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Editorial

Information Systems Research: A Teleological Approach?

The request to write this editorial came at a very opportune time, coinciding as it did with an intense examination of the development of the field of information systems and an analysis of the progress of IS research. I have therefore used this opportunity to focus my thoughts and outline some of my conclusions. By doing so I don't pretend to answer any questions, merely perhaps to stimulate thought amongst those SACJ readers involved in IS research.

The last fifteen years has seen a tremendous growth in the study of information systems. During this period a number of journals devoted to IS research appeared such as *MIS Quarterly, The Journal of MIS, Information and Management* and *Data Base.* There are now many research-based activities: the International Conference on Information Systems; the annual IS doctoral dissertation colloquium; and various awards for IS research contributions. Hundreds of universities world-wide have formed information systems departments with (reasonably) standard curricula.

Yet with all this, what has *really* been achieved from a research viewpoint? Are we any closer to understanding the true nature of information systems? Is there a general unified theory of information systems? Is there even an accepted, unique body of IS knowledge? The answer to all of these must surely be no.

We have, I believe, achieved precious little. Yes, we do understand something of IS development approaches. We understand a little more now than we used to about how users interact with systems. But to get back to the first question, do we really understand what information systems *are* and how they work? No. Which begs the question: Why not?

There are, again I believe, a number of reasons, but the foremost must be that the majority of people in the IS research community either reside in the business schools of the USA or are drawn from other disciplines. These people, it would appear, are researching for research's sake; to publish in order to secure tenure or develop a research track record, not to further the body of knowledge of the subject. There seems an almost frantic zeal to generate and test hypotheses, trying to adopt and pursue what is seen to be a "scientific approach". But there is very little focus - there can't be, or the answers to my questions earlier would be yes rather than no!

Let me hasten to add that there is nothing unique about these IS researchers. "Publish or perish" is still very much alive and well! But also they are really not all that different from other social scientists. As Nagel [3] observed:

> "... in no area of social enquiry has a body of general laws been established, comparable with outstanding theories in the natural sciences in scope of explanatory power or in capacity to yield precise and reliable predictions ..."

Why should this be the case? Is it because the great intellects gravitate to the natural sciences and the social sciences pick up the second best who are incapable of generating these general laws? I hope not! The answer may well be that we have become locked into a particular research approach which is inappropriate to developing a body of social science, and more particularly, IS knowledge. Maybe we should be learning from our own source discipline (systems theory) and be developing a real research approach which complements our field of study.

To explore this further let me go back to the roots of information systems. What is an information system? Do we really have an accepted definition? Probably the most widely referenced is that provided by Davis and Olson [2]:

> "an integrated, user-machine system for providing information to support operations, management and decision-making functions in an organization. The system utilizes computer hardware and software; manual procedures; models for analysis, planning, control and decision making; and a database".

Note how this emphasizes the man-machine interrelationship and underscores computers as a core component when they are not even necessarily a part of the information system. The worst aspect is that it does little to describe what a system is, and this may well be one of the causes of our research dilemma. Again, if we draw on systems theory then a more appropriate definition might well be: "a hierarchical set of procedures utilizing information to monitor and control organizational performance". Note that this definition fits with general systems theory that *all systems* have four basic foundations: cybernetics, hierarchy, control and information [1].

An additional aspect not apparently recognised by IS researchers is that the information system, just like any other system, biological or otherwise, suffers from the problem first identified by our own Jan Christiaan Smuts [4]: that of holism. Simply put, this says that the whole is greater than the sum of the parts. This means that information systems, unlike science, cannot be reduced to simple isolated fields of enquiry and then analyzed or tested using hypotheses and laboratory experiments from which elaborate generalizations may be inferred. They have levels of complexity with new factors emerging at each level. The problem with most of the current research is that it starts out with a reductionist approach and then focuses on the highest (or lowest) level. Thus the majority of the topics have as their target the interaction between user and computer or the management or application of technology. There is very little research that is taking place at fundamental level, that of developing a general theory of information sytems. This is the teleological approach, searching for the natural laws and developing the theory based on deduction and logical development. Until we can advance *that* area of knowledge and, from a basis of these fundamental laws, develop a hierarchy of hypotheses that can *then* be tested, we will have little focus to our IS research. It will remain a fragmented, uncohesive smattering of the work of individuals who are merely grasping at tenure. There are few people who would today argue against the inclusion of information systems as a field of study at a university or as a fruitful research area. But until such time as we focus on the foundation theory, it will remain unstructured and immature.

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The report below is the first in a two-part review produced by the authors. Part II deals with tertiary education in South Africa and will be printed in the next edition of this journal.

A Review of the Use of Computers in Education in South Africa Part I: Primary and High Schools

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Abstract

This informal review is based on personal discussions carried out within the last year with various experts in the field as to the current use of computers in primary and secondary schools. An attempt has been made to obtain information on the type of use being made of Computers (whether for Computer-Assisted Instruction, Computer Studies or Computer Literacy), the hardware and software used and any interesting research or social responsibility programs in progress. The issue of computers in education is receiving serious attention in all the departments of education in South Africa. Some are already well on their way to making the computer an integral part of the pupil's school life while others are still in the planning stage.

1. Introduction

This review draws upon information obtained during interviews with experts in the field of Computers in Education during the latter half of 1988 and the first six months of 1989. Some of these people were representatives of the various education departments, others were suppliers of educational systems and courseware, and others were headmasters or teachers. All were actively involved in some way or other in the use of computers at schools. We did not attempt to send out questionnaires to every school in the country. Such a survey, providing a statistical profile of what is happening in this field, is definitely required. It would, however, provide a completely different kind of information from that which we attempted to obtain by way of in-depth discussions with a representative sample of practitioners. Unfortunately we will inevitably have missed some interesting projects in this review but believe that we have captured the essential aspects.

Throughout this document we will abbreviate the Department of Education and Training as DET, and the various departments of Education and Culture as DEC. The specific parliamentary house to which a DEC refers will follow in parenthesis.

2. Primary Schools

2.1 Policies

The different Departments of Education have quite markedly different policies regarding the use of computers in education, as will be seen. This is, of course, as a result of the vastly different circumstances regarding teacher qualifications, availability of teachers, growth in numbers of pupils, and the economic and social circumstances of the majority of the pupils found in the different sectors of the population. These parameters are generally well known, so it has not been considered necessary to attempt to explain why different choices have been made or are appropriate.

DET Policies

The D.E.T. believes that it is essential to improve their pupils' communication and mathematical skills as a first priority. Their policy, therefore, involves using computers starting at both ends of the school career; first of all introducing Computer-Assisted Instruction in Grade 1 and Matric, then extending these efforts to Grade 2 and Standard 9 until ultimately the entire school curriculum makes use of this medium to some extent. The pupils' basic skills, which up to now have been suspect and have negatively affected their ability to master more advanced work, will be improved by reinforcing the pupils' education at the start of their schooling. In this way the department will improve the whole standard of education in the long term.

DEC (Delegates) Policies

Emphasis is on the use of computers in high schools rather than in primary schools.

DEC (Representatives) Policies
A major commitment has been made by this department to upgrade the education of pupils at primary school level by using computers in Computer-Assisted Instruction. Here the computers are simply used as a tool or a learning aid which would be virtually transparent to the pupil. The computer is used as a supplementary device, providing the pupil with additional practice in order to improve his performance. It is not intended to teach the child new concepts or to replace the teacher in any way.

DEC (Assembly) Policies
This department acknowledges that Computer Literacy is a requirement of modern society and that education can be improved and enhanced by making use of computers. The policy is, therefore, actively to promote and support the implementation of and use of computers in schools. The primary goals are as follows:
• to equip pupils with the computer knowledge and skills which will enable them to play a meaningful role in modern society; and
• to improve and enhance teaching and learning.
It is generally agreed that a national plan is essential in developing a policy for the use of computers in education.

This does not, unfortunately, mean that the department can see its way clear to providing funds to assist schools in obtaining the necessary facilities. Other means of assistance are used and will be discussed later.

2.2 Hardware and Operating Systems

DET Hardware & Operating Systems
Systems are being evaluated, in particular TOAM, which is used in 7 teacher training colleges and 5 primary schools. Unfortunately funds are not easily available at present for evaluation projects which typically require a laboratory to be equipped with the necessary hardware and then arrangements to be made for groups of pupils to use the system on a regular basis. Transport has to be provided, supervisors obtained, etc.

DEC (Delegates) Hardware & Operating Systems
Various systems have been and are in the process of evaluation. No final decisions have been made yet. As a result, hardware has been placed in a few schools for the purpose of evaluating courseware but no hardware has been allocated permanently.

DEC (Representatives) Hardware & Operating Systems
TOAM systems are to be installed in all 2800 primary schools administered by this department. Five-hundred and fifty (550) TOAM systems are to be installed in the next four years. More than 100 such systems were installed in 1988. This represents a significant investment which is being funded by the department concerned.

DEC (Assembly) Hardware and Operating Systems
The primary schools under the administration of this department are using a variety of types of hardware at present as these computers have been bought with private and/or Parent Teachers' Association funds. These include ATARIs, BBCs (particularly in the Cape Province), APPLEs, COMMODOREs and IBM personal computers or IBM compatible computers. The most recent trend is definitely towards IBM compatible computers (otherwise known as "Industry Standard" computers) or hardware on which the MSDOS operating system can be run. The Department recently sent out a directive recommending that schools buy only MSDOS-based machines and that advice and assistance can be provided by the department only for these systems. A few specific schools' systems will be discussed later in this paper.

2.3 Field(s) in which computers are used
The prime fields in which computers are used include Computer Literacy, Programming/problem-solving, Computer-Assisted Instruction

DET Usage
The Department of Education and Training expects to use computers at primary school level for drill and practice and for diagnosis of gaps and weaknesses in the pupil's knowledge and understanding. In other words, the emphasis will be on Computer-Assisted Learning. The other uses of computers are not given high priority at this stage.

DEC (Delegates) Usage
TOAM, the products from MICROLAB and finally the SERGO courseware have all been evaluated or are in the process of evaluation. This would imply that consideration is being given to the idea of using Computer-Assisted Learning, particularly for additional exercises at primary school level, despite the fact that the provision of computers to the high schools is considered more important.

DEC (Representatives) Usage
As mentioned earlier, the Department of Education and Culture (House of Representatives) believes very strongly that the most important role computers can play in assisting the primary school pupils in their care is in giving them individualised practice in language and Mathematics skills. The TOAM system has exercises in Arithmetic, Afrikaans and English as a second language for Grade 1 to Standard 5. Computer Literacy and teaching problem-solving using LOGO are not being considered, particularly since the TOAM system is not intended for these purposes and additional hardware would be required.

DEC (Assembly) Usage
LOGO is usually introduced in Standard 1. Individual

CAI lessons from various sources are also used for Mathematics, English spelling, etc. Since the beginning of 1988, the Department of Education and Culture has assisted the schools in selecting courseware by maintaining an extensive collection of lessons at the National Film Library. These lessons have been evaluated and a catalogue is maintained and distributed to schools. Teachers may borrow a copy of the item in which they are interested for a short period of time for evaluation and, if they decide they would like to use that lesson, the school concerned can then buy a copy. The Film Library has lessons written for use on all the more commonly used micro-computers, but the majority of lessons run under MSDOS. A recent acquisition is the extensive series of lessons on topics ranging from North Sotho to Mathematics which was produced by MICROLAB under the directorship of Dr. Julian Visser. A policy of buying lessons that can be run individually, rather than sets of lessons that must be used in sequence, seems to be followed. The Film Library also intends initiating, co-ordinating and promoting courseware production.

2.4 Private Schools & Individual DEC (Assembly) Schools

A few individual primary schools have made a commitment to using Computer-Assisted Learning systems as a regular part of their teaching. St. Stithian's Preparatory School in Randburg was one of the pioneers in the use of the Sergo system. (In fact, they acted as guinea pigs during the field tests of the system.) The school initially bought 15 single floppy disk drive IBM computers at the beginning of 1984. This was subsequently upgraded to 30 machines linked in a network since control of diskettes became a nuisance.

Children start using the computers in Grade 2 and continue until Standard 5. One hour a week is allocated to using the Sergo system for Mathematics, which covers the entire Primary school syllabus, or a variety of courseware such as Speed Reader and Spellit for English. Children up to Standard 2 spend half an hour working with LOGO. In the later standards this time is used on working with other packages such as word processors (Writing Assistant) and spread sheets in preparing projects for various subjects. The full spectrum of uses of the computer, i.e Computer Literacy, Programming/problem-solving and Computer-Assisted Instruction, are incorporated in the teaching. St Mary's DSG in Pretoria, Noordskool in Sasolburg and Impala Laerskool in Kempton Park also use SERGO. Auckland Park Preparatory School has a TOAM system.

2.5 Informal Education, Outreach and Social Responsibility Programs

B+D Education Systems donated a complete TOAM system to the Human Sciences Research Council and this has been housed in their new building in Schoeman Street, Pretoria. This laboratory is used at present by a group of pupils who responded to an advertisement which the HSRC placed in local newspapers. The pupils are charged ten rands a month for this service.

3. High Schools

3.1 Policies

As was the case with primary schools, the policies concerning the use of computers at high school level vary in the different education departments.

DET Policies

The need to improve the pass rate at Matric level has resulted in this department investigating the use of sophisticated approaches to Computer Assisted Instruction, including the use of Interactive Video. The availability of a sound track providing the pupil with aural as well as visual input improves his or her retention of the information and provides the correct pronunciation of the terminology. The courseware must be designed very carefully and be culturally sensitive.

Maximum use must be made of equipment. For example, school children can use the system in the morning and teachers can use it in the afternoon.

DEC (Delegates) Policies

Emphasis is at present on the use of computers in high school.

DEC (Representatives) Policies

The policy explained for primary schools is also in force for high schools, namely to use the computer as a learning machine. This department formulated its policy relatively early in the history of the use of computers in education in South Africa (shortly after the 1979 investigation by the HSRC into education). As will be seen, this pioneering step influenced many of the decisions made.

DEC (Assembly) Policies

The policy stated for primary schools applies equally (or perhaps, particularly) to high schools. The different provinces use different approaches, particularly as regards syllabi and selection of pupils for Computer Studies.

3.2 Hardware and Operating Systems

DET Hardware & Operating Systems

Since the introduction of computers into education is still in the evaluation and planning stages, hardware is not generally available in schools yet. The intention is, however, that any systems adopted must run on MSDOS-based hardware. As mentioned earlier, interactive video, high resolution colour graphics and sound are all likely to be required in these systems.

DEC (Delegates) Hardware & Operating Systems
At present there are 140 high schools, each of which has ten Industry Standard micros in a micro-computer laboratory. These laboratories have been ergonomically designed. They are funded, initiated and controlled by the department and contain ten 20 megabyte machines with 4 printers in a network. The use of interactive video is being researched.

DEC (Representatives) Hardware & Operating Systems
The pioneering efforts of this department resulted in their choosing COMMODORE as the most suitable hardware for the delivery of lessons in both high schools and primary schools. As a result, approximately 2000 COMMODORE machines were installed in schools and Teachers' Training Colleges and a great deal was invested in training staff to use these systems. The decision by the Computer Advice Committee to recommend that education departments use only MSDOS-based machines has had severe implications for the department and no further systems have been bought since 1986. Even now the good graphics, moveable object block, sprite capabilities and video controllers all make the COMMODORE competitive in the development and presentation of lessons.

DEC (Assembly) Hardware & Operating Systems
Typically, a computer centre is set up for a region and all the pupils taking Computer Studies in that region use the facilities there. The centres are equipped with Industry Standard double floppy drive computers with colour monitors. Hercules cards and monochrome screens are, however, likely to be bought in future. The computers are NOT in a network. Each centre has two printers.

Large numbers of computers are bought by the schools themselves. The Cape Education Department estimates that there are approximately 400 schools which have bought computers. These include (approximately) 750 Industry Standard machines, 700 BBC machines and 160 Apples.

3.3 Fields in which computers are being used

DET Usage
Computer Studies has not been introduced for Matric yet, but the intention is to do so once a syllabus has been approved. Priorities are seen as:

- CAI (as a teaching aid);
- school administration (for example assistance in setting up time tables);
- computer literacy; and
- Computer Studies courses.

Lessons covering the Mathematics, Science and Biology syllabi for Standards 8, 9 and 10 are likely to be introduced first.

DEC (Delegates) Usage
All Standards 6 and 7 pupils do Computer Literacy as a subject, but not for examination purposes. This system has been in place for 2 to 3 years. The syllabus includes Word processing, Graphics, Spreadsheets, Database, LOGO, DOS and typing skills. They would like to bring in GWBASIC but do not have the necessary staff skills yet.

Computer Studies can be taken in Standards 8 to 10 as a matric option. This is offered at 54 of the high schools. The first pupils wrote Matric in 1988 and did well, attaining between a C-symbol and 98%. According to research, however, Computer Studies students do not, in general, go on to study Computer Science at university but opt for Medicine and Engineering. Students are selected for Computer Studies on the basis of their Maths marks. Twenty pupils per school are accepted. The syllabus is the same as that for the TED (GWBASIC and Pascal).

A lot of courseware has been considered for high schools but cultural differences generally make much of it unsuitable. The department would very much like to develop their own courseware but are hindered by a lack of finance and of suitable staff. The decision has been to wait, rather than to use inferior courseware.

There are Computer Clubs in most schools which depend on the enthusiasm of the staff and parents. Computer laboratories at the high schools are made available to the community and are used by them fairly extensively.

Computers are used for school administration but the systems are small and informal.

DEC (Representatives) Usage
The use of computers is at present restricted to Computer-Assisted Instruction. One of the initial reasons for choosing to use COMMODORE was the existing courseware. Much of this was eventually considered unsuitable, so most of the courseware is written in BASIC by the department itself. The subject advisor is the Subject Inspector who is supposed to provide the lesson content while the Media Centre implements it. As is usually the case, however, the inspectors struggle to find the time to do this.

Two systems have been developed for typing (COMPUTYPE and ACCUROTYPE). These systems assist the teacher in evaluating the pupils' typing skills and have proved to be helpful. Biology courseware covering Physiology and Anatomy for Standard 10 was delivered to the schools in late 1988. Evaluation has not yet been completed. Authoring shells were developed for use in training courses and teachers' development. The idea was that teachers would develop courseware and the Media Centre would evaluate and distribute it. This has not really happened.

The House of Representatives intends offering Computer Studies as a sixth subject for Matric.

DEC (Assembly) Usage
Computer Studies may be taken as a seventh subject for Matric. Classes are given after normal school hours and students spend about 3 hours a week on this subject, half of which is on theory and half on practical work. The syllabi vary from province to province. Pupils usually start off using LOGO, progress to a high level programming language such as Turbo Pascal (or GWBASIC) and packages are introduced to enable the pupil to use graphics, communications and do file handling.

Computer Literacy programs are financed by the schools themselves and hence the schools have the freedom to choose what they do in these classes. LOGO, context free courseware such as word processing and "desktop publishing", as provided by such products as Newsmaster, Fleetstreet and Newsroom, and some Computer-Assisted Learning courseware are all popular. The enthusiasm of the school headmaster and teachers has, as is frequently noted, a major influence on how much time is spent on these activities during school hours and the type of activities undertaken.

Computer Clubs exist at many schools where programming and games playing seem to predominate.

3.4 Problem Areas
Obtaining suitably qualified staff *and keeping them* is often mentioned as a problem. The Cape Education Department has a policy of employing graduates with at least Computer Science II to teach Computer Studies, but has found it difficult to get and keep such staff. The reasons are largely that one can earn considerably more in the private sector as a computer professional than one can in teaching. The system in the Cape, where Computer Studies teachers work largely in the afternoons, prevents them from being properly integrated into the staff and also results in frequent staff loss.

The House of Representatives has completely different requirements for staff using computers in teaching. They train the teachers themselves, placing more emphasis on educational aspects, and minimise the teaching of programming. They actually avoid using Computer Science graduates when training teachers in order to try to reduce the loss of staff.

3.5 Selection of pupils
A variety of different methods are used to select pupils to do Computer Studies at school. The most popular methods depend on pupils' results in Mathematics, first language and overall aggregate or programming aptitude tests and/or additional tests concerning logical reasoning ability. Norton [4] undertook an extremely interesting investigation on behalf of the Cape Education Department regarding existing and effective selection criteria. This study was undertaken because of the worrying drop-out rate of pupils selected to take Computer Studies. A new set of criteria taking the pupil's interest in the subject, academic ability and a number of other outside interests into account (as a simple lack of time is perceived to be a factor) will now be introduced.

3.6 Outreach Projects
One of the most successful and best established Outreach programmes is that of the University of the Western Cape. Not long after the university had obtained their mainframe based PLATO system, it decided to use this system to raise the standard of education received by prospective students *before* they came to the university as well as for university students. They have been very successful in raising funds for this programme and, over the years, have been able to extend it. Pupils from certain schools in the Cape Peninsula come by bus to the centre which is located on the UWC campus. The centre has 50 terminals attached to the Cyber mainframe computer. The classes take place after school and on Saturdays, and the pupils use the SASSC (South African Secondary School Curricula) Mathematics and General Science courseware developed by CDC from the Standard 9 and 10 syllabi and subsequently modified and translated into Afrikaans by the staff of the University of the Western Cape. The university insists that the use of the courseware be carefully integrated with the work being done by the pupils in class and that the teachers at the schools are involved in the programme as well.

A mobile laboratory has since been equipped with 20 micro-computers. It travels a set route around the Peninsula and parks in the grounds of selected schools for about 2 weeks at a time. The intention is to set up communications networks from these schools to the mainframe, thus freeing the bus to tour the rural areas which are in even greater need of this service.

As a spin-off from the success of the UWC Outreach Programme, a sponsor has initiated an outreach programme linked to the University of Zululand's Cyber computer. At present, schools using this service are within walking distance of the University's centre, which has 15 terminals linked to the mainframe. The program is to be extended by putting terminals into other schools, technical colleges, etc.

Rhodes University has a different approach in that they sell computer resources to sponsors, who then donate the computer access to educational institutions. Trinity High School has the use of terminals sponsored by CDC and Firestone.

Staff of the Department of Computer Science of the University of Pretoria, together with the Church Action in Need (CAN), which is associated with the Nederduitse Gereformeerde Kerk in Afrika, have set up a project to enable selected children from Mamelodi and Eersterust to take Computer Studies for Matric. They write the Joint Matriculation Board examinations. This project started in 1988 and the first 12 pupils wrote

Matric in 1989. The three-year syllabus was covered in two years, but as of 1990, Standard 8 pupils will be selected and the syllabus will be covered in three years. Classes are held once a week, for one hour, at a community centre between Mamelodi and Eersterus, and practical classes are held once or twice a month. The HSRC has donated computers to CAN for use by these pupils, which has been of great assistance. The classes are given by Computer Science students at the university who are remunerated by the department of Computer Science.

3.7 Other Social Responsibility Programmes

Control Data Corporation's extensive library of PLATO courseware is available at a number of privately run community centres such as the St. Anthony's centre, the CDC learning centres in Soweto and Alexandra, the SOS Children's Village in Mamelodi and the LEAF school at present housed in the Kyalami Ranch Hotel. (The LEAF school project is sponsored by ESKOM and the terminals can be linked to the ESKOM mainframe at Megawatt Park.) This courseware includes lessons on academic subjects and vocational subjects such as word processing and keyboard skills. This courseware was generally developed in the United States. Whereas in the past, PLATO terminals with touch sensitive screens had to be connected to a Cyber mainframe computer, use is now made of intelligent terminals and CDC1-10s which are stand-alone PCs.

4. Conclusion

The issue of using computers in education is receiving serious attention in all the departments of education in South Africa. Some are already well on the way to making the computer an integral part of the pupil's school life. Others are still in the planning stage.

It is extremely important to recognise that computers can serve a number of completely different purposes in education. In the cases where there is a shortage of teachers and where pupils need additional help in mastering school subjects such as Mathematics, General Science, English and Afrikaans, computers can be used most effectively in drill and practice exercises as well as in more sophisticated tutorial mode. Since the operating system is invisible to the student, it really does not matter to him or her whether these systems are MSDOS-based or not. It is unlikely that there will be sufficient time in the timetable to use the same computers to teach computer literacy. On the other hand, courseware has to be obtained (and this generally appears to mean "be written locally") to run on each of the systems used.

In those departments where there are sufficient numbers of well-trained teachers, the emphasis tends to shift to teaching Computer Literacy to the majority of the pupils and Computer Studies to a few selected pupils. Here the use of context-free software such as word processors and spread sheets, and integrating their use into the rest of the curriculum is ideal. It is sensible to make use of MSDOS-based systems for this purpose.

A disquieting fact which became obvious during this investigation is the amount of duplication of effort that is occurring in the extremely time consuming and hence expensive area of writing courseware. No less than three groups have written courseware covering the Mathematics and Science syllabi for Standards 9 and 10, all of which run on MSDOS-based computers. There are also at least three sets of courseware for Mathematics at primary school level. Can we really afford this duplication?

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NOTES FOR CONTRIBUTORS

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