988a). Columna del Director [The Director's column]. *Boletín de Informática Educativa, 1*(1), 7-8.

Galvis P., Alvaro H. (1988b). Materiales educativos computarizados [Computerized educational resources] [Editorial]. *Boletín de Informática Educativa, 1*(2), 115-116.

Ganske, L., Hamamoto, P. (1984). Response to a crisis: A developer's look at the importance of needs assessment to teacher educators in the design of computer literacy training programs. *Educational Computer Technology Journal, 32*(2), 101-113.

Gilbert, Steven W., & Green, Kenneth C. (1986a). New computing in higher education. *Change, 18*(3), 33-50.

Gilbert, Steven W., & Green, Kenneth C. (1986b, April 10). Software piracy, its cost and the consequences. *The Wall Street Journal*, 47-49.

Gillespie, Robert, (1983). How computers are transforming higher education. *New Directions for Higher Education, 11*(4), 53-67.

Gómez Moreno, Bernardo (1989). La hoja electrónica en la enseñanza de la Física. [The electronic spreadsheet in Physics teaching]. In *1er Encuentro Nacional en Tecnología Educativa [1st National Meeting on Educational Technology]* (pp. 107-115). Bogotá, Colombia: Instituto Colombiano para el Fomento de la Educación Superior (ICFES).

González Fiegehen, Luis E. (1987). La computación de la información en los sistemas educativos de América Latina y el Caribe. [Information computing in educational systems in Latin America and the Caribbean]. *Revista de Tecnología Educativa, 10*(1), 55-61.

Graham, Peter, & Karlsson, Göran (1987). Information technology in the education process at the Royal Institute of Technology. *European Journal of Engineering Education, 12*(2), 179-188.

Haigh, R. W. (1985). Planning for computer literacy. *Journal of Higher Education, 56*(2), 161-171.

Harvey, William B. (1983). Educational technology and third world development. *Journal of Educational Tecnology Systems, 11*(3), 265-270.

Hasset, J. (1984). Computers in the classroom. *Psychology Today*, 22-28.

Helms, Susan (1985). The computer as a tool: Basis for a university-wide computer literacy course. *T.H.E. Journal, 13*(2), 104-106.

Hungwe, Kedmon (1989). Culturally appropriate media and technology: A Perspective from Zimbabwe. *Tech Trends, 34*(1), 22-23.

Jackson, W. J., & Clements, D. G., Jones, L. G. (1985). Computer awareness and use at a research university. *Journal of Educational Technology Systems, 13*(1), 47-56.

Jacobs, Judith E. (1985). Let's prepare computer educators—NOT computer science educators. *The Computing Teacher, 13*(1), 17-18.

Janssen Reinen, Ingeborg, & Plomp, Tjeerd (1992). *Staff development as condition for computer integration.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, California, April 20-24, 1992.

Kay, Robin H. (1989). Bringing computer literacy into perspective. *Journal of Research on Computing in Education, 22*(1), 35-43.

Kling, Rob (1983). Value conflicts in computing developments. *Telecommunications Policy, 7*(1), 12-34.

Lapointe, Archie E., & Martínez, Michael E. (1988). Aims, equity, and access in computer education. *Phi Delta Kappan, 70*(1), 59-61.

Latapí, Pablo (1990). Some challenges for educational research in Latin America. *Prospects, 20*(1), 1990.

Lennon, Oscar (1988). Cultural variations, cognitive styles, and education in Latin America. *Prospects, 28*(3), 413-420.

Lora, Ricardo (1984). La calidad de la educación en la República Domicana: Problemas y soluciones. [The quality of Education in the Dominican Republic: Problems and solutions]. *Eme-Eme: Estudios Dominicanos, 12*(70), 49-72.

Loyd, Brenda H., & Gressard, Clarice (1984a). The effects of sex, age, and computer experience on computer attitudes. *AEDS Journal, 18*(2), 67-77.

Loyd, Brenda H., & Gressard, Clarice (1984b). Reliability and factorial validity of computer attitude scales. *Educational and Psychological Measurement, 44*(2), 501-505.

Loyd, Brenda H., & Loyd, Douglas E. (1985). The reliability and validity of an instrument for the assessment of computer attitudes. *Educational and Psychological Measurement, 45*(4), 903-908.

Luna, Eduardo, González, Sarah (1984). Estudio comparativo del rendimiento en Matemática en la República Dominicana. [Comparative study of Mathematics achievement in the Dominican Republic]. *Eme-Eme: Estudios Dominicanos, 12*(70), 3-47.

Magendzo Kolstrein, Abraham (1987). Curriculum y computación: Una relación a investigar. [Curriculum and computing: A relation to be examined]. *Revista de Tecnología Educativa, 10*(1), 43-54.

Mariño Drews, Olga (1988). Informática educativa: Tendencias y visión prospectiva. [Educational Computing: Trends and prospective vision]. *Boletín de Informática Educativa, 1*(1), 11-32.

Marshall, D. G. (1984). Computer technology in third world education. *Computer Education, 8*(4), 377-381.

Mecklenburger, J. (1990, November). Issue: Computers in education: Boon or Bust? *ACSD Update, 32*(9), 7.

Mejía, Radhamés (1988, November). Marco histórico de la evolución de la educación superior en la República Dominicana. [Historical account of the evolution of higher education in the Dominican Republic]. *Simposio Permanente Sobre la Universidad [Permanent Symposium on Universities].* Asociación Dominicana de Rectores de Universidades (ADRU), Santo Domingo, Dominican Republic.

Moont, S. (1987). Computer literacy: An archeological view. *ECCO Output, 7*(2), 14-17.

Mudd, Samuel, & Wilson, William (1987). Achieving curriculum-integrated computing. *Computers and education, 11*(1), 63-69.

NACUBO: National Association of College and Universities Business Officers (1986). Small College software survey. *Nacubo Business Officer 19*(9), 27-31.

Naiman, A. (1987, February). A hard look at educational software. *Byte*, pp. 193-200.

Nelson, L. R. (1974). *Guide to LERTAP: Use and interpretation.* Dunedin, New Zealand: University of Otago.

NTFET: The National Task Force on Educational Technology (1986). Transforming american education: Reducing the risk to the nation. *T.H.E. Journal, 14*(1), 58-67.

O'Neil, John (1990). Computer "revolution" on hold. *ACSD Update, 32*(9), 1.

Oeffinger, John C. (1987). Merging Computers and Communication: A Case Study in Latin America. *Telematics and Informatics, 4*(3), 195-210.

Palmer, Janet (1986). Computer education in Ecuador: Preparing for a competitive future. *T.H.E. Journal, 13*(5), 103-104.

Papert, Seymour (1980). *Mindstorms: Children, computers and powerful ideas.* New York: Basic Books.

Papert, Seymour (1987). Nuevas teorías para aprendizajes nuevos. [New theories for new learning]. *Revista Desarrollo*, 5, 13-22.

Pelgrum, Willem J., & Plomp, Tjeerd (1991). *The Use of Computers Worldwide.* New York: IEA, Pergamon Press.

Pickert, S., & Hunter, B. (1983). Redefining literacy. *Momentum, 14*(3), 7-9.

Pimienta, Daniel (1991, December). *Proyecto REDALC: Red de América Latina y el Caribe. [REDALC Project: Latin American and Caribbean Network].* Paper presented at the REDALC development seminar of Unión Latina, Santo Domingo, Dominican Republic.

Ploch, M. (1984). Micros flood campuses. *High Technology, 4*(3), 47-49.

Pogrow, Stanley (1990, November). Issue: Computers in education: Boon or Bust? *ACSD Update, 32*(9), 7.

Railsback, C. E. (1983). Microcomputers: Solutions in Search of Problems. *Phi Delta Kappan, 65*(2), 118-120.

Rojas Cortés, Carlos A. (1988). Uso de los computadores en las escuelas rurales de Nemocón. [Use of computers in the rural schools of Nemocón]. *Boletín de Informática Educativa, 1*(1), 45-47.

Rueda Fajardo, Francisco (1988). Investigación sobre informática educativa: Experiencias del grupo de informática educativa UNIANDES. [Research on educational computing: Experiences of the UNIANDES educational computing group]. *Boletín de Informática Educativa, 1*(1), 59-63.

Rundall, R. A. (1985). A child's problem: Which computer? *Clearing House, 59*(4), 174-175.

Scheffler, I. (1986). Computers at school?. *Teachers College Record, 87*(4), 513-528.

Schiefelbein, Ernesto (1978). Educational reseach networks in Latin America. *International Review of Education, 24*(4), 483-500.

Schultz, Karen A., & Hart, Lynn C. (1983). Computers in education. *Arithmetic Teacher, 31*(4), 36-37.

SEEBAC: Secretaría de Estado de Educación, Bellas Artes y Cultos (1984). *Diagnóstico del Sector Educativo (Sumario). [Diagnostic of the educational sector (Summary)].* Santo Domingo, Dominican Republic: SEEBAC.

Shor, Richard (1988). The Educational importance of local area networks in secondary schools. *Computers and Education, 13*(2), 129-134.

Soto Bello, Dinápoles (1984). El reto de la investigación científica en República Dominicana. [The challenge of scientific research in the Dominican Republic]. *Eme-Eme: Estudios Dominicanos, 12*(70), 73-81.

Stevens, Dorothy Jo (1984). Microcomputers: An educational challenge. *Computers and Education, 8* (2), 263-267.

Sutphin, Dean (1987). Educating teachers on instructional applications of microcomputers. *T.H.E. Journal, 14*(6), 54-58.

Sybouts, Ward, & Stevens, Dorothy Jo (1986). A system model to introduce computers into an educational program. *NASSP Bulletin, 70*(489), 28-31.

Taylor, Robert (Ed.) (1980). *The computer in the school: Tutor, tool or tutee.* New York, London: Teachers' College Press.

Troxell Sellew, Kathleen (1987). *Dominican Republic: A Study of the Educational System and a Guide to Academic Placement of Students in Educationl Institutions of the United States.* Washington, D.C.: IEAG/AACRAO.

Tucker, M. S. (1983). The turning point: Telecommunications and higher education. *The Journal of Communication, 33*(1), 118-130.

Vermette, Sandra M., Orr, R. Robert, & Hall, Michael H. (1986). Attitudes of elementary school students and teachers toward computers in education. *Educational Technology, 26*(1), 41-47.

Weston, Cynthia B. (1988). Critical factors for educational technology interventions in developing countries. *ETTI, 26*(2), 122-128.

Woodrow, Janice E. (1987). Educators' attitudes and predispositions towards computers. *Journal of Computers in Mathematics and Science Teaching, 6*(3), 27-37.

Yin, Robert K. (1988). *Case study research: Design and methods.* California: SAGE Publications.

Zapata, Amarilis (1988, November). El sistema educativo Dominicano. Algunos problemas indicadores de la situación actual. [The Dominican educational system. Some problems indicative of the current situation]. *Simposio Permanente Sobre la Universidad [Permanent Symposium on Universities].* Asociación Dominicana de Rectores de Universidades (ADRU), Santo Domingo, Dominican Republic.

Zemke, R. (1984). The Slippery Menace of Computerphobia. *Training, 21*(6), 34-42.

APPENDIX A

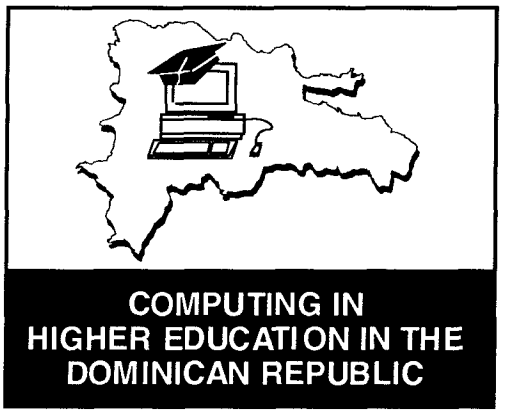
Professor Questionnaire

(Original)

LA COMPUTACION EN EDUCACION SUPERIOR EN LA REPUBLICA DOMINICANA

Un estudio auspiciado por The University of British Columbia

ING. THOMAS C. GARCIA S.



Cuestionario de Profesores

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Estimado profesor:

Gracias por acceder a participar en este estudio nacional acerca del uso de los computadores en las universidades dominicanas. Mucho se ha dicho del beneficio del uso de los computadores en todas las áreas, tanto administrativas como educativas en las universidades, pero para poder sacarle el verdadero provecho a los mismos, debemos aprender aún más de cómo están siendo utilizados y cómo deben utilizarse.

Este proyecto realizado en diversas universidades del país representa el primer estudio formal acerca del uso de los computadores en las universidades dominicanas; está siendo desarrollado por un servidor bajo la supervisión del Departamento de Educación en Ciencias y Matemática de la Universidad de Columbia Británica (UBC), en Vancouver, Canada. La idea del mismo surgió originalmente de un estudio que está llevando a cabo la IEA (International Association for the Evaluation of Educational Achievement) en instituciones educativas alrededor del mundo.

Entendemos que esta recolección de datos exige mucho tiempo de su parte, pero esta es la única forma de obtener datos útiles acerca del uso de los computadores en nuestras universidades.

Gracias por su colaboración,

Thomas C. García
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INTRODUCCION Y PROPOSITO

Introducción	El presente estudio acerca del uso de los computadores en las universidades dominicanas es de caracter nacional. El mismo está siendo conducido bajo la supervisión de un equipo de asesores del Departamento de Educación en Ciencias y Matemática de la Universidad de Columbia Británica. Es un proyecto de investigación más auspiciado por dicha universidad, la cual tiene otros proyectos manejados desde el Centro de Investigaciones de la Universidad Católica Madre y Maestra. Más que esto, representa un esfuerzo por mejorar el estado general de la computación en la educación superior en la República Dominicana.
El cuestionario	En este cuestionario se solicita información acerca de su experiencia personal en asuntos relacionados con computadores. Debe tomarle unos 20 minutos el completarlo.
Necesitamos su ayuda	Esperamos que usted tome el tiempo necesario para contestar las siguientes preguntas tan cuidadosa y correctamente como sea posible. La calidad de los resultados de este estudio depende de la exactitud y de qué tan completa sea la información que cada profesor ofrezca.
Cómo contestar	Si usted no tiene la información necesaria para contestar alguna pregunta en particular, por favor, consulte otras personas en el departamento que puedan ayudarle a contestarla.
Lapicero	Por favor, utilice un lapicero para marcar sus respuestas.
Tipografía	Sugerencias de cómo contestar las preguntas aparecen en *cursiva.* Si la respuesta '_____' aparece, usted debe escribir su propia respuesta. Por favor escriba en letras de molde o en letra bien legible. La mayoría de las preguntas pueden ser contestadas marcando el cuadrito correspondiente o encerrando la respuesta correcta en un círculo. Cuando una pregunta lee: *Por favor, marque todas las que apliquen* usted puede marcar más de una respuesta.
Confidencial	Toda información recabada en este estudio es confidencial. En ningún momento o bajo ninguna circunstancia será identificado el departamento o el individuo que llenó el cuestionario. En caso de alguna duda respecto a alguna pregunta o al estudio en sí, siéntase libre de llamarnos al 582-1024 o de enviarnos un fax al 582-1001, en Santiago.

1. ¿Usa usted computadores?

☐ Sí
☐ No

SI NO USA USTED COMPUTADORES,
POR FAVOR PASE A LA SECCIÓN B, PÁG 7

SECCION A: PREGUNTAS PARA LOS QUE USAN COMPUTADORES

2. ¿Por cuántos años ha usado usted computadores?

☐ Este es mi primer año
☐ 1-3 años
☐ 4 años o más

3. ¿Cuándo y dónde utilizó usted un computador por primera vez?

☐ Nunca he utilizado un computador
Usé un computador por primera vez en 19 ____:
☐ En la universidad o durante una sesión de entrenamiento
☐ En la universidad (como profesor)
☐ En casa
☐ En otro lugar (por favor, especifique) _____

4. ¿Qué tipo de entrenamiento ha recibido usted en el uso de computadores?
Por favor, marque todas las que apliquen

☐ Entrenamiento básico como estudiante en la universidad.
☐ Entrenamiento de profesores dado por la universidad u alguna otra institución educativa.
☐ Curso técnico fuera de la universidad.
☐ Nunca he recibido entrenamiento.
☐ Otro (por favor, especifique) _____

5. ¿Cómo se mantiene usted al tanto de la tecnología de la computación?

☐ A través de revistas de computadores.
☐ Información recibida de la universidad.
☐ Amigos o colegas.
☐ No tengo tiempo para mantenerme al día.
☐ Otro (por favor, especifique) _____

6. ¿Existen computadores disponibles para su uso?

☐ En la universidad.
☐ En casa.
☐ Ambos.

7. ¿Cuáles aplicaciones (programas) usa usted, con qué frecuencia y para qué fines?
Por favor, para cada aplicación, señale la frecuencia y el tipo de uso, encerrando en un círculo la respuesta correspondiente.

APLICACION	FRECUENCIA DE USO					TIPO DE USO		
Enseñanza y práctica	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Procesamiento Palabras	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Dibujo/Artes Gráficas	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Música	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Simulación	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Juegos	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Programación BASIC	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Programación LOGO	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Otros Lenguajes _____	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Hojas de cálculo	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Gráficos	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Estadística	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Bases de Datos	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
Lab. Electrónica	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos
CAD (Arq./Ing.)	Nunca	Rara vez	A veces	A menudo	Siempre	Pers	Educ	Ambos

8. ¿Qué tan adecuados diría usted que son los recursos siguientes en su universidad?
Por favor, para cada recurso, señale qué tan adecuado considera usted que el mismo es, encerrando en un círculo la respuesta correspondiente.

RECURSO				
Número de computadores	Muy adecuado	Adecuado	Inadecuado	Muy inadecuado
Electricidad	Muy adecuado	Adecuado	Inadecuado	Muy inadecuado
Disponibilidad computadores	Muy adecuado	Adecuado	Inadecuado	Muy inadecuado
Ubicación computadores	Muy adecuado	Adecuado	Inadecuado	Muy inadecuado
Disponibilidad personal técnico	Muy adecuado	Adecuado	Inadecuado	Muy inadecuado
Experiencia personal técnico	Muy adecuado	Adecuado	Inadecuado	Muy inadecuado
Info. general de computadores	Muy adecuado	Adecuado	Inadecuado	Muy inadecuado

9. Conteste SI o NO a las preguntas siguientes.

Conozco varios usos de los computadores.	SI	NO
Conozco algunas ventajas de usar computadores en educación.	SI	NO
Conozco diferentes criterios en base a los cuales juzgar la calidad de un impresor.	SI	NO
Conozco lo que es un MODEM.	SI	NO
Conozco diferentes tipos de computadores: MS-DOS, Apple II, Macintosh, UNIX.	SI	NO
Sé cómo escribir un programa simple para un computador.	SI	NO
Sé cómo intercambiar datos entre dos tipos diferentes de computadores.	SI	NO
Sé cómo copiar un archivo de un disco a otro disco.	SI	NO
Sé cómo editar un documento en un procesador de palabras.	SI	NO
Sé cómo crear un archivo de datos en un computador.	SI	NO

10. ¿Cuál de los siguientes problemas experimenta usted al usar computadores en la universidad?
Por favor, marque todas las que apliquen

PROBLEMAS DE EQUIPO

- ☐ El número de computadores no es suficiente.
- ☐ El número de periféricos (impresores, discos, etc.) no es suficiente.
- ☐ El mantenimiento de los equipos en operación es deficiente.
- ☐ Limitaciones de los equipos actuales (obsoletos, lentos, mala calidad, memoria insuficiente).
- ☐ El servicio de electricidad es deficiente.

PROBLEMAS CON LAS APLICACIONES (PROGRAMAS)

- ☐ No hay suficientes aplicaciones (programas) para uso del público.
- ☐ Las aplicaciones (programas) son muy difíciles de utilizar.
- ☐ Los manuales y materiales de soporte están incompletos o no existen.
- ☐ No hay información acerca de las diferentes aplicaciones o su calidad.
- ☐ Las aplicaciones (programas) están en inglés y no hay versiones disponibles en español.

PROBLEMAS CON EL USO DE LOS COMPUTADORES PARA LA CLASE

- ☐ No hay suficiente ayuda para supervisar los estudiantes que usan computadores.
- ☐ Hay problemas tratando de integrar el computador al curriculum.
- ☐ Los profesores carecen del conocimiento necesario para utilizar computadores en educación.
- ☐ No hay suficiente guía/experiencia para ayudar a los profesores a usar los computadores.

10. (cont.)

PROBLEMAS DE ORGANIZACION/ADMINISTRACION

- ☐ No hay suficiente tiempo para que profesores o estudiantes aprendan de computadores.
- ☐ No hay suficiente asistencia técnica para operar o dar mantenimiento al equipo.
- ☐ Los computadores no están suficientemente accesibles para los profesore.
- ☐ No hay suficiente oportunidad de entrenamiento para los profesores.
- ☐ No hay soporte administrativo suficiente.
- ☐ No hay soporte financiero suficiente.

MISCELANEOS

- ☐ No hay interés por parte de los profesores.
- ☐ No hay interés por parte de los estudiantes.
- ☐ Otro (*por favor, especifique*) _____

11. ¿Cuántas de las aplicaciones (programas) que usted utiliza están en español?

- ☐ Ninguna.
- ☐ Menos de un 10%
- ☐ 10%-49%
- ☐ 50%-90%
- ☐ Más de un 90%
- ☐ Todas

SECCION B: PREGUNTAS PARA LOS QUE NO USAN COMPUTADORES

SI USA USTED COMPUTADORES,
POR FAVOR PASE A LA SECCIÓN C, EN ESTA MISMA PAGINA

12. A continuación de listan un número de razones para no usar computadores.
¿Cuáles de estas razones se aplican a usted?
Por favor, marque todas las que apliquen

- ☐ No tengo tiempo para aprender de computadores.
- ☐ No tengo interés en aprender a utilizar computadores.
- ☐ No se ofrecen las facilidades necesarias para aprender a utilizar computadores.
- ☐ Los computadores son muy difíciles de utilizar.
- ☐ No tengo necesidad de usar computadores en mi trabajo.
- ☐ Para usar computadores necesariamente hay que saber inglés.
- ☐ El número de computadores no es suficiente.
- ☐ El servicio de electricidad es deficiente.
- ☐ No hay suficiente guía/experiencia para ayudar a los profesores a usar los computadores.
- ☐ Los computadores no están suficientemente accesibles para los profesore.
- ☐ No hay suficiente oportunidad de entrenamiento para los profesores.
- ☐ No hay soporte administrativo suficiente.
- ☐ No hay soporte financiero suficiente.
- ☐ Otra (*por favor, especifique*) _____

SECCION C: PREGUNTAS PARA TODOS LOS PROFESORES

13. A continuación se le presenta una serie de afirmaciones. No hay respuestas correctas a estas afirmaciones. Están diseñadas para permitirle indicar qué tan de acuerdo está usted con ellas.
Para cada afirmación, marque con una "x" el cuadrito que corresponda.

	Muy de acuerdo	De acuerdo	En desacuerdo	Muy en desacuerdo
a. Me gustaría trabajar con computadores.	☐	☐	☐	☐
b. No creo que podría hacer trabajos muy sofisticados en el computador.	☐	☐	☐	☐
c. Creo que trabajar con computadores sería estimulante y agradable.	☐	☐	☐	☐

13. (cont.).

	Muy de acuerdo	De acuerdo	En desacuerdo	Muy en desacuerdo
d. Aprender acerca de computadores es importante	☐	☐	☐	☐
e. Estoy seguro de poder trabajar con computadores	☐	☐	☐	☐
f. No me molestaría tener que tomar cursos de computación.	☐	☐	☐	☐
g. Creo que tengo pocos usos para un computador en mi vida diaria.	☐	☐	☐	☐
h. Los computadores me hacen sentir incómodo	☐	☐	☐	☐
i. No entiendo cómo algunas personas pueden pasar tanto tiempo trabajando con computadores y parecer que lo disfrutan.	☐	☐	☐	☐
j. No puedo imaginar ninguna manera en la cual yo utilizaría computadores en mi carrera	☐	☐	☐	☐
k. Creo que usar computadores sería muy difícil para mí.	☐	☐	☐	☐
l. Me sentiría cómodo usando un computador	☐	☐	☐	☐

14. ¿Qué ventajas ve usted en usar computadores en la universidad?
Por favor, marque todas las que apliquen

☐ El trabajo se hace mucho más rápido.
☐ Se mejora la comunicación.
☐ Se mejora la calidad de la educación.
☐ Otra (*por favor, especifique*) _____

☐ No veo ninguna ventaja en usar computadores en la universidad.

15. ¿Qué desventajas ve usted en usar computadores en la universidad?
Por favor, marque todas las que apliquen

☐ No se le saca provecho a los equipos porque son muy difíciles de utilizar.
☐ El dinero utilizado para comprar computadores puede ser usado para mejores fines.
☐ Otra (*por favor, especifique*) _____

☐ No veo ninguna desventaja en usar computadores en la universidad.

SECCION D: PREGUNTAS ADICIONALES PROFESORES UNIBE

16. ¿Ha participado usted en algun curso de capacitación en computación ofrecido por UNIBE?

☐ No se ha ofrecudo ningún curso de capacitación en computación.
☐ Se han ofrecido cursos, pero no he participado en ninguno.
☐ Sí he participado en uno o varios cursos de capacitación en computación.

17. ¿Acerca de cuáles de los siguientes tópicos aprendió usted en entrenamientos para profesores tanto fuera como dentro de la universidad?

COMPUTADORAS Y LA SOCIEDAD

☐ historia/evolución
☐ importancia de la computadora (personal, industrial, en educación)
☐ impacto de las aplicaciones de la computadora
☐ temas éticos (privacidad, derechos de autor, etc.)

APLICACIONES

☐ edición/procesamiento de palabras/autoedición
☐ dibujo/arte/ilustración
☐ hojas de cálculo electrónicas
☐ manejo de base de datos
☐ aplicaciones de estadística
☐ inteligencia artificial/sistemas expertos
☐ lenguages de enseñanza
☐ modelación y simulación
☐ instrumentación de laboratorios

17. (cont.)

- ☐ digitalización/procesamiento de imágenes
- ☐ CAD/CAM/control de procesos/robótica
- ☐ telecomunicación (correo electrónico)/redes de computadoras
- ☐ juegos educativos/recreativos
- ☐ generación de música

ANÁLISIS DE PROBLEMAS Y PROGRAMACIÓN

- ☐ conceptos generales (archivos, variables, arreglos, ciclos)
- ☐ procedimientos generales de programación
- ☐ estructura de programas
- ☐ lenguages de programación
- ☐ análisis de problemas (algoritmos, etc.)

PRINCIPIOS DE ESTRUCTURA DE HARDWARE Y SOFTWARE

- ☐ conceptos básicos acerca de las computadoras y los sistemas de computación
- ☐ equipos (arquitectura de computadoras, CPU, control de flujo de datos)
- ☐ aplicaciones (arquitectura de software, software de sistema)

ASPECTOS INSTRUCCIONALES/PEDAGÓGICOS

- ☐ aplicación de programas de enseñanza, práctica y supervisión
- ☐ cómo buscar evaluaciones de programas educativos
- ☐ como evaluar programas educativos
- ☐ integración de los programas en clases existentes
- ☐ organización del uso de las computadoras durante las lecciones
- ☐ Otro (*por favor, especifique*) _____

NINGUNO DE LOS ANTERIORES

18. Con relación a los resultados de estos cursos de capacitación, ¿cuál sería su opinión, tomando en cuenta todos los aspectos pedagócios y técnicos de los mismos?

- ☐ Excelente
- ☐ Bueno
- ☐ Regular
- ☐ Deficiente
- ☐ Mediocre

SECCION E: ANTECEDENTES PERSONALES

19. Indique el grado académico más alto que usted ha obtenido.

- ☐ Universitario - parcial
- ☐ Universitario - completo
- ☐ Universitario - maestría
- ☐ Universitario - doctorado
- ☐ Otro (*por favor, especifique*) _____

20. ¿Cuántos años de experiencia en educación tiene usted?

Años de experiencia en educación: _____

21. ¿En qué año nació usted?

19 ____

22. ¿Cuál es su sexo?

- ☐ Masculino
- ☐ Femenino

23. Si desea hacer algún comentario adicional sobre cualquier aspecto de los computadores, tanto personal como para educación, por favor utilice las líneas siguientes.

_____

_____

_____

_____

_____

_____

_____

APPENDIX B

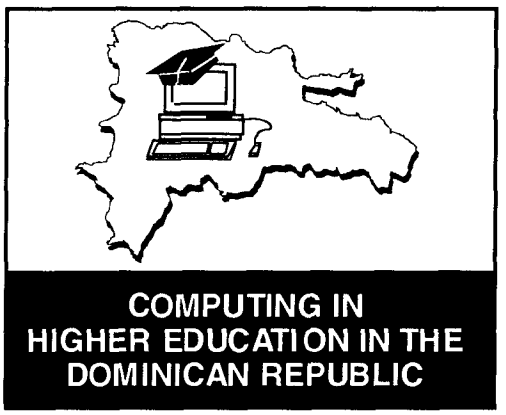
Professor Questionnaire

(Translated)

COMPUTING IN HIGHER EDUCATION IN THE DOMINICAN REPUBLIC

A Study Sponsored by The University of British Columbia

THOMAS C. GARCIA S.



Professor Questionnaire

THE UNIVERSITY OF BRITISH COLUMBIA

Faculty of Education
Department of Mathematics and
Science Education
2125 Main Mall
Vancouver, B.C. Canada V6T 1Z5

Tel: (604) 228-5422 Fax: (604) 228-4714

Dear professor:

Thanks for participating in this national study about the use of computers in Dominican universities. A lot has been said about the benefits of using computers in all educational areas, both administrative, and academic. However, to be able to take full advantage of these benefits, we must first learn more about how are computers being used today, and how they should be used.

This project, in which several universities are participating, represents the first formal study about the use of computers in Dominican universities; it is being carried out by myself under supervision of the Department of Mathematics and Science Education of The University of British Columbia, in Vancouver, Canada. The idea behind the project originally came from a study conducted by the IEA (International Association for the Evaluation of Educational Achievement) in educational institutions around the world.

We understand that this data collection process requires some of your time, but it is the only way to obtain useful information about the use of computers in our universities.

Thanks for your cooperation,

Thomas C. García
Project Coordinator
Faculty of Education
The University of British Columbia

INTRODUCTION AND PURPOSE OF THE STUDY

Introduction	This project is a national study about the use of computers in Dominican universities. It represents an effort to improve the level of educational computing in higher education in the country. It is being carried out under the supervision of an advisory committee of the Department of Mathematics and Science Education of the University of British Columbia, which also supports other projects through the Research Centre of the Pontificia Universidad Católica Madre y Maestra in Santiago.
The questionnaire	In this questionnaire we ask you for information about your personal experience with computing matters. It should take you about 20 minutes to complete.
We need your help	We hope you will take the time necessary to complete the following questions as carefully and correctly as possible. The quality of the results of this study depends on how precise and complete is the information provided by each professor.
How to answer	If you do not have the necessary information to answer a particular question, please consult other persons in your department who might be able to help you answer them.
Use a pen	Please, use a pen to answer the questionnaire.
Typography	Suggestions on how to answer most questions appear in *italics*. If the answer '_____' appears, you should write down your own answer. Please print or write clearly. Most of the questions can be answered by checking the corresponding box or circling the correct answer. When a question reads: *Please, mark all that apply.* you can select more than one answer.
Confidential	All data gathered in this study is confidential. Under no circumstances will an individual or his/her department be identified for any purpose. In case you have any doubts or questions about any particular question or about this study, feel free to call me at (809) 582-1024, or send a fax to (809) 582-1001, in Santiago.

1. Do you use computers?

☐ Yes
☐ No

IF YOU DO NOT USE COMPUTERS,
PLEASE SKIP TO SECTION B, PAGE 7

SECTION A: QUESTIONS FOR PROFESSORS WHO USE COMPUTERS

2. For how many years have you used computers?

☐ This is my first year
☐ 1-3 years
☐ 4 years or more

3. When and where did you use computers for the first time?

☐ I have never used a computer
I used a computer for the first time in 19 ____:
☐ At the university or in a training session.
☐ At the university (as a professor).
☐ At home.
☐ Somewhere else (*please, specify*) _____

4. What kind of training have you received in the use of computers?
Please, mark all that apply.

☐ Basic training in the university as a student.
☐ Basic training taken as a professor at the university or any other educational institution.
☐ Technical training taken outside the university.
☐ I have never received training.
☐ Other (*please, specify*) _____

5. How do you keep up-to-date in computing technology?

☐ Through computer magazines.
☐ Information received from the university.
☐ Though friends or coleagues.
☐ I don't have time to keep up-to-date.
☐ Other (*please, specify*) _____

6. Are there computers available for you to use?

☐ At the university.
☐ At home.
☐ At both places.

7. Which applications (programs) do you use, how often, and for what purpose?
For each application, please indicate the frequency and type of use, by circling the appropriate answer in each case.

APPLICATION	FREQUENCY OF USE					TYPE OF USE		
Drill and practice	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
Word processing	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
Drawing/Graphic Arts	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
Music	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
Simulations	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
Games	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
BASIC programming	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
LOGO programming	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
Other languages _____	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
Spreadsheets	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
Graphics	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
Statistics	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
Databases	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
Data Acquisition	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both
CAD (Arch./Eng.)	Never	Rarely	Sometimes	Often	Always	Pers	Educ	Both

8. How adequate would you say these resources are in your university?
For each resource, please indicate how adequate you think it is, by circling the appropriate answer in each case.

RESOURCE				
Number of computers	Very adequate	Adequate	Inadequate	Very inadequate
Energy supply	Very adequate	Adequate	Inadequate	Very inadequate
Availability of computers	Very adequate	Adequate	Inadequate	Very inadequate
Location of computers	Very adequate	Adequate	Inadequate	Very inadequate
Availability of technical personnel	Very adequate	Adequate	Inadequate	Very inadequate
Experience of technical personnel	Very adequate	Adequate	Inadequate	Very inadequate
General information on computers	Very adequate	Adequate	Inadequate	Very inadequate

9. Please answer YES or NO to the following statements.

I know several uses of computers.	YES	NO
I know some advantages of using computers in education.	YES	NO
I know several criteria to judge printers.	YES	NO
I know what a MODEM is.	YES	NO
I know different kinds of computers: MS-DOS, Apple II, Macintosh, UNIX.	YES	NO
I know how to write a simple program for a computer.	YES	NO
I know how to exchange data among different kinds of computers.	YES	NO
I know how to copy a file from one disk to another disk.	YES	NO
I know how to edit a document with a word processor.	YES	NO
I know how to create a data file in a computer.	YES	NO

10. Which of the following problems do you experience when using computers at the university? *Please, mark all that apply.*

HARDWARE PROBLEMS

- ☐ The number of computers is insufficient.
- ☐ The number of peripherals (printers, hard disks, etc.) is insufficient.
- ☐ Maintenance of available equipment is deficient.
- ☐ Limitations of current equipment (obsolete, slow, low quality, insufficient memory).
- ☐ The supply of energy (electricity) is inadequate.

SOFTWARE PROBLEMS

- ☐ There are not enough applications (programs) available for public use.
- ☐ The available applications are very difficult to use.
- ☐ The manuals and support materials are incomplete or inexistent.
- ☐ There is no information available about the different applications or their quality.
- ☐ The applications are in English, and there are no Spanish versions available.

PROBLEMS WITH THE USE OF COMPUTERS FOR THE CLASSROOM

- ☐ There is not enough help to supervise students who use computers.
- ☐ There are problems when trying to integrate the computer to the curriculum.
- ☐ Professors lack the necessary knowledge to use computers for educational purposes.
- ☐ There is insufficient guidance/experience to help professors use computers.

10. (cont.)

ORGANIZATIONAL/ADMINISTRATIVE PROBLEMS

- ☐ There is insufficient time available for the professors or students to learn about computers.
- ☐ There is insufficient technical assistance to operate or give maintenance to the equipment.
- ☐ Computers are not accesible enough for professors.
- ☐ There is not enough training opportunity for professors.
- ☐ There is not enough administrative support.
- ☐ There is not enough financial support.

MISCELLANEOUS

- ☐ There is not enough interest on the part of professors.
- ☐ There is not enough interest on the part of students.
- ☐ Other (*please, specify*) _____

11. What percentage of the applications you use are actually in Spanish?

- ☐ None.
- ☐ Less than 10%
- ☐ 10%-49%
- ☐ 50%-90%
- ☐ More than 90%
- ☐ All.

SECTION B: QUESTIONS FOR PROFESSORS WHO DO NOT USE COMPUTERS

IF YOU USE COMPUTERS,
PLEASE SKIP TO SECTION C, THE BOTTOM OF THIS PAGE

12. The following is a list of reasons why not to use computers.
Which of these apply to you?
Please, mark all that apply.

- ☐ I do not have time to learn about computers.
- ☐ I am not interested in learning how to use computers.
- ☐ The support needed to learn how to use computers is nonexistent.
- ☐ Computers are very difficult to use.
- ☐ I do not have the need to use computers in my job.
- ☐ You must know English to be able to use computers.
- ☐ The number of computers is insufficient.
- ☐ The energy supply is deficient.
- ☐ There is insufficient guidance/experience to help professors use computers.
- ☐ Computers are not accesible enough for professors.
- ☐ There is not enough training opportunity for professors.
- ☐ There is not enough administrative support.
- ☐ There is not enough financial support.
- ☐ Other (*please, specify*) _____

SECTION C: QUESTIONS FOR ALL PROFESSORS

13. The following is a list of statements designed for you to indicate whether you agree or not with each one of them. There are no correct or incorrect answers to these statements.
For each statement, please mark with an "x" the appropriate box.

	Strongly agree	Agree	Disagree	Strongly disagree
a. I would like working with computers.	☐	☐	☐	☐
b. I do not think I could do advanced computer work.	☐	☐	☐	☐
c. I think that working with computers would be enjoyable and stimulating .	☐	☐	☐	☐

13. (cont.)

	Strongly agree	Agree	Disagree	Strongly disagree
d. Learning about computers is worthwhile.	☐	☐	☐	☐
e. I am sure I could do work with computers.	☐	☐	☐	☐
f. It wouldn't bother me at all to take computer courses.	☐	☐	☐	☐
g. I expect to have little use for computers in my daily life.	☐	☐	☐	☐
h. Computers make me feel uncomfortable.	☐	☐	☐	☐
i. I don't understand how some people can spend so much time working with computers and seem to enjoy it.	☐	☐	☐	☐
j. I can't think of any way that I will use computers in my career.	☐	☐	☐	☐
k. I think that using computers would be very hard for me.	☐	☐	☐	☐
l. I would feel comfortable working with a computer.	☐	☐	☐	☐

14. What advantages do you see in using computers at the university?
Please, mark all that apply.

☐ Work gets done much faster.
☐ It improves communication.
☐ It improves the quality of education.
☐ Other(*please, specify*) _____

☐ I do not see any advantages of using computers at the university.

15. What disadvantages do you see in using computers at the university?
Please, mark all that apply.

- ☐ No advantage is taken of the equipment, because it is too difficult to use.
- ☐ The money used for buying computers could be used for better purposes.
- ☐ Other (*please, specify*) _____

☐ I do not see any disadvantages of using computers at the university.

SECTION D: ADDITIONAL QUESTIONS

16. Have you participated in any training course on computing offered by your university?

- ☐ No training course has been offered to professors.
- ☐ Some courses have been offered, but I have not participated in any of them.
- ☐ Yes, I have participated in one or more training courses on computing.

17. Which of the following topics did you learn about in teacher training courses, both in or out of the university?

COMPUTERS AND SOCIETY

- ☐ history/evolution.
- ☐ importance of computing (personal, business, and educational).
- ☐ impact of the applications of the computer.
- ☐ ethical issues (privacy, author copyright, etc.).

APPLICATIONS

- ☐ editing/word processing/desktop publishing.
- ☐ drawing/art/illustration.
- ☐ spreadsheets.
- ☐ database management.
- ☐ statistical applications.
- ☐ artificial intelligence/expert systems.
- ☐ tutoring languages.
- ☐ modelling and simulation.
- ☐ laboratory data acquisition.

17. (cont.)

- ☐ scanning/image processing.
- ☐ CAD/CAM/processes control/robotics.
- ☐ telecommunications/e-mail/computer networking.
- ☐ educational/recreational games.
- ☐ music.

PROBLEM ANALYSIS AND PROGRAMMING

- ☐ general concepts (files, variables, arrays, loops).
- ☐ general programming procedures.
- ☐ structured programming.
- ☐ programming languages.
- ☐ problem analysis (algorithms, etc.)

HARDWARE AND SOFTWARE PRINCIPLES

- ☐ basic concepts about computers and computing systems.
- ☐ hardware (computing architecture, CPU, control data flow).
- ☐ applications (software architecture, system software).

INSTRUCTIONAL AND PEDAGOGICAL ISSUES

- ☐ applications of tutoring, drill and practice programs.
- ☐ how to look for evaluations of educational programs.
- ☐ how to evaluate educational programs.
- ☐ integration of computer programs to existent classes.
- ☐ organization of the use of computers during the lectures.
- ☐ Other (*please, specify*) _____

☐ NONE OF THE ABOVE

18. Taking into consideration the results of these training courses, as well as all pedagogical and technical aspects, what would be your opinion about them?

- ☐ Excellent
- ☐ Good
- ☐ Average
- ☐ Deficient
- ☐ Mediocre

SECTION E: PERSONAL INFORMATION

19. Please indicate the highest educational degree you have received.

- ☐ Undergraduate - partial
- ☐ Undergraduate - complete
- ☐ Graduate - Masters
- ☐ Graduate - Doctorate
- ☐ Other (*please, specify*) _____

20. How many years of experience have you had in the field of education?

Years of experience in education: _____

21. What year where you born?

19 _____

22. What is your gender?

- ☐ Male
- ☐ Female

23. If you want to make any additional comments about any aspect of computing, both personally or for education, please use this space to do so.

_____

_____

_____

_____

_____

_____

_____

APPENDIX C

Administrative Interview Schedule

ADMINISTRATION INTERVIEW SCHEDULE

BACKGROUND QUESTIONS

1. Location of the university.

2. Size of the university
   - Approximate student population and trend over past three years.
   - Number of branches.
   - Approximate General Budget.
   - Percentage of Budget that is covered by subsides.

3. Mission of the university
   - Orientation (Technical, Social, Arts).
   - Majors offered.
   - Availability of technical careers.
   - Market, target population of the university.

4. History
   - Goals set by the founders of the university.
   - Development of th university.

STRUCTURE OF THE UNIVERSITY

1. Organizational structure
   - Decision-making organisms.
   - Administrative departments.
   - Academic deparments.
   - Role of computer centre in administration.
   - Flow of administrative decisions regarding computing.

2. Professors
   - Number of professors.
   - Salary structure.
   - Requirements.

COMPUTING

1. Computing organizational structure and trend (centralized/distributed).

2. Experience of the university with computing for administrative/academic purposes.

3. Percentage of the budget dedicated to computing matters.

4. Trends of investment in computing over the last few years.

5. Special programs for professors
   - Training
   - Incentives for computer purchases/financing
   - Incentives to use computers

6. Purchase of computing equipment
   - Funds for adquisition of computing equipment
   - Agencies or aid programs that contribute to adquisition of computing equipment (if any).
   - General description of the last major purchase of equipment
     - Approximate date.
     - Kind of equipment.
     - Rationale.
   - Frequency of adquisition of computing equipment.

7. Perceived advantages of computing
   - For administration
   - For education

8. Problems of computing
   - For administration
   - For education

9. Future Plans

APPENDIX D

Technical Interview Schedule

TECHNICAL INTERVIEW SCHEDULE

HARDWARE AND OPERATING SYSTEMS

1. Number of computers.

2. Types of computers
   - Mainframes.
   - Minicomputers.
   - Workstations.
   - Microcomputers.

3. Operating systems
   - Mainframes.
   - Minicomputers.
   - Workstations.
   - Microcomputers.

4. Experience with the use of computers.

5. Plans for the future.

6. Budget for computing.

7. Number of computers available
   - For administration.
   - For professors.
   - For students.

8. Types of computers available
   - For administration.
   - For professors.
   - For students.

APPLICATION SOFTWARE

1. Availability of application software
   - For administration.
   - For professors.
   - For students.

2. Software development
   - For administration.
   - For professors.
   - For students.

3. Off-the-shelf software used.
   - For administration.
   - For professors.
   - For students.

PHYSICAL SUPPORT

1. Availability of power generators.
2. Quality of energy service (with and without generator).
3. Availability of computers:
   - Location of computing resources
   - Access to computing resources (local/remote)

HUMAN SUPPORT

1. Available of technical support:
   - For administration.
   - For professors.
   - For students.

2. Experience of techical staff.

3. Training
    - For administration.
    - For professors.
    - For students.

4. General information provided about computing.

APPENDIX E

Tables for Figures in Chapter 4

Table for Figure 5

Distribution of the highest degrees held by surveyed professors accross universities.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
UnderGrad (Partial)	0.00	0.00	0.00	3.57	3.85	0.00	8.33
UnderGrad (Complete)	55.26	80.00	20.00	60.71	76.92	55.56	66.67
Master's	39.47	11.43	64.00	25.00	11.54	27.78	16.67
Doctoral	5.26	8.57	12.00	10.71	7.69	11.11	8.33
Other	0.00	0.00	4.00	0.00	0.00	0.00	0.00
Did not answer	0.00	0.00	0.00	0.00	0.00	5.56	0.00
Total %	99.99	100.00	100.00	99.99	100.00	100.01	100.00

Table for Figure 6

Percentage of computer-using professors accross universities.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
User	73.68	37.14	52.00	21.43	34.62	50.00	25.00
Non-user	26.32	62.86	48.00	78.57	65.38	50.00	75.00
Total %	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table for Figure 7

Computing experience of computer users accross universities.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
1 year	10.71	15.38	7.69	16.67	0.00	0.00	16.67
1-3 years	25.00	23.08	7.69	66.67	44.44	22.22	0.00
4 years or more	64.29	61.54	84.62	16.67	55.56	77.78	83.33
Total %	100.00	100.00	100.00	100.01	100.00	100.00	100.00

Table for Figure 9

Computing experience of computer users accross universities.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Univ/Traning	42.86	30.77	53.85	50.00	33.33	44.44	33.33
Univ/Professor	0.00	0.00	15.38	0.00	0.00	0.00	0.00
At Home	10.71	0.00	7.69	16.67	11.11	11.11	16.67
Somewhere else	46.43	69.23	23.08	33.33	55.56	33.33	16.67
Did not answer	0.00	0.00	0.00	0.00	0.00	11.11	33.33
Total	100.00	100.00	100.00	100.00	100.00	99.99	100.00

Table for Figure 10

Percentage of YES and NO responses to knowledge questions about computers.

	YES	NO	DNA	Total %
K1: I know several users of computers	90.48	8.33	1.19	100.00
K2: I know several advantages of using computers in education	88.10	10.70	1.19	99.99
K3: I know several criteria to judge printers	66.67	32.14	1.19	100.00
K4: I know what a modem is	70.24	27.38	2.38	100.00
K5: I know different kinds of computers	72.62	26.19	1.19	100.00
K6: I know how to write a simple computer program	73.81	25.00	1.19	100.00
K7: I know how to exchange data among different kinds of computers	41.67	57.14	1.19	100.00
K8: I know how to copy a file from one disk to another	89.28	9.52	1.19	99.99
K9: I know how to edit a document in a word processor	88.10	10.71	1.19	100.00
K10: I know how to create a data file in a computer	88.10	10.71	1.19	100.00

Table for Figure 12

Percentage of computer users who said they had computers available at their universities.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Available	75.00	69.23	100.00	33.33	55.56	55.56	50.00
Not Available	25.00	30.77	0.00	66.67	44.44	44.44	50.00
Total %	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table for Figure 13

Percentage of users who said the number of computers was adequate, and inadequate.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Adequate	35.71	84.62	30.77	33.33	44.44	11.11	0.00
Inadequate	60.71	15.38	61.54	16.67	33.33	77.78	83.33
Did not answer	3.57	0.00	7.69	50.00	22.22	11.11	16.67
Total %	99.99	100.00	100.00	100.00	99.99	100.00	100.00

Table for Figure 14

Percentage of computer users who experienced hardware-related problems.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Limitations of equipment	35.7	23.1	30.8	0	0	33.3	33.3
Maintenance is deficient	42.9	23.1	23.1	0	33.3	44.4	50
Insufficient peripherals	35.7	46.2	30.8	50	33.3	33.3	50

Table for Figure 15

Percentage of non-users who did not use computers because of hardware-related reasons.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Insufficient computers	10	4.55	33.33	18.18	11.76	22.22	11.11
Computers not accesible	60	45.45	58.33	59.09	47.06	66.67	38.89

Table for Figure 16

Percentage of computer users who experienced software-related problems.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Apps are difficult to use	7.14	7.69	30.77	0.00	0.00	0.00	16.67
Apps only in English	21.43	15.38	23.08	16.67	44.44	11.11	16.67
No information on Apps	21.43	23.08	46.15	16.67	44.44	11.11	16.67
Not enough Apps	46.43	38.46	23.08	33.33	22.22	11.11	16.67
No Manuals & Support	50.00	38.46	46.15	50.00	44.44	33.33	50.00

Table for Figure 17

Percentage of users who said the location of computers was adequate, and inadequate.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Adequate	46.43	61.53	61.54	33.34	55.55	44.44	50.00
Inadequate	42.86	7.69	30.77	16.67	22.22	44.44	33.34
Did not answer	10.71	30.77	7.69	50.00	22.22	11.11	16.67
Total %	100.00	99.99	100.00	100.01	99.99	99.99	100.01

Table for Figure 18

Percentage of users who said the supply of electricity was adequate, and inadequate.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Adequate	57.14	53.84	69.23	0.00	55.55	44.44	16.67
Inadequate	32.15	7.69	23.07	33.34	22.22	44.44	66.67
Did not answer	10.71	38.46	7.69	66.67	22.22	11.11	16.67
Total %	100.00	99.99	99.99	100.01	99.99	99.99	100.01

Table for Figure 19

Percentage of computer users who obtained computer training by different means.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Univ/ as a professor	21.43	23.08	38.46	0.00	11.11	11.11	33.33
Other	32.14	38.46	0.00	33.33	44.44	33.33	0.00
Univ/ as a student	53.57	46.15	69.23	16.67	33.33	55.56	66.67
Technical Institute	53.57	76.92	23.08	66.67	55.56	22.22	83.33

Table for Figure 20

Percentage of professors who thought there was not enough training opportunity.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Non-users	70.00	36.36	66.67	54.55	35.29	55.56	38.89
Users	46.43	61.54	30.77	50.00	55.56	55.56	66.67

Table for Figure 21

Percentage of professors who were aware of, and given training courses at their university.

	INTEC	UNIBE	UNPHU
Some courses offered, but I have not participated in any of them	60.53	46.15	50.00
No courses have been offered	13.16	42.31	44.44
Yes, I have participated in one or more courses in my university	26.32	7.69	5.56
Did not answer	0.00	3.85	0.00
Total %	100.01	100.00	100.00

Table for Figure 22

Percentage of professors who said these topics were taught in training courses.

	INTEC	UNIBE	UNPHU	TOTAL	N
Computers and Society					
1: History and evolution of computers	45.45	46.15	42.86	45.24	19.00
2: Importance of computing.	63.64	61.54	71.43	64.29	27.00
3: Impacts of the applications of computers	54.55	53.85	42.86	52.38	22.00
4: Ethical Issues (Privacy, copyright, etc.)	9.09	23.08	14.29	14.29	6.00
Applications					
5: Editing, word processing, publishing	77.27	61.54	71.43	71.43	30.00
6: Drawing, art, illustration	9.09	38.46	42.86	23.81	10.00
7: Spreadsheets	54.55	30.77	42.86	45.24	19.00
8: Database management	45.45	46.15	42.86	45.24	19.00
9: Statistical applications	36.36	15.38	0.00	23.81	10.00
10: Artificial intelligence, expert systems	4.55	0.00	28.57	7.14	3.00
11: Tutoring languages	13.64	38.46	28.57	23.81	10.00
12: Modelling and simulation	13.64	15.38	0.00	11.90	5.00
13: Laboratory data acquisition	4.55	0.00	14.29	4.76	2.00
14: Scanning, image processing	4.55	38.46	0.00	14.29	6.00
15: CAD/CAM, processes control, robotics	9.09	15.38	14.29	11.90	5.00
16: Telecommunications, e-mail, networking	13.64	15.38	42.86	19.05	8.00
17: Educational, recreational games	13.64	23.08	42.86	21.43	9.00
18: Music	4.55	15.38	14.29	9.52	4.00

Table for Figure 22 (cont.)

	INTEC	UNIBE	UNPHU	TOTAL	N
Problem Analysis and Programming					
19: General concepts (files, variables, etc.)	72.73	53.85	42.86	61.90	26.00
20: General programming procedures	54.55	23.08	42.86	42.86	18.00
21: Structured programming	36.36	15.38	42.86	30.95	13.00
22: Programming languages	45.45	30.77	42.86	40.48	17.00
23: Problem analysis (algorithms, etc.)	40.91	15.38	28.57	30.95	13.00
Hardware and Software Principles					
24: Basic concepts about computers	81.82	53.85	85.71	73.81	31.00
25: Hardware (comp. architechture, CPU, etc)	27.27	38.46	28.57	30.95	13.00
26: Applications (system software, etc.)	13.64	30.77	14.29	19.05	8.00
Instructional and Pedagogical Issues					
27: Applications of tutoring, drill and practice	18.18	15.38	28.57	19.05	8.00
28: How to look for evaluations of educ. pgm	0.00	0.00	14.29	2.38	1.00
29: How to evaluate educational programs	4.55	7.69	28.57	9.52	4.00
30: Integration of software to existing classes	9.09	15.38	14.29	11.90	5.00
31: Organiz. of computer usage in classes	4.55	7.69	28.57	9.52	4.00
32: Other	0.00	0.00	0.00	0.00	0.00

Table for Figure 23

Professors rating of the training courses received in their university.

	INTEC	UNIBE	UNPHU
Mediocre	19.05	20.00	14.29
Deficient	23.81	0.00	0.00
Average	19.05	0.00	0.00
Good	33.33	30.00	85.71
Excellent	4.76	50.00	0.00
Total %	100.00	100.00	10.000

Table for Figure 24

Percentage of users who said the availability of technical personnel was adequate, and inadequate.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Adequate	39.28	61.54	30.77	33.33	44.44	55.56	50.00
Inadequate	42.85	30.77	61.53	16.67	22.22	33.33	33.33
Did not answer	17.86	7.69	7.69	50.00	33.33	11.11	16.67
Total %	99.99	100.00	99.99	100.00	99.99	100.00	100.00

Table for Figure 25

Percentage of users who said the experience of technical personnel was adequate, and inadequate.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Adequate	53.57	53.85	46.15	33.33	66.67	66.67	66.67
Inadequate	28.57	15.38	46.15	16.67	11.11	22.22	16.67
Did not answer	17.86	30.77	7.69	50.00	22.22	11.11	16.67
Total %	100.00	100.00	99.99	100.00	100.00	100.00	100.01

Table for Figure 26

Percentage of professors who thought poor maintenance of equipment was a problem.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Is a problem	32.14	23.08	15.38	0.00	22.22	33.33	50.00
Not a problem	64.29	76.92	69.23	83.33	66.67	55.56	50.00
Did not answer	3.57	0.00	15.38	16.67	11.11	11.11	0.00
Total %	100.00	100.00	99.99	100.00	100.00	100.00	100.00

Table for Figure 27

Sources of information for computer users who keep up-to-date in computing.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
University Info	14.29	15.38	0.00	0.00	11.11	0.00	16.67
Other	10.71	30.77	7.69	16.67	33.33	22.22	16.67
Magazines	42.86	69.23	46.15	33.33	44.44	22.22	66.67
Friends and Colleagues	64.29	76.92	76.92	83.33	100.00	22.22	66.67

Table for Figure 28

Percentage of professors who thought availability of information was adequate, and inadequate.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Adequate	28.57	46.15	46.15	50.00	55.55	22.22	33.33
Inadequate	53.57	15.38	38.46	0.00	22.22	66.67	50.00
Did not answer	17.86	38.46	15.38	50.00	22.22	11.11	16.67
Total %	100.00	99.99	99.99	100.00	99.99	100.00	100.00

Table for Figure 29

Number of users and non-users that were aware of, and participated in training courses.

	USERS	NON-USERS
Yes, I have participated in one or more courses in my university	9	4
Some courses offered, but I have not participated in any of them	27	17
No courses have been offered	10	14
Total (n)	46	35

Table for Figure 30

Percentage of the applications used by professors that are in Spanish.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
None	25.00	7.69	53.85	33.33	22.22	22.22	16.67
Less than 10%	50.00	53.85	38.46	50.00	33.33	55.56	66.67
10% – 90%	21.43	23.07	0.00	16.67	44.44	22.22	0.00
More than 90%	3.57	15.38	0.00	0.00	0.00	0.00	16.67
Did not answer	0.00	0.00	7.69	0.00	0.00	0.00	0.00
Total (%)	100.00	99.99	100.00	100.00	99.99	100.00	100.01

Table for Figure 31

Percentage of computes users who experienced administrative/organizational problems.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Not enough student interest	3.57	23.08	0.00	0.00	11.11	11.11	0.00
Not enough professor interest	21.43	30.77	30.77	16.67	44.44	33.33	16.67
Not enough time to learn	46.43	61.54	15.38	16.67	22.22	44.44	0.00
Not enough admin. support	46.43	30.77	38.46	16.67	33.33	55.56	33.33
Not enough financial support	50.00	46.15	61.54	16.67	0.00	44.44	100.00

Table for Figure 32

Percentage of non-users who thought these were reasons for not using computers.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
No interest in learning comp.	0.00	0.00	8.33	0.00	5.88	0.00	0.00
Not enough admin. support	30.00	18.18	16.67	36.36	17.65	22.22	11.11
Not enough guidance for profs	30.00	27.27	41.67	31.82	5.88	33.33	38.89
Not enough financial support	50.00	13.64	33.33	40.91	11.76	55.56	22.22
Not enough time to learn	30.00	54.55	25.00	13.64	35.29	11.11	50.00

Table for Figure 33

Percentage of computes users who experienced problems using computers for instruction.

	INTEC	O&M	PUCMM	UCSD	UNIBE	UNPHU	UTESA
Problems integrating computers to the curriculum	50.00	0.00	23.08	0.00	11.11	22.22	33.33
Not enough help to supervise students	42.86	38.46	7.69	33.33	44.44	11.11	33.33
Profs lack knowledge on using computers for education	53.57	38.46	61.54	16.67	22.22	44.44	50.00
Not enough guidance to help professors use computers	57.14	38.46	38.46	0.00	55.56	55.56	66.67

Table for Figure 34

Percentage of professors who use each kind of computer application.

APPLICATION	% USERS
Word Processing	83.33
Spreadsheets	64.29
Graphics	55.95
Database	55.95
BASIC	50.00
Stats	45.24
Graphic Arts/Drawing	42.86
Games	41.67
Other Languages	38.10
Drill & Practice	32.14
Simulations	23.81
CAD	21.43
Data Acquisition (Labs)	8.33
Music	7.14
LOGO	7.14

Table for Figure 35

Frequency with which professors who use each kind of computer application.

	ALWAYS	OFTEN	SOMETIMES	RARELY
Word Processing	32.14	32.14	17.86	1.19
Spreadsheets	16.67	22.62	17.86	7.14
Graphics	11.90	19.05	13.10	11.90
Database	11.90	15.48	21.43	7.14
BASIC	10.71	9.52	19.05	10.71
Stats	3.57	11.90	20.24	9.52
Graphic Arts/Drawing	5.95	11.90	14.29	10.71
Games	2.38	5.95	16.67	16.67
Other Languages	10.71	13.10	9.52	4.76
Drill & Practice	11.90	10.71	4.76	4.76
Simulations	1.19	7.14	8.33	7.14
CAD	1.19	5.95	9.52	4.76
Data Acquisition (Labs)	1.19	0.00	1.19	5.95
Music	0.00	0.00	2.38	4.76
LOGO	1.19	2.38	2.38	1.19

Table for Figure 36

Percentage of professors who use applications for personal, educational use, or both.

	PERSONAL	BOTH	EDUCATIONAL
Word Processing	32.14	46.43	3.57
Spreadsheets	25.00	32.14	5.95
Graphics	28.57	19.05	7.14
Database	34.52	15.48	4.76
BASIC	27.38	14.29	7.14
Stats	26.19	13.10	4.76
Graphic Arts/Drawing	23.81	14.29	3.57
Games	35.71	2.38	2.38
Other Languages	14.29	17.86	4.76
Drill & Practice	2.38	16.67	10.71
Simulations	11.90	5.95	4.76
CAD	14.29	5.95	1.19
Data Acquisition (Labs)	4.76	3.57	0.00
Music	5.95	0.00	0.00
LOGO	4.76	0.00	2.38