Revolutionary Development of Computer Education – A Success Story

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Abstract. The University of Colombo, Sri Lanka has been in the forefront of the "Computer Revolution" in Sri Lanka. It has introduced the teaching of computer programming and applications as early as in 1967, more than a decade before other educational institutions, thereby producing, over the years, a large number of pioneer computer scientists and IT graduates out of students entering the university from a variety of disciplines. They are presently employed as researchers, educators, data processing managers, analyst programmers, software engineers and in many others in the professional field of information technology, not only in Sri Lanka but also in other countries. Established in 1870 as the Ceylon Medical College by the government of that day under the leadership of Governor Sir Hercules Robinson, the University of Colombo could claim to have been associated with higher education for over 130 years. The University has become a center of excellence of international repute that contributes significantly towards national development and human resource development in the field on computer science and information communication technology, particularly in the South and South East Asian Region. This paper presents the milestones of the success story, which did not occur without a policy, plan, leadership, group work, collaboration, and donor support.

1. Introduction

The Democratic Socialist Republic of Sri Lanka, known in short as Sri Lanka is a free, sovereign, and independent democratic socialist republic. It is an island in the Indian Ocean located closer and to the north of the equator. With a total land area of 65,610 sq. km., it spans a length of 445 km. and a breadth of 225 km., encompassing

beaches, green vegetation, a mountainous mass somewhat south of centre with heights reaching about 2,500 meters, surrounded by broad plains.

Sri Lanka has a population of 19 million of whom the majority is Sinhalese (74%). Other ethnic groups are made up of Sri Lankan Tamils, Indian Tamils, Moors, Malays and Burghers. Although it is a multi-religious country, Buddhists constitute the majority (69%) and other religious groups are Hindus, Muslims and Christians. Sri Lanka has 46% of its population below 20 years. The literacy rate is 91%, one of the highest in Asia. Considering the infant mortality rate and the Life Expectancy etc., Sri Lanka continued to rank high in the world by indicators of Physical Quality of Life.

In terms of various e-readiness criteria, Sri Lanka is also ranked higher than neighboring Asian countries in spite of her relatively low penetration of computers, internet and other telecommunication media. According to the United Nations Report on e-Government Benchmarking [1], Sri Lanka is ranked at the eleventh among twenty-three countries in East/Southeast/South Asia region. Especially she marked a high ranking in Human capital index and E-Participation index.

Table 1. UNPAN's E-Government and E-Participation Index 2003

	E-Government Readiness				E-Participation	
Country	Index 2003	Web measure	Telecom	Human capital	Country	Index 2003
Singapore	0.746	0.703	0.666	0.87	Philippines	0.672
Korea	0.744	0.607	0.675	0.95	Korea	0.483
Japan	0.693	0.524	0.626	0.93	Singapore	0.466
Philippines	0.574	0.747	0.064	0.91	Japan	0.431
Brunei	0.549	0.266	0.250	0.86	Mongolia	0.379
Malaysia	0.524	0.480	0.292	0.80	**Sri Lanka**	**0.293**
Thailand	0.446	0.380	0.117	0.84	Indonesia	0.259
Indonesia	0.422	0.432	0.045	0.79	India	0.259
China	0.416	0.332	0.116	0.80	Pakistan	0.155
Maldives	0.410	0.262	0.069	0.90	Nepal	0.138
Sri Lanka	**0.385**	**0.279**	**0.036**	**0.84**	Cambodia	0.138
India	0.373	0.522	0.027	0.57	Malaysia	0.121
Vietnam	0.357	0.183	0.048	0.84	Thailand	0.103
Mongolia	0.343	0.140	0.040	0.85	China	0.069
Myanmar	0.280	0.087	0.003	0.75	Maldives	0.034
Nepal	0.268	0.319	0.006	0.48	Vietnam	0.017
Cambodia	0.264	0.127	0.004	0.66	Brunei	0.017
PNG	0.250	0.170	0.031	0.55	Bhutan	0.017
Pakistan	0.247	0.297	0.026	0.42	Bangladesh	0.017
Lao	0.192	0.048	0.007	0.52	PNG	0
Bangladesh	0.165	0.092	0.004	0.40	Myanmar	0
Bhutan	0.157	0.035	0.015	0.42	Lao	0
DPRK	0	0	0.011	0	DPRK	0

Source: UNPAN, e-Government Benchmarking Report 2003.

Another survey [2] conducted by regional association of information processing societies in the region, SEARCC (Southeast Asia Regional Computer Confederation), shows that age cohort of IT professionals over 40 occupies 15% in Sri Lanka (see Fig. 1 & 2). This percentage is the second largest next only to Japan among eight countries surveyed. It means that IT manpower training started since as early as the 1980s at substantial degree in Sri Lanka. Later in this paper, we reveal that this cohort corresponds to those who were trained under certificate courses offered by the University of Colombo during 80's. Actually, most of the senior managers in the IT Industry today had gone through training programs introduced during 1980s. Moreover, graduate level professionals trained later through 1990s were added to the pool of IT professionals.

In this article, authors try to describe historical process of IT education in this country. They also try to show how higher education sector has been instrumental in this process.

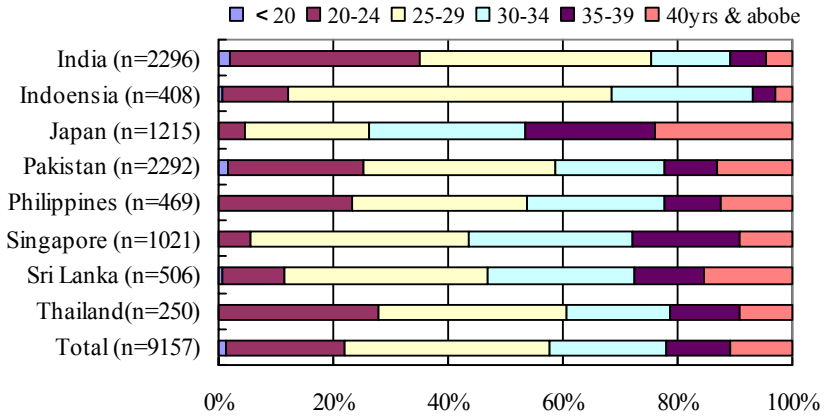

Fig. 1. Distribution of ICT Professionals by Age Group

2. Computing and Computer Education at the University of Colombo

2.1 Background: Sri Lanka - The land of free education

Before going to the recent development of computer education in Sri Lanka, the paper goes back to the traditions of education in the country. The world's first

museum and library were built in Sri Lanka 2200 years ago. The museum housed the parts of the ship that brought the *Bodhi* sapling to Sri Lanka from India in 3rd century B.C. In 1805, after the British invasion, education system was developed based on the British System and University of Colombo established in the year 1870, as the Ceylon Medical College.

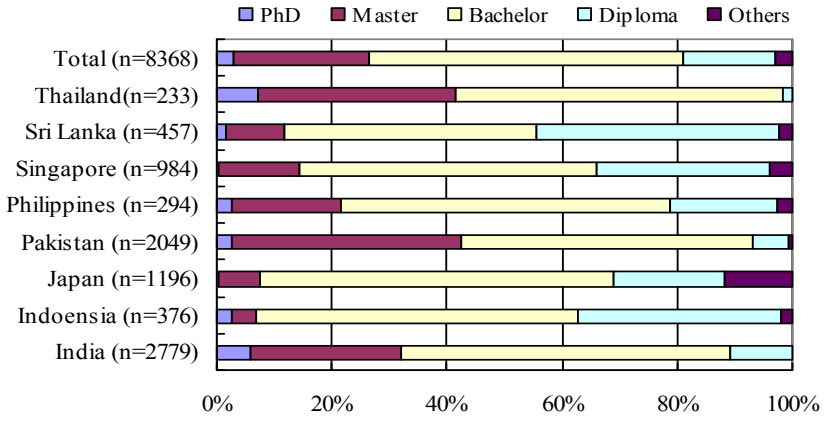

Fig. 2. Distribution of ICT Professionals by Education
Source: SEARCC Manpower and Skills Survey 1999-2000

A few years before receiving independence from the British, Hon. *C. W. W. Kannangara*, the then Minister of Education introduced several far-reaching policies in education. They included primary education in the mother tongue, free education, establishment of a number of quality schools in the all regions of the country and the provision of a mid day meal in school. These measures earned him the name "Father of Free Education". They have contributed immensely towards opening up higher education to the masses as opposed to the elite that benefited until then.

2.2 Teaching FORTRAN without computers

Teaching of computer programming and the use of computer applications for research at the University of Colombo commenced in 1967. The ICL 1901 computer at the State Engineering Corporation was used free of charge thanks to the encouragement given by their management towards the introduction of computing at the Universities in Sri Lanka. A few years later in 1971, the Department of Census and Statistics allowed the University free computer time on their IBM 360/25. The fact that these installations were close to the University of Colombo, the interest of both organizations in statistical and scientific applications helped the university researchers to make very good use of this invaluable gesture.

According to the development plan of the Faculty of Science [3] introduced in 1967, first teaching was restricted to FORTRAN programming to staff and students as an extra curricular activity. However, within a few years a combined course in Computer Programming and Numerical Methods was introduced as a paper in Applied Mathematics for the general degree. A single course unit in Computer Programming was introduced in the late seventies. The number of courses offered increased in late 1970's and the course unit system operating at the University of Colombo made it possible to offer a range of third year degree options. After the study on the introduction of Computer Studies submitted to the Ministry of Higher Education by Prof. Reeves (*Reeves, C. M.* [6]), Computer programming and Applications became a part of most postgraduate and undergraduate courses in the country.

During the initial stage of this activity, the practical sessions were not available for the students due to the non-availability of computer(s) at the University of Colombo. However, the students who were keen to take the course unit in FORTRAN programming had to imagine the machine's internal functionality and code accordingly to solve problems only on the paper and then transferred to punched cards and sent to the computer elsewhere. One of the significant achievements in computing history in Sri Lanka noted here; the introduction of the Glossary of Technical Terms for Mathematics and Computing [7] for Sinhala & Tamil languages in 1956 is unforgettable.

The above programmes were initiated by the Mathematics Department of the University of Colombo, which was at that time developing the field of Applied Statistics. A Statistical Unit that was established in 1968 at the request of the Department of Mathematics, the Department of Geography, and the Faculty of Medicine did not survive long, due manly to the loss of several key staff members to overseas universities. However, thanks to the support received from the staff of the Department of Applied Statistics of the University of Reading, UK with British funding, the Statistical Unit was revived. Reading was involved in a link arrangement since 1974 and helped the Statistical Unit to progress steadily to become a National Center for Statistical Research, Teaching and Consultancy.

2.3 Computer Programming Course Units for non-science students

Under the Higher Education Reforms that took place in 1972 (*Prof. Jayarthne* Report), the Department of Mathematics and the Statistical Unit of the University of Colombo made the remarkable attempt to initiate new course units in Mathematics, Statistics and FORTRAN Programming for Faculty of Art degree students following the newly introduced Special Degree in Development Studies. 30 students were selected among 210 reading for the above degree and given the opportunity to follow a special degree stream that was specially designed and managed by the

Department of Mathematics of the University of Colombo. This combination of art and computing education is a unique and visionary attempt ever seen.

2.4 First computer of the University of Colombo

The requirement of the Statistical Unit of the University of Colombo in the form of computing support for research, consultancy and teaching resulted in a substantial increase on the computing field. Soon thereafter, it was felt that the Statistical Unit should have its own computer for teaching and consultancy in addition to using the free computer time available for research at the Department of Census and Statistics as indicated earlier. An HP9825 desktop microcomputer (HP claimed that this is a Calculator) was obtained under the link arrangement with British Government Assistance in 1977. This introduced in-house computing at the University of Colombo and a small computer center was established in the same year. Unfortunately, difficulties arising out of the non-availability of local servicing facilities made this excellent machine (at that time) rather unpredictable. In 1978, the HP9825 microcomputer was send back to UK for repairs, and it was lost in the process and was never seen again. In 1980, a serious attempt [4] was made to fulfill the need for computing power with a modern computer, capable of statistical work and therefore having a configuration allowing the implementation of some of the well-known statistical packages. The result was the purchase of a Data General Eclipse S/140 mini computer with time sharing, multi user interactive capabilities together with adequate disc storage (20 MB), RAM (128 KB) and a magnetic tape drive with three terminals. The purchase was made possible by the pooling of funds from Netherlands Universities Foundation for International Cooperation (NUFFIC), University Grants Commission (UGC) and the Equipment Vote of the Faculty of Science of the University of Colombo. Authors wish to record our appreciation of this timely assistance to introduce a multi-user, multitasking computer to the University of Colombo. One major objective in selecting the particular computer configuration was the implementation of third party software packages used worldwide such as GLIM, MINITAB and SPSS which have been implemented on these machines.

Up to the early seventies, teaching was confined to one member of staff. In the late seventies, more were available and the support staff recruited for the Statistical Unit were able to double up as teachers of computing. Some of the academic staff who had obtained their postgraduate degree in statistics in overseas also devoted a considerable amount of their efforts towards matters relating to computer applications [5].

2.5 Computers go public

One of the main demarcation points of history of computing in Sri Lanka was the introduction of computers for assisting the Commissioner of Elections for processing and telecasting results for the National Presidential Election held in November 1982. In late 1981, thanks to the Reading-Colombo Link programme, Colombo made a request to Overseas Development Assistance (ODA), UK for assistance to purchase a few BBC microcomputers, due to be released to the market in 1982. When they did arrive, in October 1982, this remarkable microcomputer was an immediate success and the Compute Center received much publicity among the public by their computer display that enabled the telecast of the 1982 Presidential Elections. This saw the use of computers to process election results and the release of results as graphics displays for telecasting. For this, floppy disk drives for the BBC microcomputer were used even before they were introduced to the UK market. This process of release of results of every national election has continued without a single break thereafter, with technological improvement at every stage. In addition, this was the one of the early attempt to introduce local language processing in the country.

The BBC microcomputer has been exploited for use as a tool for teaching statistics, programming and for research in addition to its value as an aid for promoting computer literacy. In 1983, ODA, UK granted GBP 10,000/- in addition to the GBP 3,000/- given in 1982 and the UGC grant for microcomputers was used together with this grant to establish a networked laboratory of 13 BBC microcomputers and also purchase several stand alone BBC microcomputers with disc drives, second processors and other peripherals and software.

2.6 First ever computer courses for public and government employee

With high publicity received by the University of Colombo due to the release of the Presidential Election results, the Computer Center was able to inaugurate a Certificate Course in Computer Applications for the general public, to be held during week ends, not interfering with the undergraduate courses. These courses were primarily meant for the employed to gain knowledge of computer applications rather than to those wanting to learn computer programming for employment. Furthermore, preference was given to those in the scientific and educational sectors. Literacy courses were conducted for students of the Institute of Workers' Education of the University of Colombo and proved to be a success. This success is reflected in Fig.2 where the large number of high ranking IT professional in the industry are holding diplomas and it is the highest among region.

As highlighted by the National Computer Policy for Sri Lanka [8], University of Colombo realized an important aspect of the its Computer Center's extension work

through a Computer Literacy programme in Schools. In early 1983, the Ministry of Education introduced Computer Assisted Education to three schools as a pilot project and the University of Colombo helped the Ministry in launching its Computer Education Programme through teacher training. Managing the selection and training of the Sri Lankan team to the International Olympiad in Informatics (IOI) where during the period of participation since 1992, 3 gold, 5 silver and 14 bronze medals have been won. The IOI of 2004 in Greece saw an excellent performance from the Sri Lankan team which won one gold and three bronze medals coming fifth among Asian countries.

While developing its computing facilities and skills of its staff in computing, the University of Colombo also took steps to encourage actively the use of computers in scientific research. A computer exhibition on "Computers for Scientific Research" was held by the Computer Center during Annual sessions of the Sri Lanka Association for the Advancement of Science (SLAAS) in December 1982 and several seminars, training sessions etc. have been held since then. The large number of computers and applications exhibited at the Natural Resources, Energy and Science Authority of Sri Lanka (NARESA) sponsored "National Exhibition on Science and Technology" held in 1985 clearly indicated the advances made by then.

Due to the demand increased, the Data General Mini Computer was upgraded to have 15 terminal and later facilities at the Computer Center was upgraded with an additional Data General MV2000 with 1MB RAM and AOS/VS operating system. There were by then three microcomputer laboratories of BBC microcomputers and accessories at Colombo University. The IBM-PC and WANG-PC computers were in heavy demand. A Kaypro 2 received as a gift, and the RadioShack TRS80-16 were used for student projects as well as consultancy work.

The staff of the Computer Center have succeeded in making the BBC a terminal for the Data General Mini Computer thus making available a versatile and low cost terminal as well as a device for data transfer between two computer systems. "INSTAT", a Statistical Package for the BBC microcomputer, developed with the collaboration of the University of Reading in the UK, was released to the overseas market [9].

2.7 Early regional training activities

The University of Colombo was involved with the organisation of the Asian Regional College on Microprocessor in June 1984 supported by the International Centre for Theoretical Physics, Trieste, Italy and co-sponsored by the UGC and The Council for Information Technology (CINTEC). This benefited 40 foreign and 32 Sri Lankan participants. A sum of US$ 120,000/- was raised for the Collage. Of this US$10,000/- was funds earmarked for the University of Colombo by UNESCO. This resulted in a valuable set of books being made available for the Library. Another international course was supported by the University of Reading and

cosponsored by the Computer Center and the Statistical Unit in December 1984, on "Statistics in Agriculture", with a heavy bias towards computer use in agriculture. Fourteen foreign and ten local participants took part and they were supported by several international and national organizations including the Agrarian Research and Training Centre, Sri Lanka. This was repeated in 1985 for 30 local participants. In 1984, the Computer Center helped the British Council and the Ministry of Education to conduct two-week courses on "Computer Education" for school teachers and curriculum developers. All these activities have provided valuable experience to the staff and have also contributed significantly towards promoting the development of computer applications in the country.

2.8 Staff exchange programmes and postgraduate training

British Assistance for Statistics provided for staff training in Computing too through the link with the University of Reading, UK. The UGC initiative following the Reeves Report [6] also provided training in Computing at the University of Wales, UK. Subsequent support from the UNDP helped continue this trend. Many staff members returned with a Diploma, M.Sc., M.Phil., and PhD. in Computer Science during 80's and 90's as a result of these initiatives. Many received training in Japan too. Although there was some staff loss to the private sector or overseas, new blood was pumped into the Center. Incentives in the form of job satisfaction, additional remuneration received from extension courses and consultancy work, and an ever improving range of available hardware and software and good work environment, together with challenging projects made many stay, in spite of much better job prospects elsewhere.

2.9 Collaborative research activities

A collaborative research project on crop and climate data between the University of Colombo and the University Reading resulted in a data base being developed at Colombo University and many local and overseas groups and Research Institutes were able to obtain data for their research. This Crop and Climate Database project computerised the range of daily climate data, including temperature, rain, wind etc. collected from 100 metrological stations established around the island for the past 100 years. This, together with the consultancy work done in the areas of Agriculture, Health and Education made the Computer Center a very useful resource in Sri Lanka. It developed expertise in the packages INFORMIX, SAS and SPSS and became the only expert group for such packages in the county at that time [13][14].

The Collaborative work with Research Institutes such as the Rubber Research Institute (RRI), Tea Research Institute (TRI), Coconut Research Institute (CRI) and

Meteorology Department grew during early 1980's with advice given on computing including evaluation of needs and assistance in purchasing of computer equipment and also training.

2.10 Establishment of a fully pledged academic department for computing

In January 1985, the existing Department of Mathematics split into two departments [10]; one remained as the Mathematics Department and a new Department of Statistics and Computer Science (DSCS) was established. It was only in 1986 that the formal separation took place as the separation of activities was not a simple exercise.

The Department of Computer Science (DCS) of the University of Colombo was established in year 2001 by splitting the Department of Statistics and Computer Science (DSCS), which functioned since 1985 as part of the Faculty of Science of the University of Colombo. While the DCS was responsible for undergraduate and postgraduate training in Computer Science, the Department of Statistics (DS) was responsible for statistical education in both undergraduate and postgraduate education. Although the University of Colombo, its first batch of students specializing in Computer Science and obtaining the B.Sc special degree graduated in 1992, the first such group in Sri Lanka.

2.11 Establishment of Institute of Computer Technology (ICT)

In early 1984, the University of Colombo Computer Center, while consolidating its position as leading computer installation and consultancy service, worked on plans for the establishment of an Institute of Computer Technology (ICT) with the assistance of the Japanese Government [11][12].

An initiative of CINTEC, the University of Colombo, and the UGC resulted in the establishment of the Institute of Computer Technology (ICT) at the University of Colombo in 1987 as an Institute established under the Universities Act [15]. The ICT was provided with the largest mainframe computer system in the country then with other peripherals and staff training under Project Type Technical Co-operation of the Japan International Cooperation Agency (JICA), Government of Japan. The ICT was to conduct Postgraduate Training programs to produce Analyst Programmers for the country. This was a result of the Japanese Mission's visits to the Computer Center of the University of Colombo in April 1984 and in February 1986 in relation to the proposed Institute and very hard negotiations to win from among several proposals from other countries. Finally, the University of Colombo was able to convince the Japanese Mission as well as the Government of Japan, the need of such institution. This was a milestone of success of computer education in Sri Lanka.

2.12 Third country training programmes

The Japanese assistance provided to the ICT resulted in building sufficient capacity both in human resources and in facilities. The donor having seeing the satisfactory completion of this phase moved on to the next where the ICT was expected to use these resources to provide training for those from other (Third) countries through the Third Country Training Programme (TCTP). Accordingly, from 1993 to 1998 a TCTP in Structured Systems Analysis and Design was held annually for 20 participants from 15 Asian countries. On successful completion of this program, a second TCTP in Information Systems Engineering was conducted from 1998 to 2002 for 20 participants each from 18 Asian, Far East and African countries. This programme continues up to today and has trained more than three hundred participants. In 1998, the ICT received the JICA President's Award for the Best Regional Training Center among its 60 JICA assisted countries. This excellent concept of south - south cooperation was later introduced to Sida, the Swedish international development agency who sponsored a TCTP in the Design, Installation, Management and Maintenance of Network Systems for twenty participants from Asian, African and even Latin American Countries for the last few years.

2.13 Year 2000 and beyond

The developments in Computing indicated above resulted in the University of Colombo becoming a Centre of Excellence by the dawn of the new millennium. Several landmark events took place thereafter enabling the consolidation of the status it had built up in the last three decades of the 20th Century.

The ever increasing demand for IT graduates both globally and locally combined with the inadequacy of the state sponsored free education system prompted the staff of the ICT to launch a very innovative external degree program for the Bachelor of Information Technology Degree (www.bit.lk) This was an instant success with over 5000 students registering for year one in 2000. The ICT developed the curriculum and was to hold the examinations while the University of Colombo was to award the degree. The private sector was to provide the training as the students were registered as external and not internal students. This was supplemented by web based course details, quizzes, model papers and answers and also by a weekly TV programme. This was an excellent example of Public Private Partnership with over 50 private institutions preparing students.

In 2002, the ICT and the DCS merged to form the University of Colombo School of Computing, UCSC, as a centre of higher learning affiliated to the University of Colombo with a fair amount of financial and administrative autonomy [16]. This merger helped to bring together over 50 academic staff with around 15

Ph.d's and a large number of postgraduate qualified IT specialists and also all the resources of the two institutions under a single entity (www.ucsc.cmb.ac.lk). The UCSC has three academic departments and five centres. It is now enjoying the status of being the best IT centre for higher education in the country with intake of 240 students annually for its B.Sc (Computer Science) and B.ICT degree programs, over 2000 annually for its external degree BIT and 200 annually for its three M.Sc programs in Advanced Computing, Computer Science and IT and many extension courses as well as consultancy, research and development activities. In addition, the UCSC conducts third country training programs with funding from Japan and Sweden and has research collaboration with several international research groups. Examples are the IDRC funded PAN localisation project and the Pandora Distance Learning project, both involving regional cooperation. UCSC has recently established an Advanced Digital Media Technology Centre (ADMTC) with JICA assistance, National e-Learning Centre with Swedish government support and the BIT program will be converted into an e-Learning based e-BIT with EU support and collaboration with Swedish and Dutch universities. UCSC has a reputation for producing excellent graduates for the fast developing IT industry in the country which includes international software leaders who have outsourcing facilities locally.

3. Conclusion

Sri Lanka has throughout its recorded history given priority to human development and in particular towards education. This has resulted in a high quality of life even though pure economic indicators make the country one that is still developing. In the field of computing, which was recognized as important even in the late sixties, a strategy of sharing whatever knowledge one had without awaiting expensive resources has shown results [17, 18, & 19]. Another aspect was the policy of computers for all ages, professions and for the society at large. The development of Computer education has been well planned taking into account not only the currently available technology but also future trends as envisaged by the policy makers. This included the provision of resources both human and material and the strategic and optimum utilization of limited donor assistance. These initial steps have quite rightly led to international recognition and regional collaboration.

Today, the UCSC continues to grow from strength to strength, proving beyond doubt, the benefits of the initial planning and positive approach of the successive development phases of its predecessor institutions and their members. Its stature as a centre of international repute and success is also a strength to the many donors who have assisted in the early development efforts who can now see positive results from their investments in development.

Acknowledgements

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