THE APPLICATION OF MICROCOMPUTER TECHNOLOGY FOR INFORMATION RETRIEVAL IN LIBRARY RESOURCE CENTRES OF INDIAN SECONDARY SCHOOLS IN SOUTH AFRICA

by

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ABSTRACT

This study assesses the growth and development of the library resource centres in Indian secondary schools in South Africa and the role that microcomputer technology is playing, and can play, in bibliographic information retrieval in these centres.

The library service of Indian secondary schools in South Africa is reviewed from an historical perspective and an in-depth analysis is made of the various factors that have contributed towards the growth and development of the library. It is evident that variable growth has taken place in terms of accommodation, budget, media and staff development.

Information retrieval requirements as advocated by the relevant Education Department are critically examined and the need for a more efficient retrieval system is consequently established. Although libraries have developed applications in the conventional large computer environment and have sophisticated aids at their disposal to design, code, debug, and test systems, the development of microcomputer technology as a cost-effective alternative for information retrieval is explored. The rapid "leap-frog" development of

microcomputer technology and a corresponding reduction in production costs have offered the smaller budget-conscious library a low-cost solution to computerised information retrieval.

The information retrieval environment is complex and it is necessary for the teacher-librarian to understand the context in which information retrieval systems operate. Microcomputers have limitations, especially in terms of handling bibliographic files for information retrieval as these files tend to be extremely large. Various file development procedures for information retrieval systems are critically considered and the suitability of the microcomputer as an efficient file manipulator is ascertained.

A procedural framework is designed specifically for the needs of the library resource centre in Indian secondary schools in South Africa. With modifications for specific applications being carefully made, this framework is applicable to other similar library resource centres.

Recommendations and suggestions for further study are made in terms of the school library resource centre providing a microcomputer based information retrieval service.

DECLARATION

I, the undersigned hereby declare that the work contained in this thesis is my own original work and has not previously in its entirety or in part been submitted at any university for a degree.

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G. GOVENDER

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Dedicated to my parents for their foresight and faith in education

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CHAPTER ONE

1. NATURE OF THE STUDY

1.1 INTRODUCTION

Over the last decade there has been an intensification within our society of pressures demanding change. Library information services operate in a social, political, economic and technological environment which is sensitive to these pressures and changes. If the quality of the professional services rendered is to be maintained, then it is imperative that the school library resource centres must also either control or adapt to these pressures and changes.

The technological environment with its rapid development offers greater challenges for the library resource centres than ever before. Information processing technology, especially the computer and the microcomputer, is profoundly affecting our lives. It is important to keep abreast of these technological developments so that benefit from these changes can be maximized. Although the pace of technology is moving so rapidly, it is only recently that education departments, which are constrained by fiscal difficulties, are adopting to these changes. While the use of computers in schools was minimal in the early 80s, education authorities are now serious about the implementation of computers in schools. With the launching of the South African Bibliographic Network **(SABINET)** more libraries will move towards computerization of their information retrieval services. Computer-ization will involve financial outlay both in terms of capital development and infra-structure changes. Poorly made decisions could prove to be costly.

1.2 THE PROBLEM

Over the last decade the libraries in Indian secondary schools have seen considerable growth from makeshift accommodation to large modern library resource centres. Coupled with this growth in physical size was the concurrent development of the libraries' holdings. While this physical growth has been able to cope to some extent with the explosion of information, the increased holdings in the library resource centre have resulted in concomitant problems.

Whereas in the past it was possible for the efficient and well organized teacher-librarian to easily manage his library resource centre so that the location and retrieval of information for the relatively simple needs of his patrons was possible, this is no longer true today. It has become practically impossible for the library resource centre to offer service excellence to the relatively sophisticated user because of the explosion of knowledge. Students in the classroom are exposed to today's technologically advanced environment, e.g. computers, videos, autotellers etc. The utilization of the card catalogue does not appeal to these pupils because of the relative cumbersomeness that increases proportionally with the increasing size of the catalogue. The school library is no longer seen as a mere book distribution room from where recreational material is dispensed, but rather as an information centre. In order for the teacher-librarian to fulfil this new and demanding role adequately, he must look at a more efficient system of information storage and retrieval. The microcomputer with suitable software offers a possible viable and cost-efficient solution to this dilemma. The present study will view possible and actual applications of computerization in historical perspective, as well as in the current situation as it exists in South Africa specifically, and internationally in general.

1.3 PURPOSE

The purpose of this study is to assess the growth and development of the library resource centres in Indian secondary schools together with the growth of their total holdings, and the role microcomputer technology is playing and can play in bibliographic information retrieval in these centres. This assessment will assist in ensuring that service excellence, as pertaining to the location and retrieval of information, is maintained. The current situation will be evaluated in the light of the application of similar technology in similar situations. Recommendations for the application of microcomputer technology in Indian secondary schools in South Africa will be made, in the light of the findings of this study. Additionally, by focusing attention on school library resource centres, this study will serve further to enhance the role of these centres in the educational process.

During the development of this study it was necessary to develop a coherent history of the development of libraries and library resource centres in Indian schools. While a by-product of this study, this history is a valuable body of knowledge that previously did not exist in coherent form, and is in itself a contribution to the discipline.

1.4 SIGNIFICANCE

Whilst there have been a number of studies conducted into computer technology and library information services, it appears that no significant study has addressed the application of microcomputers for bibliographic information retrieval in library resource centres in South African Indian secondary schools. This study creates a new body of relevant knowledge concerning the application of microcomputer technology for information retrieval in library resource centres of Indian secondary schools in South Africa that is essential for decision making in this critical area. In the larger view, this study provides direction, points out areas in need of investigation, and provides a basis for further study in similar areas world wide. The results of this study illuminate the phenomenal growth and development of these libraries and the resultant problems associated with this growth e.g. increases in information resources and user demands. By illuminating these problems and the possible solutions offered by computerization, appropriate action could be taken by those concerned on the firm basis of a critical evaluation, rather than from the present situation, where the paucity of relevant, reliable data makes decisions as to the appropriate action to be taken difficult, if not impossible. It is hoped that both the staff and the students, as users of the system, would see that a computerization programme for the resource centre that is better managed and better organized should, **cetris paribus**, offer an improved service. If the resource centre is the hub of the school, then the quality of information service offered by the centre should influence the quality of education in the classroom.

By examining the implications of computerized information storage and retrieval, the study suggests inter-alia a revision of attitudes and approaches by the teacher-librarian in the dissemination of information to his clientele, the revision of attitudes and approaches by both the students and the staff in their search for information and, more importantly, a revision of attitude and direction by the Education Department concerned. Indirectly the study will also influence the teacher training programmes offered by the colleges of education under the control of the Education Department and teacher development programmes as offered by various institutions, in South Africa and other countries.

1.5 LITERATURE SURVEY

A review of the literature in the area of computerized information retrieval revealed the following investigations relevant to the present study:

Dunlop (12, p37) states that although the use of mechanical or semi-automated equipment in libraries can be traced to the 1930s when Ralph Parker introduced punched card procedures at the University of Texas, and to the 1940s when the order division of the Library of Congress began using punched cards, widespread interest in the use of electronic equipment did not take place until the 1960s. In 1967 Joseph Becker (2, p2) stated that "aside from housekeeping and management ... research is still under way to find ways of using the computer for reference work and information retrieval".

Although microcomputers were built early in the 1970s, it was not until the second half of the decade that serious consideration was given to them in the field of data processing. Woods and Pope (47, p1) maintain that it was towards the close of the 1970s that librarians began predicting that computers could take the information field "by storm", automating a variety of tasks at a cost that even smaller libraries could afford. They state further that, because microcomputers are both highly flexible and relatively easy to use, applications would include cataloguing. Reference information and other databases could also be made available for library staff and patrons. Microcomputers could also be used for instruction, or linked to form networks among libraries, or with other institutions (47, p1). However, the **MITRE** Corporation which was funded by the United States Office of Education in 1978 to examine current and potential uses of the microcomputer, found that most of the microcomputers in use at that stage were exorbitantly expensive and were clearly out of the price range of most libraries (40). Woods and Pope (47, p1) concluded that the microcomputer had yet to make its presence felt on the library world.

It was only after a pre-conference workshop on microcomputers sponsored by the American Society for Information Science and the subsequent publishing of the July 1980 Library Journal that the microcomputer revolution was in "full bloom" (47, p7). However, until 1981 there was still a fairly strong resistance to microcomputers on the part of librarians owing to various reasons e.g. limited memory and storage capacity and the scarcity of good software for library applications (47, p4). According to Woods and Pope (47, p4) it was only at the end of 1982 when IBM, XEROX and Digital Equipment legitimized the industry that most resistance to microcomputers by librarians had dissipated and many information professionals were dubious not about purchasing a microcomputer, but rather which microcomputer to buy.

Don Williams, sales development manager at Apple Computers, stated that there were eight things that could really be done with any computer system, and a small personal computer (microcomputer) could do seven of them well (quoted by 47, p5). They (47, p5) concluded that perhaps, more importantly these tasks could be performed on a microcomputer at a fraction of the cost required by larger mini or mainframe computers. This view is supported by Simpson (40, pvii) who states that while microcomputers are relative newcomers to the library automation field, they nevertheless offer the libraries the ability to automate at costs which are lower than they have ever been.

Martins (31, pv) is of the opinion that libraries are increasing their use of computers and other technologies and it has become evident that even small libraries can afford microcomputers. This leads her to believe that within a few years no library would be able to afford operating without some form of technological assistance (microcomputers). She states further that for all sizes of libraries (including school library resource centres) manual catalogue production involves much checking, typing and other routine clerical work. She concludes that computer technology would definitely streamline the labour intensive catalogue procedures (31, p12). According to Grosch (19, p77-78) it was on the threshold of the 80s that the picture changed. In the very rapidly developing microcomputer area both hardware and software have matured to the point where library applications could be developed practically and economically using readily available hardware and systems software products from a variety of manufacturers.

The card catalogue used to be regarded as an essential key to the library stock. More recently it has been described as a white elephant by Grose and Line (quoted by 24, p254) who state that there are many more keys to unlock the doors of knowledge in the form of bibliographies, indexes and computerized databases. Users could find out very quickly via a computer terminal what is available by a given author or on a given subject. Williams, Petrie and Lowie (45, 46 and 34) describe the advantages offered by microcomputers for online information retrieval. CAIRS - a computer assisted information retrieval system was developed through the information department of the Leatherwood Food Research Association, and arose out of a need to improve the existing manual information handling system. The continuing growth in the size of the card catalogue and the inadequate type of indexing used, led to the decision that a new computerized system should be introduced. This decision was based on the fact that the application of computers to information storage and retrieval was being widely accepted and offered many advantages over manual systems (32, p78-79).

This view is supported by Chen (7, p1) who states that the low cost microcomputers are currently able to perform many useful tasks in libraries and information situations that were previously impracticable because of cost and/or complexity. The functional capabilities of microcomputers are increasing rapidly and the prices continue to decrease. The dividing line between classes of computers, specifically the mini and the microcomputer is fading (7, p1). He concludes by stating that as more and more sophisticated operating systems and user oriented software are forthcoming, microcomputers will be of even greater use to libraries in performing the tasks which were previously only possible by mainframe computers (7, p2).

The use of computers for information retrieval has been beyond the reach of many small to medium-sized libraries and information units until very recently (32, p89). The costs involved in setting up and running such systems previously did not allow potential users to take advantage of the benefits of the computer. These benefits included speed, accuracy, processing power and storage capacity. However, with the development of the microcomputer at lower cost, and user friendly software many of the tasks common to library and information departments can be readily computerized. User friendly software programs allow both library staff and patrons with little or no computer experience to use the system.

Finally Falk (13, p7) concludes that microcomputers are rapidly moving into every area of application where larger computers were previously used. In the area of library patron services, microcomputers seem to be ideal vehicles for storing and retrieving information (13, p7)

1.6 DEFINITION OF SIGNIFICANT TERMS AS USED IN THIS STUDY

1.6.1 **Computer** : an electronic machine controlled by a program stored in its memory that accepts data as input, works upon it as instructed and outputs the results. Computers fall into three basic categories according to their memory size, speed and power: mainframe computers, minicomputers and microcomputers.

1.6.2 **Microcomputer** : a small computer consisting of a processor on a single silicon chip, together with chips containing the internal memory, a keyboard for the entry of data and programs, a screen for display purposes and interfaces for the connection of peripheral devices, such as disk drives and printers. Microcomputers as defined here would include the IBM PC, or compatibles, that comprise 640k XTs and ATs operating on at least 10mhz, with a 20-40mb hardrive.

1.6.3 **Hardware :** the physical parts of a computer system including the electric/ electronic components and the mechanical components viz. keyboard, disk drives, central processing unit etc.

1.6.4 **Software :** the programs used in a computer system, which in addition to the hardware, enable the computer system to be operational. These programs include operating systems, assemblers, compilers, utility or service programs and applications programs.

1.6.4.1 **Systems Software :** an essential accompaniment to the hardware in order to provide an effective overall computer system. These programs assist the computer system to function effectively whatever the nature of the work being performed.

1.6.4.2 **Applications software:** ready made programs designed in standard form for the widest possible use. Each application requires a suite of programs which typically contain programs for validation, sorting, calculating, updating and printing.

1.6.5 **Teacher-Librarian :** the teacher in charge of the administration of the library resource centre in the school. These teachers fall into two categories viz. those with dual qualifications - a teaching diploma and a library qualification and those with only a teaching qualification.

1.6.6 **Management :** all those activities undertaken by the teacher-librarian in managing the library resource centre, e.g. planning, organising, staffing, directing, control reporting and budgeting.

1.6.7 **Information Retrieval :** all those processes involved in the successful locating and retrieving of material in the library resource centre. The information retrieval system is bibliographic if it is systematically organized on one of the information units found within the bibliographic details of the document such as author, title, publisher, date of publication or journal name, volume, part or page number. It may also be organized into subject divisions. Although subject descriptors are not included in the bibliographic details of a reference, subject indexing is nevertheless inextricably interwoven with bibliographic information retrieval.

1.6.8 **Cetris paribus** : other things being equal.

1.6.9 **Library resource education** : a course in systematic book education and library skills offered to students in the school library resource centre in Indian schools.

1.6.10 **Education Department** : House of Delegates: Department of Education and Culture.

1.6.11 **Post positivist foundation** : a methodological approach founded on the philosophical system of Auguste Comte that recognizes only positive facts and observable phenomena.

1.6.12 **Indian schools** : Indian schools in the Republic of South Africa constitute those schools that have been established in terms of the Indian Education Act No. 61 of 1965 and these schools are funded by the State Treasury. Pupils and teachers in these schools are, with few exceptions, Indians.

1.7 ASSUMPTIONS

The methods and approach of this study reflect the following basic assumptions:

1.7.1 Individuals will continue to acquire and use technology that can increase their ability to manage and communicate information.

1.7.2 Information and access to information are crucial elements in the progress of society and libraries provide a major service role in managing information and providing access to this information.

1.7.3 Library resource centres are an important educational source and the services offered by the centre must be systematically refined with a view to improved and more effective education. These centre have to change their existing technology and organization to remain relevant.

1.7.4 Teacher-Librarians are committed to their work and are constantly striving for both self improvement of their image and the service offered by the library resource centre.

1.7.5 Teacher-Librarians are working under pressure in terms of academic work load, resource centre management duties and extra-curricular activities.

1.7.6 It is regarded as unethical if a professional attempts to render a service based on inadequate or outdated expertise.

1.8 SCOPE AND LIMITATIONS

The services offered by the library resource centre is wide ranging and diversified. These services include a fundamental component, viz. the effective storage and retrieval of information, and it is this service that is under scrutiny. In order to keep the study within manageable bounds certain limitations were necessarily set. The first limitation was to restrict the application of microcomputers for bibliographic information retrieval and the second limitation of this study was to restrict the particular library type surveyed. In this study, the needs of secondary school library resource centre under the control of the House of Delegates: Department of

Education and Culture was considered. This study was also limited in its analytical approach. Garrison (15, p233) noted in his study that "what is measured is the association between variables and not cause and effect [and] the correlations are between properties of groups and not of individuals". These limitations are also relevant to this study.

1.8.1 Computerization

History has clearly demonstrated that technological development almost invariably results in social change. The second half of the twentieth century has been characterized by progress, especially in two areas: the electronic computer and telecommunications. As librarians, we are interested in the consequences of micro-electronics and telecommunications as it effects the services rendered by the school library resource centre, and also how it directly affects the tasks of the teacher-librarians. However, the field of computers and telecommunications is so vast and complex that it is not practical to cover the entire field in this study and therefore, in this regard, this study is limited to the application of microcomputer technology for the storage and bibliographic retrieval of the information.

1.8.2 Information Retrieval

Katz (26, p5) argues that an integral feature of the reference service of the library is formal and informal instruction in the use of the library or information centre and its resources. In this context effective information retrieval by students and staff must be respected as a highly valuable educational force which promotes knowledge across the entire curriculum.

One of the primary functions of the school library resource centre is to provide its clientele with information which is relevant to their queries. While the catalogue may provide an insight into the contents of the library, it is not always an entirely satisfactory means of answering all reference questions speedily and effectively. Even the indexes provided at the back of books often do not direct readers to all the information contained within the book itself. For these reasons, the quality of reference services offered by the library resource centre in satisfying the needs of its clientele, is dependent upon, inter-alia, the quality of information retrieval. One obvious source of information retrieval behaviour is direct observation. Direct experiences with a given object results in the formation of attitudes about the object, which in this study are expressed in response to a questionnaire. There is no necessary connection between such responses and the teacher-librarian's real life action. Therefore this study is focussed on the attitudes teacher-librarians are willing to express and limited to them. These inherent limitations must be added to limits imposed by sample bias, instrument reliability, non-response and the limitations of the statistical procedures used.

Finally, while individual techniques and methods for bibliographic information retrieval will be stated and discussed, the main emphasis will be on the general philosophy of the methods that may be employed and the limitations that are imposed by them.

1.9 ORGANIZATION OF THE STUDY

The methodology employed in this study is set out in **Chapter Two.** In **Chapter Three** the development of Indian secondary school library resource centres is examined. The library service is briefly reviewed from a historical perspective and an in-depth analysis is made of the various factors that have contributed towards the growth and development of the libraries into library resource centres. The consequences of this growth for information retrieval were determined in order to form the basis for the consideration of computerized information retrieval systems that would provide a more efficient and effective service.

Chapter Four explores the requirements of an information retrieval system as advocated by the Department of Education. The need for a more efficient retrieval system is consequently established. **Chapter Five** examines the development of microcomputer technology to illustrate the rapid advances that have been achieved in memory, speed and storage capacity. These advances have helped to blur the line between the larger, more expensive minicomputers and the microcomputer. The basis for the utilization of these efficient low-cost microcomputers in information retrieval is ascertained.

The use of computers for cataloguing and indexing is reviewed in **Chapter Six.** The requirements of cataloguing and indexing are discussed and the automation of these procedures is examined. The role of the microcomputer in its application for various cataloguing and indexing functions is subsequently explored in order to establish its suitability for these functions. The requirements of a computerized information retrieval system is considered in **Chapter Seven.** The various file development procedures are critically discussed and the suitability of the microcomputer as an efficient file manipulator is substantiated. In **Chapter Eight** a procedural framework is developed for the introduction of a computerized information retrieval service. This framework is designed specifically for the needs of library resource centres of Indian secondary schools in South Africa, but is applicable to other library resource centres, with modifications for the specific applications being carefully made.

The steps to be followed in the various phases of the project are formulated. The summarized findings of the study are presented in **Chapter Nine** together with recommendations. The five appendices include the following:

Appendix A : Questionnaire to teacher-librarians

Appendix B : Covering letter to principals

Appendix C : Covering letter to teacher-librarians

Appendix D : Second letter to principals

Appendix E : Original questionnaire

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CHAPTER TWO

2. METHODOLOGY

2.1 INTRODUCTION

This research set out to examine the growth and development of library resource centres in Indian secondary schools in South Africa and the role which the microcomputer could play in bibliographic information retrieval in these schools. An examination was made of the tasks to be achieved and the suitability of the microcomputer to achieve these tasks. Techniques were explored for the application of the microcomputer with its advantage of speed, vast storage capacity and accuracy for information retrieval. The research methodological approach of the research is based on post-positivist foundations. The study uses the methodology of correlational research, questionnaires and observations. As indicated in **Chapter One,** while individual techniques and methods are stated and discussed, the main emphasis is on the general philosophy of the methods that may be employed and the limitations that are imposed.

2.2 METHOD OF INVESTIGATION

This study has investigated the application of microcomputers for information retrieval in school library resource centre. As in the case with other investigations in the field, a survey approach was deemed to be appropriate as a means of obtaining relevant data from the teacher-librarians. The schools in the population sample are located in three of the four provinces of the Republic of South Africa: Natal, Transvaal and the Cape Province (there are no Indian schools in the province of the Orange Free State because of the government's "Group Areas" policy). As a result of the wide distribution of the schools, information pertaining to these library resource centres was elicited through postal questionnaires which were distributed to the teacher-librarians who are in charge of centres located in these areas. Prior to the final collection of data, a pre-test was conducted in selected Indian secondary schools in the greater Durban area. These responses were then used to refine the questionnaire before it was mailed to the sample population. The analysis of the responses to this original questionnaire **(Appendix E)**, is not included in this study as it is considered that the analysis would not make a significant contribution to the existing body of knowledge.

These teacher-librarians were found to be relatively homogeneous as far as educational qualifications are concerned. Wallace (13, p48-51) has noted that homogeneity positively influences respondent levels. Franzen and Lazarsfeld's (4, p310) supports this finding as they noted, that in respect of the response of a population, two-thirds of which had a measure of college education, and where interviews were used as a measure of control, that "for most practical purposes the biases are not large or can be corrected so that they need not distort to any serious degree a picture of the universe obtained by mail questionnaire sample". All the teacher-librarians in these schools have at least a matriculation certificate and a professional teaching qualification. Moreover, these teacher-librarians are also homogeneous in that they are of Indian descent. The primary objectives of the questionnaire were to determine:

2.2.1 the physical growth of the school libraries into modern library resource centres.

2.2.2 the changes in the budget for the purchase of resources.

2.2.3 the growth of the total holdings of the library resource centres.

2.2.4 how information is currently catalogued and indexed.

2.2.5 the success or otherwise of information retrieval.

2.2.6 the need for microcomputer technology to address current limitations.

2.3 THE SUBJECTS

The population of this study included all the teacher-librarians in charge of resource centres in Indian secondary schools under the control of the House of Delegates: Department of Education and Culture in the Republic of South Africa. This study included both groups of teacher-librarians who are in charge of these centres i.e. teachers holding both library qualifications and teaching qualifications and also those teachers who hold only a teaching qualification. These teachers were selected primarily on the basis of a chart on the relationship between sample size and the total population as published by Robert Krejcie and Daryl Morgan (9, p609). These authors concluded that as the sample size increased towards the total population the sample characteristics tend to become relatively stable. Therefore **all** of the teacher-librarians in Indian secondary school libraries, being 100% of the population, were selected in order to maximize the total sample size so that sample characteristics are stabilized.

2.4 THE SCHOOL LIBRARY RESOURCE CENTRES

All 136 Indian secondary school library resource centres in the Republic of South Africa were included in the survey. As these secondary schools are graded according to student population, this grading has an effect on the type, size, staff, budget and holdings of these resource centres. Consequently these libraries exhibited widely varying levels of resources and also differed in respect to the size of the communities they served. Analyses of the responses to the questionnaires indicated how these differences influenced sample size is a self-selected 86.7% of the population. Due to the large sample size and the lack of any discernable pattern in those who did not return the questionnaires, it is considered that the self-selection factor is not significant with regard to the sample being a true reflection of the population. The following table indicates the number of schools in the sample and the response rate from the teacher-librarians in charge of the school library resource centres:

No. of secondary schools	136
No. of responses	118
Percentage of response	**86.7%**

Table 2.1

The Sample Population

2.5 THE SURVEY INSTRUMENT

Questions pertaining to the various aspects of the investigation have been formulated as clearly as possible. Questions dealing with the same aspects have been grouped together while general questions have preceded specific questions. Questions were formulated while general questions have preceded specific questions. Questions were formulated in such a way so as not to condition the respondents to react in a particular way. The questionnaires included structured and unstructured questions, alternative questions and closed questions. Closed questions were pre-coded to facilitate the processing of the data. According to Cilliers (3, p93) this method lends a very strict formally structured character to the whole investigation which has obvious implications for the validity of the information obtained. The closed questions included a number of previously formulated alternative answers and the respondent was requested to mark the one that was most applicable to him/her. To provide for the possibilities not covered by these alternatives, the additional alternative "other" has been included in order to allow for greater freedom of responses. For some of the questions only one answer of several possible answers was required. This restriction was desirable in that the respondent was required to select the answer most applicable to him/her.

Another type of question required that frequency or intensity be indicated by marking one of the following "never", "sometimes" and "often". While this type of response may not be entirely suitable, the total reaction to these questions would provide an indication or pattern which could be regarded as representative of the value attached to the terms by the average respondent.

Line (10, p62-63) is of the opinion that the use of such questions in combination is well established as a method of obtaining data, and is believed to increase the reliability of the response. The questions were pre-coded to facilitate a computerized analysis of the responses.

2.6 PROCEDURES FOR DATA COLLECTION

The questionnaires **(Appendix A)** were mailed to the teacher-librarians in the care of the principal of the school, together with a stamped, self-addressed envelope in order to facilitate the highest possible rate of return. A covering letter to the principal **(Appendix B)** that was enclosed with the questionnaire briefly indicated the subject of the research and noted that the approval of the Chief Executive Director for the distribution of the questionnaires was secured, and requested the help of the principal in monitoring the completion and return of the questionnaire. An additional letter to the teacher-librarian **(Appendix C)** also described the scope of the research and the importance of the teacher-librarian's response to the questions. The questionnaires were mailed to all 136 Indian secondary schools. This initial mailing resulted in a response of 54%.

Approximately three weeks later, a further letter **(Appendix D)** together with another copy of the questionnaire, was posted to the principals of the non-responding schools advising that the completed questionnaire was still outstanding. This step increased the response rate to 86.7%

As the Education Department adopted a prescriptive approach in the administration of the school library resource centre through its circular minutes, education bulletins and orientation courses for its teacher-librarians, it was reasoned that these resource centres would adopt a common management and administration policy in terms of information storage and retrieval. A few resource centres were randomly selected for observation, and the teacher-librarians were interviewed in order to substantiate questionnaire responses.

2.7 DATA ANALYSIS

Questionnaire responses were tabulated by computer and summarized with percentage distribution for comparison by using a statistical software application package, **Statsgraphic** (12). In order to facilitate easier comprehension, the data was also graphed using the **Harvard Graphics** (6) software program. The responses were sub-grouped and where applicable, examined by cross-tabulation of the variables. This was done according to the procedures advocated by Nachmias and Nachmias (11), Babbie (1) and other similar texts which treat this method of multivariate analysis. Where applicable, the percentage differences in the cross tabulations were assessed for statistical significances through the chi square method.

The main findings of the questionnaire responses are presented in the form of tables and graphs with accompanying textual analysis.

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CHAPTER THREE

3. THE DEVELOPMENT OF SCHOOL LIBRARY RESOURCE CENTRES IN INDIAN SECONDARY SCHOOLS

3.1 INTRODUCTION

J. Willemse, chairman of the Committee for a Computerized Catalogue Network states in his forward to SABINET that "contemporary society is based on a free flow of information and that our democratic way of life, as well as economic, technological and other developments, depends on up-to-date and precise information which is being made available by means of hundreds of thousands of publications each year..." (3, foreword).

School libraries in Indian secondary schools have also become depositories for this information which has to be classified, catalogued, stored and eventually retrieved and disseminated to both students and staff. The evolving changes in information needs has resulted in a corresponding change in the character and format of school libraries. The combination of computer and telecommunications technology offers the opportunity to address the cumulative problems associated with the changes experienced by the school library.

The South African Library Conference held in Bloemfontein in 1928 resolved that adequate provisions for a library service should be made for the "Non-European" section of the population. As a result of this resolution the Carnegie Corporation made available to the South African Library Association three thousand pounds sterling (8, p9). The Natal Education Department was allocated five hundred pounds of this amount to utilize for library services.

A management committee was formed in 1929 to take charge of the administration of these funds and subsequently a circulating library service was established. Initially 346 volumes were purchased, catalogued and prepared for distribution, and in 1931 five selected Indian schools viz. Sastri College, Clairwood Indian School, Stanger Indian School, Maidstone Indian School and Umpumulo Indian School, received their first consignment of library books. An Inspector of Education was given the responsibility to organize and supervise the service. It was reported that there was an eager demand for books by the Indian population and thus a further 216 books were added to the stock in 1932. By 1948 an additional 12 schools received block book loans. This saw the beginning of library services in Indian schools in Natal. Nevertheless, few schools boasted of central library facilities and as a rule books were kept in boxes or cupboards "under the control of a teacher of English at each school" (7, p7).

Only secondary schools in Natal received an allocation for the purchase of library books, while in Transvaal all the schools were given an annual monetary allocation for the purchase of library books. Notwithstanding this fact the need for school libraries or even decentralised book distribution centres was not adequately catered for by both the Natal and Transvaal Education Departments which controlled Indian schools. This resulted in the principals, teachers and pupils raising funds for the purchase of library resource materials for their individual school libraries (7, p7).

In 1966 control of Indian Education was transferred from the Provinces to the State, which established the Division of Indian Education under the Department of Indian Affairs. This Division was responsible for implementing a "uniform policy" so that "every Indian School develops a respectable library facility that would meet the educational needs of pupils and teachers" (7, p7). Almost ten years later, in 1975, the Department embarked on a project to convert libraries into resource centres (7, p7).

3.2 DEVELOPMENT OF LIBRARIES INTO RESOURCE CENTRES

In 1974 a staffroom and an adjacent stockroom was converted into a resource centre at the Witteklip Secondary School, in Chatsworth, a suburb to the south of Durban, and as this project proved successful in terms of usage both by staff and pupils, the Department launched a programme to convert selected school libraries into resource centres (7, p8). In addition to the development of eighteen regional resource centres provision was also made to update ten schools per annum with the necessary audio-visual equipment and furniture so that these libraries could be converted to "multi-media resource centres" (7, p8).

3.2.1 Accommodation

The library bookstock which consisted mainly of English fiction was usually stored in cupboards under the control of the English teacher and this lack of centralized accommodation "adversely affected the proper organization ... of the library resources". (7, p7). This observation in the Fiat Lux sums up the type of library accommodation in secondary schools that prevailed in the sixties.

In the ensuing years the library was accommodated as and where space became available. It was usual for space to be in short supply as the demand for teaching room received priority. Invariably the library had to take second place for the available space and when this became available it was usually a vacant section in the caretaker's quarters, a storeroom or a stockroom. Over the years these premises were gradually upgraded to classrooms and multi-purpose rooms that became available mainly as a result of the movement of the local population to Phoenix, a new suburb to the north of Durban, and the subsequent drop in the roll of the schools. Of the 46 government secondary schools in existence prior to the takeover of Indian Education by the State in 1966, the majority of school libraries were housed in makeshift accommodation as there was no provision for proper library facilities in the physical planning of the schools. The following table lists the original accommodation of the libraries on the opening of the responding schools:

TABLE 3.1

ORIGINAL ACCOMMODATION OF THE LIBRARY RESOURCE CENTRES

DESCRIPTION	Frequency	Percentage
Caretaker's quarters	3	2.5
Storeroom/ stockroom	8	6.8
Classroom	23	19.5
Multi-purpose room	8	6.8
Purpose-built resource centre	70	59.3
Other	4	3.3
No response	2	1.7
Total	**118**	**100%**

While the table indicates that 42 schools had unsuitable library facilities, the percentage is actually higher than 35.6% as 90 schools of the total of 136 Indian secondary schools were built after 1966. In other words over 90% (42 out of the 46 schools) of the responding schools had makeshift library accommodation for, from 1966 onwards, the new schools benefitted from a revised building programme that made provision for proper library resource centres. 38.9% of libraries were originally housed in caretaker's quarters, stockrooms, storerooms or other unsuitable accommodation.

With the Education Department's policy of upgrading older schools, a significant number of these schools have been provided with modern library resource centres. A large percentage of these makeshift libraries have been upgraded and currently 14.4% of the libraries are housed in unsuitable accommodation as indicated in the following table showing the present accommodation of the responding libraries in secondary schools:

TABLE 3.2

PRESENT ACCOMMODATION OF THE LIBRARY RESOURCE CENTRES

DESCRIPTION	Frequency	Percentage
Caretaker's quarters	0	0.0
Storeroom/ stockroom	2	1.7
Classroom	15	12.7
Multi-purpose room	8	6.8
Purpose-built resource centre	92	78.0
Other	0	0.0
No response	1	.8
Total	**118**	**100%**

From **Tables 3.1** and **3.2** it is noticed that an additional 22 schools have been provided with proper modern library resource centres.

Central library accommodation of 89.19 square metres was provided for each secondary school built by the State between 1966 and 1977 and thereafter the building programme was revised to allow for a floor space of 194.7 square metres for library resource centres. This area is allocated for reprographics, audio facilities, displays, storage facilities, and the shelving of books and periodicals. The resource centre is also fitted with "wet" (with electricity) carrels for individual study. The following figure **(Figure 3.1)** illustrates the floor plan of a library resource centre in an Indian secondary school:

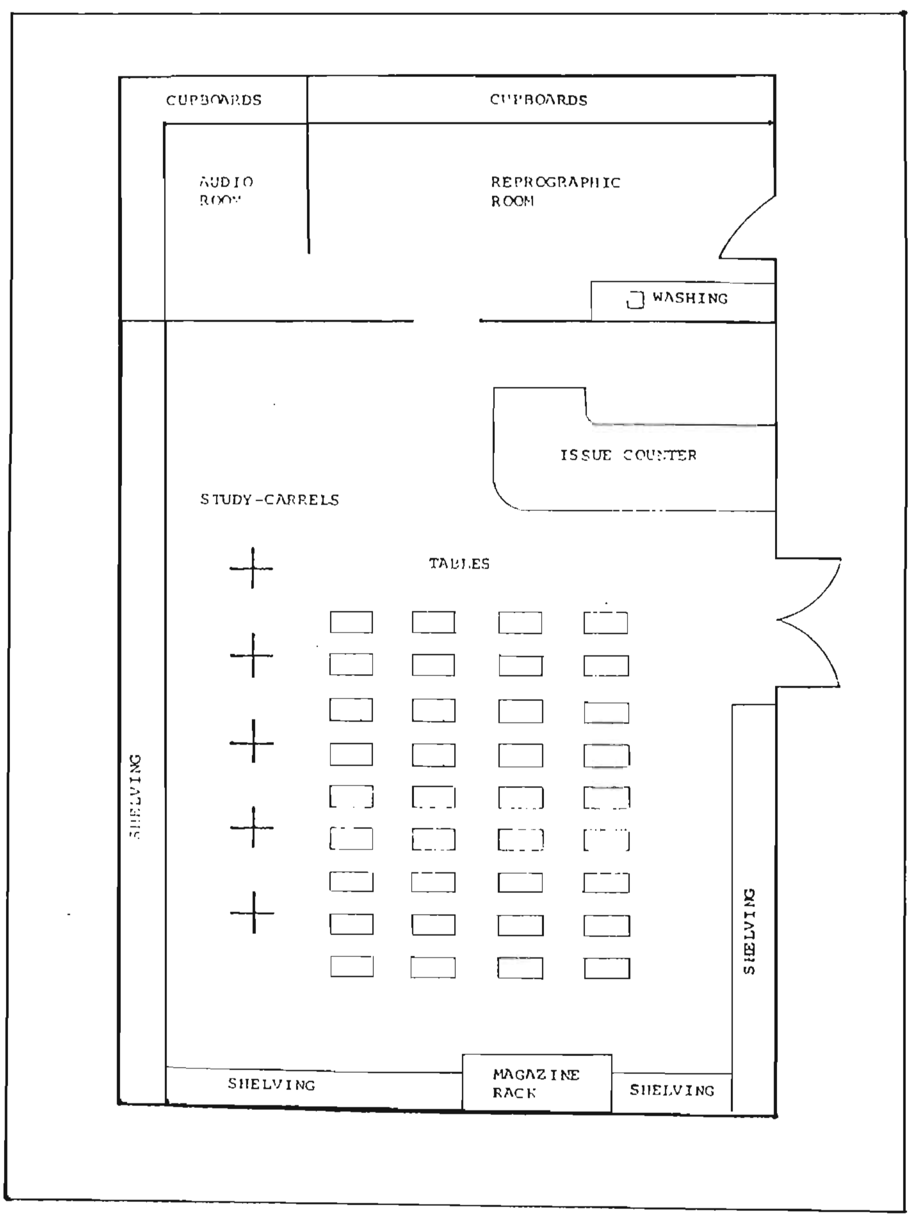
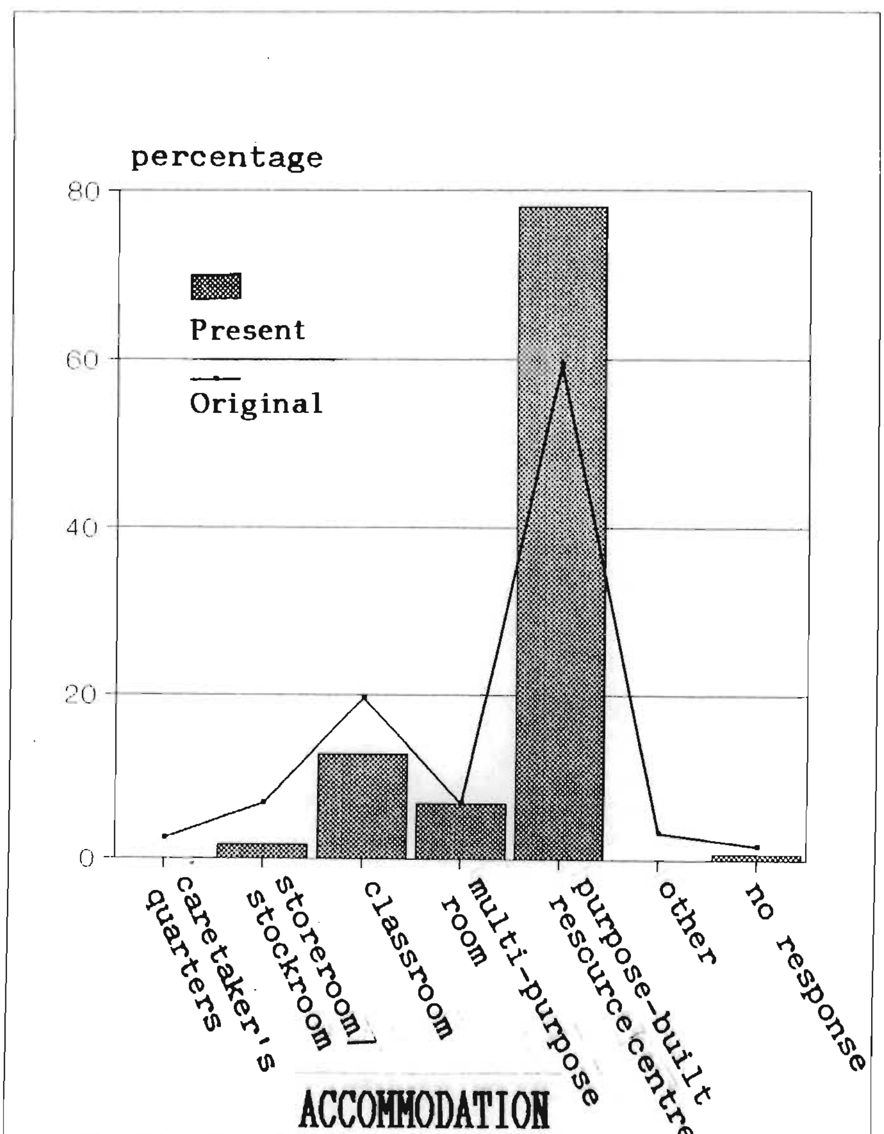


Figure 3.1 : Floor Plan of a Library Resource Centre in an Indian Secondary School

The change in the provision of library facilities over the years in terms of accommodation is clearly indicated in the following graph illustrating the original and present accommodation of these libraries.

GRAPH 3.1

Original and Present Accommodation of the Libraries



Two distinct features are noticeable in the graph. With the decrease of makeshift accommodation (caretaker's quarters, stock/ storerooms etc) there is an increase in modern library resource centres.

3.2.2 Budget

For each financial year school libraries are allocated a predetermined sum of money to be expended on the purchase of library resources. The amount allocated to these libraries is decided upon by the Education Department according to inputs made by the Library Services of the Department. These inputs are considered in terms of the global amount made available to the education budget. Two separate allocations are made. Firstly a basic amount is made to each library resource centre and secondly a per capita amount (per student) is voted in the budget e.g. in a given financial year the basic amount may be R500 plus an additional R3,50 for each student in the school. The basic amount and the per capita amount allocated have steadily increased over the years. 10 years ago in the 1980/1981 budget the basic amount was R99,00 and the per capita amount was R2,40. Over five years the basic amount increased by 88.8%

and the per capita amount increased by 28.8%. For the 1990/91 financial year the basic amount allocated is R1230 and the per capita amount is R7,40 indicating an increase of 1142% and 208% respectively over 10 years. The increases in the library budget over the last 10 years is indicated in the following table:

TABLE 3.3

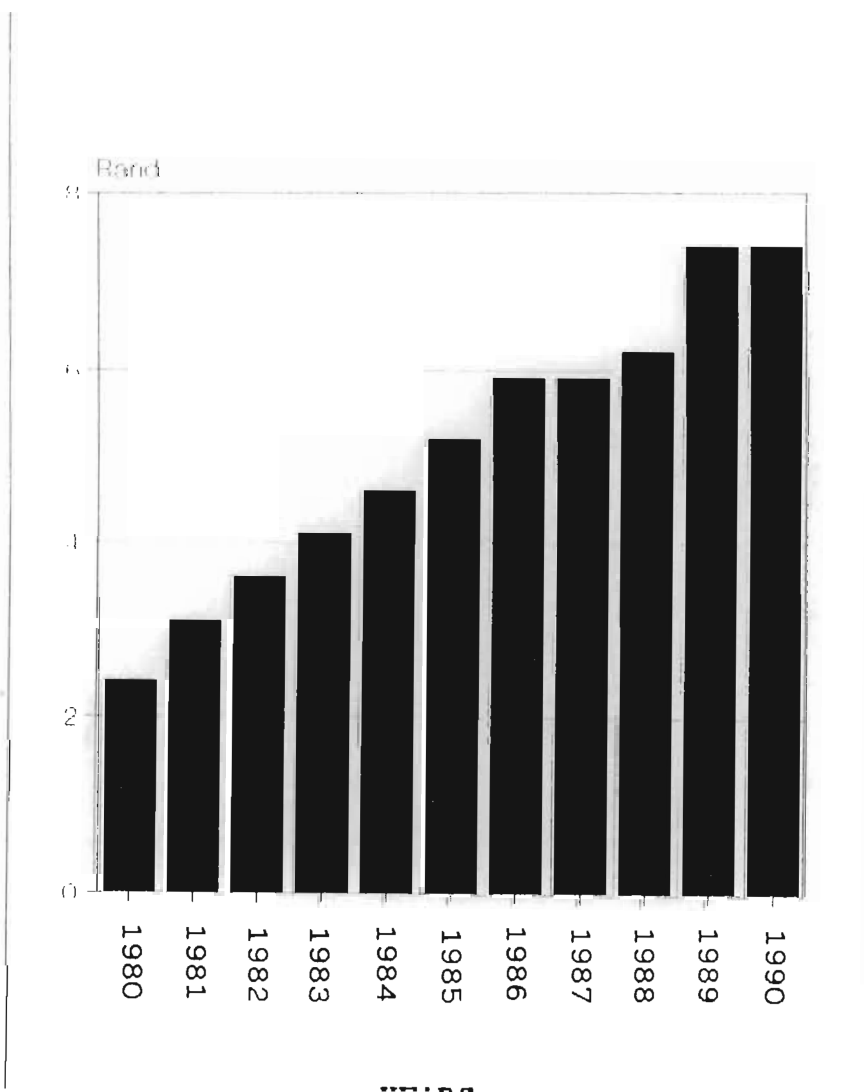
LIBRARY BUDGET FOR THE 1980/1 TO 1990/1 FINANCIAL YEARS

Year	Basic Amt	Per Capita Amt
1980	R99	R2,40
1981	R525	R3,10
1982	R620	R3,60
1983	R700	R4,10
1984	R780	R4,60
1985	R870	R5,20
1986	R990	R5,90
1987	R1120	R6,70
1988	R1120	R6,70
1989	R1230	R7,40
1990	R1230	R7,40

In 1988 there was a departure from the normal procedure of steadily increasing the budget for library resource centres. In this year no increases are noted in the monetary allocation. In 1989 the basic amount was increased by R110 to R1230 and the per capita amount was increased by 70 cents to R7,40. The monetary allocation for 1990 also did not change from the previous year. It can only be assumed that the financial cuts imposed by the Treasury also affected the library budget. The following graphs clearly illustrate the increases in the budget from 1980 to 1990:

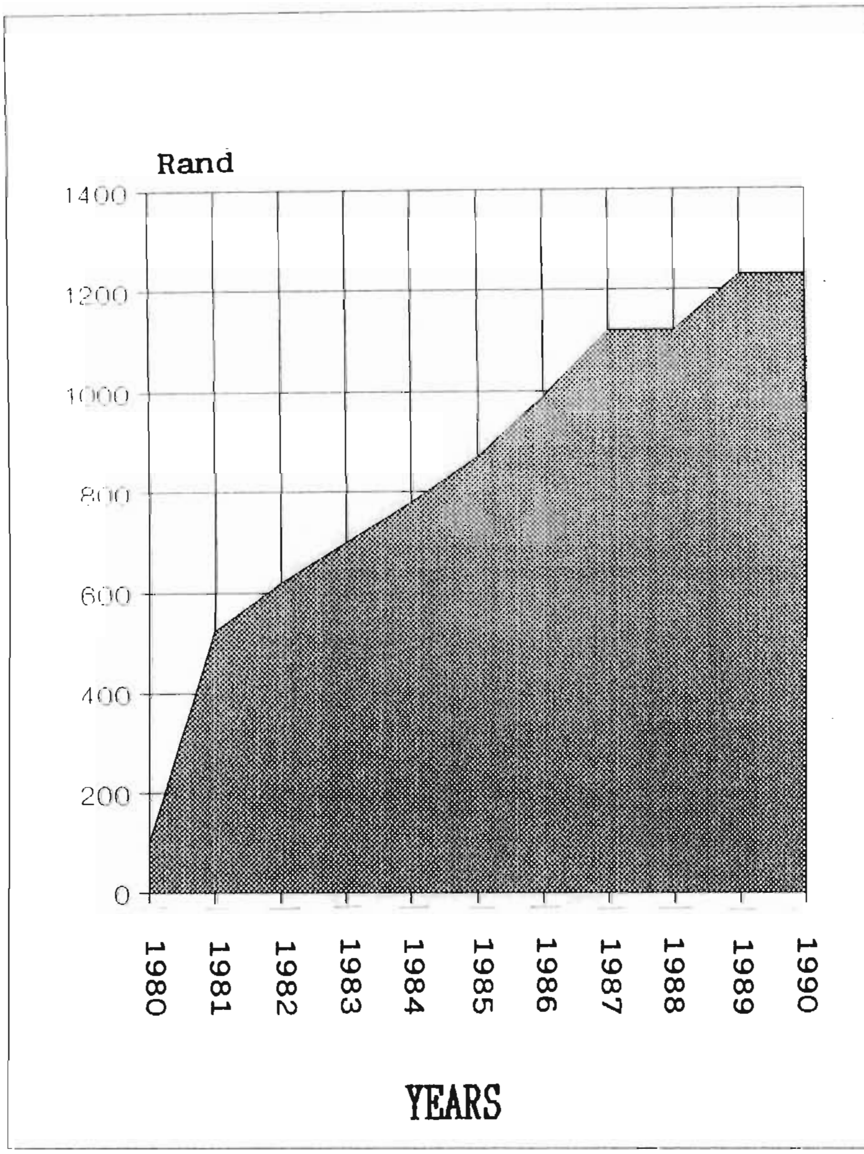
GRAPH 3.2

Per Capita Increases in the Library Budget from 1980 to 1990



GRAPH 3.3

Increases in the Basic Amounts from 1980 to 1990

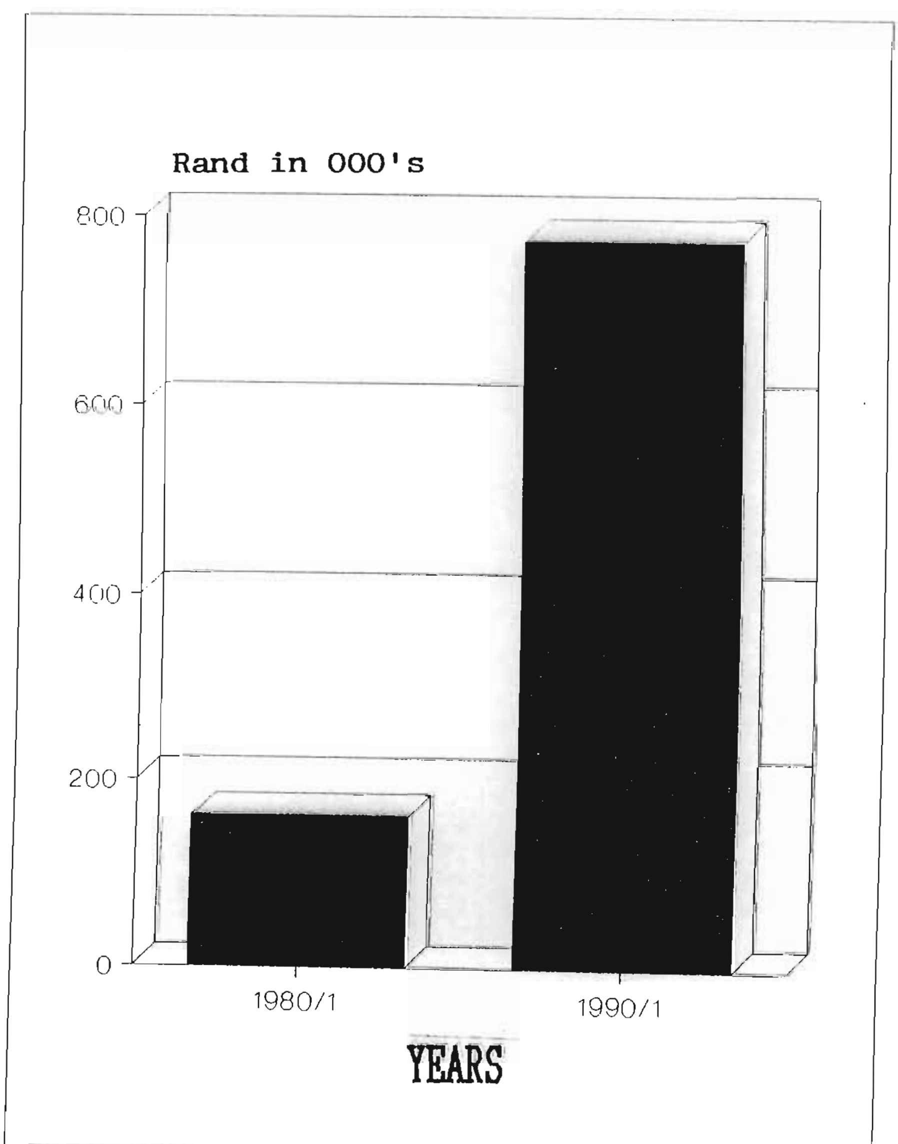


The total amount made available for library resources in terms of the per capita norm has been indirectly increased due to an increase in the student population in secondary schools over the years. In 1980 the total per capita amount for State secondary schools was

R160987,20 (R2,40 x 67078 students) and the 1990 total per capita allocation amounted to R775483,00 (R7,40 x 104795 students), an increase of R614495,80. In the following graph this difference in the budgeted funds for library purchases in the 1980/1 and 1990/1 financial years is clearly illustrated:

GRAPH 3.4

A comparison of the Difference in the Budgeted Amounts for 1980/1 and 1990/1



3.2.3 Library Holdings

The library resource centre holdings consist primarily of books, periodicals and non-book media including audiocassettes, slides, stripfilms, videocassettes, transparencies, and newspaper cuttings/project files. The sources of funding for the purchase of these items include the Department's annual budgetary allocation, the school fund and donations.

3.2.3.1 Books

Books are added to the collection primarily through purchases made by Departmental funding, purchases made through the school fund and donations made by wellwishers. Purchases made through the school fund are made on an ad-hoc basis rather than on a regular basis while Departmental funds are made available for each financial year. Donations too, also occur infrequently.

The steadily increasing amounts allocated by the Education Department for the purchase of library resources have resulted in a gradual but steady increase in the book holdings of the resource centre.

TABLE 3.4

OPENING BOOKSTOCK OF THE LIBRARIES

STOCK	Frequency	Percentage
Less than 500	53	44.9
500-1000	24	20.3
1001-1500	12	10.2
1501-2000	6	5.1
2001-2500	4	3.4
2501-3000	4	3.4
More than 3000	8	6.8
No response	7	5.9
Total	**118**	**100%**

44.9% of the responding schools opened their libraries with less than 500 books on their shelves and a total of 80.5% of these schools did not have an opening bookstock greater than 2000 books. 13.6% of these schools had an initial bookstock of over 2000 books. This comparatively larger opening bookstock may be explained by the procedures that usually occur on the closing down of a school and its library. The library bookstock is usually transferred to another or other school libraries on the advice of the Library Services of the Education Department. The average opening bookstock of a school is 921 books. In comparison to the low opening bookstock none of the responding schools has a current bookstock of less than 1000 books as at the lowest level 12.7% of the schools carry a bookstock of between 1000 to 2000 books and the average bookstock is 5940 books. This is indicated in **Table 3.5.**

TABLE 3.5

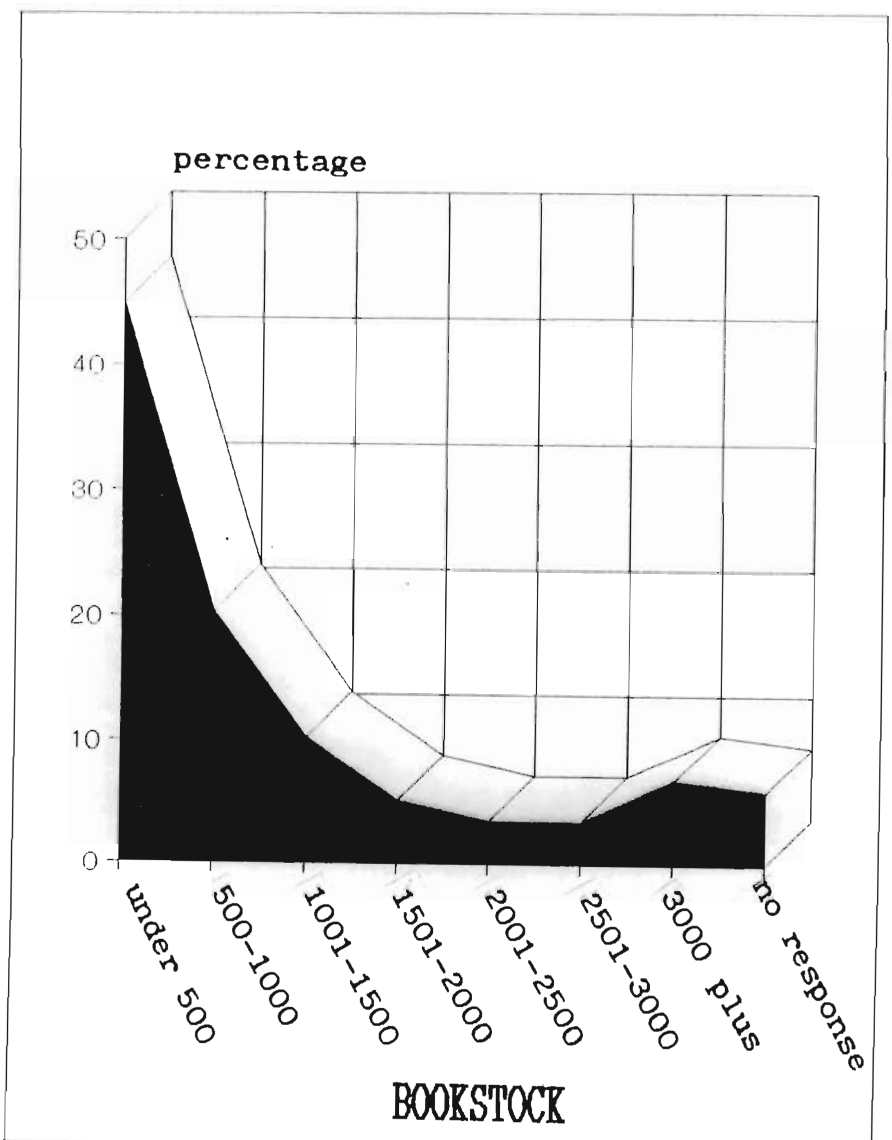
PRESENT BOOKSTOCK OF THE LIBRARY RESOURCE CENTRES

STOCK	Frequency	Percentage
1000-2000	8	6.8
2001-3000	7	5.9
3001-4000	8	6.8
4001-5000	17	14.4
5001-6000	23	19.5
6001-7000	19	16.1
7001-8000	11	9.3
8001-9000	12	10.2
9001-10000	7	5.9
More than 10000	6	5.0
Total	**118**	**100%**

56.8% of the schools have a bookstock ranging from between 3001 to 7000 books and approximately a third of the responding libraries hold more than 7000 books. 5% of the schools have a bookstock greater than 10000 The following graphs display the opening and current bookstock of the libraries.

GRAPH 3.5

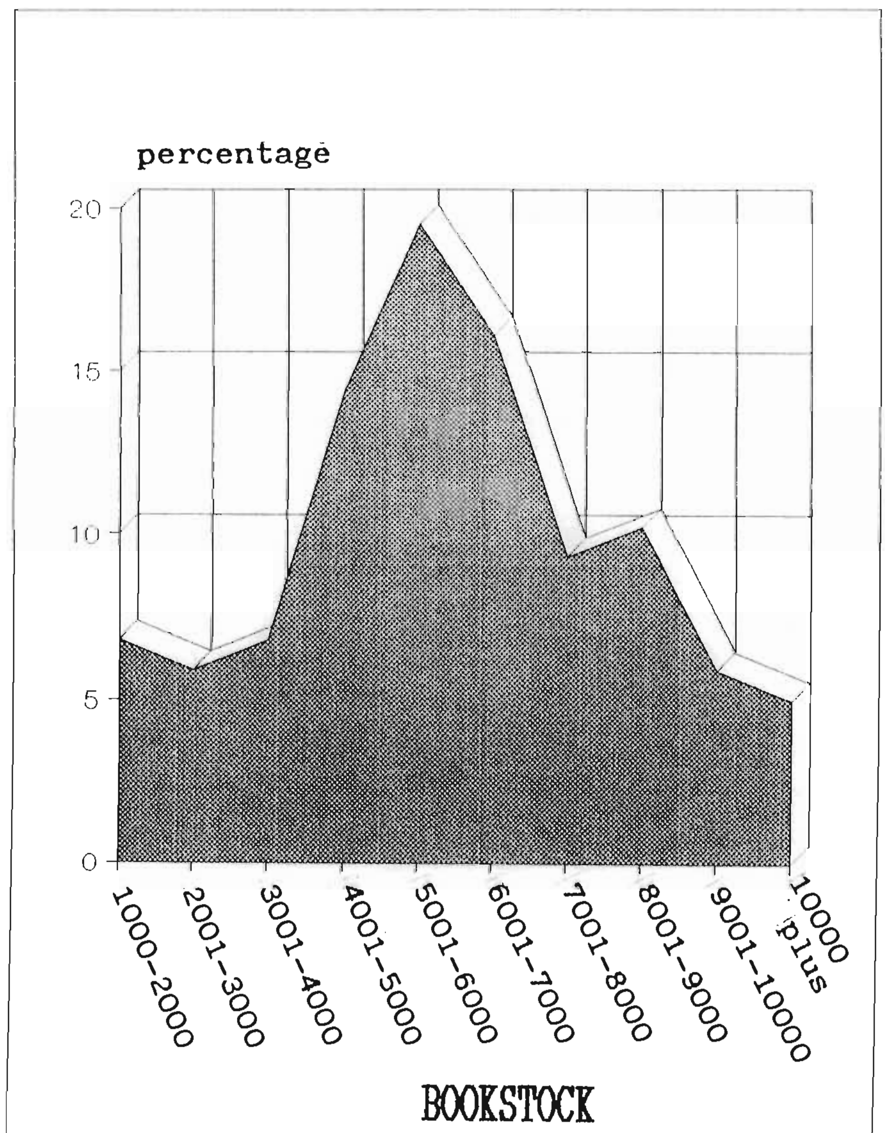
Opening Bookstock of Libraries



The graph indicates the high percentage of libraries with an initial opening bookstock of less than 500 books.

GRAPH 3.6

Current Bookstock in the Library Resource Centres



In comparison to **Graph 3.5**, this graph indicates a positive trend that begins at 1000 books and peaks at 10000 books illustrating a definite growth in the number of books held in the library resource centres.

3.2.3.2 Periodicals

The periodical collection is developed through subscriptions and also by requesting for gratis publications. In the first instance the teacher-librarian allocates an amount for selected periodicals determined by his line budget. Teacher-Librarians also request that their schools be placed on the mailing list of those institutions and societies that issue gratis copies of periodicals. From the high number of periodicals received in the library resource centre it is apparent that libraries have taken advantage of this source as the subscription fees for periodicals have become prohibitively expensive, thus restricting the number of paid subscriptions. The following table indicates the number of individual titles received by the libraries. As can be expected, the frequency of the issues will be varied:

TABLE 3.6

TOTAL NO. OF PERIODICAL TITLES RECEIVED ANNUALLY IN THE LIBRARY RESOURCE CENTRE

PERIODICALS	Frequency	Percentage
Less than 5	10	8.5
5-10	36	30.5
11-15	31	26.3
16-20	19	16.1
More than 20	21	17.8
No response	1	.8
Total	**118**	**100%**

The average number of periodical titles received annually in each library is 15 titles.

3.2.3.3 Non-book Resources

The library budget for each financial year is to be used primarily for the purchase of books and periodicals and only with the prior approval of the Library Services of the Education Department may these funds be appropriated for the acquiring of non-book resources. As is the case with the purchase of books and periodicals, the school fund and wellwishers are additional sources for this type of resource. The Department may, in certain instances, provide school library resource centres with relevant non-book media. The local teachers' centres are also providers of non-book material. It is a resourceful teacher-librarian who utilizes every opportunity to collect these resources. The staff of the school is also a ready source of material. It is expected that the teachers make transparencies, charts, audiocassettes etc and leave these in the library resource centre so that others may also benefit by their use. Thus a set of slides made by one teacher is made available to the entire staff and in some instances to the students. This sharing of resources helps to promote the development of a wide variety of resources and duplication is also usually avoided.

The following table indicates that over 90% of the responding schools have a variety of non-book media in the their resource centres.

TABLE 3.7

NON-BOOK MEDIA HELD IN THE LIBRARY RESOURCE CENTRES

MEDIA	Frequency	%	Total
Slides/stripfilms	107	90.7	118
Transparencies	112	94.9	118
Cuttings/project files	110	93.2	118
audio media	112	94.9	118
Videocassettes	112	95.7	118

3.2.4. Staff

Prior to 1976 it was not unusual to see an English teacher in charge of the library. If this was not possible then these duties would be "farmed" out to another teacher to bring up that teacher's workload to the required norm. The teacher in charge of the library had no stipulated clerical help in the execution of library duties, thus the help of a few willing students was usually solicited to execute the routine library chores.

3.2.4.1 Professional Staff

It may be reasonably assumed that a professionally qualified librarian is, **cetris paribus**, in a better position to successfully administer a library than one who does not have suitable qualifications. Prevailing service conditions in the Department precluded a person from being permanently appointed in a school without professional teaching qualifications in spite of the provisions of schedule 9 posts that allows for permanent appointments in certain other categories (4, p102). In other words a person with just library qualifications would not and could not be appointed in a permanent capacity in a school library. Moreover, until 1975 there was no incentive or motivation for the teacher to obtain a library qualification.

However, in 1976 teachers were informed of the new requirements pertaining to school library qualifications (5,6). They were advised that those teachers who obtained the Diploma in Special Education (School Library Science) from the University of South Africa or the Resource Centre Management Diploma from the University of Durban-Westville would, under certain conditions, qualify to be placed on the next grade e.g. from M+3 to M+4 or M+4 to M+5. The minimum requirement to offer this diploma in school library science was an M+3 Education Diploma i.e. a post-matric teaching diploma obtained after three years of full-time study (4, p50). This teaching qualification pre-requisite revealed the Department's thinking in terms of the role of the library resource centre. The Education Department was aware that the incumbent for the post of teacher-librarian in a school would have a demanding role. On the one hand the teacher-librarian would have to administer a resource centre according to acceptable management principles and on the other hand the teacher-librarian had to relate to both the teachers and students in the teaching-learning situation. The need for also having an approved teaching qualification becomes clearly apparent. The upgrading to the next grade meant that the teacher-librarian would enjoy both a monetary benefit which is a powerful incentive, and status which is a strong motivator. It is generally accepted that very few, if none, of the teachers on the establishment had a school library qualification prior to 1976. The Department's programme to upgrade library facilities, increase library budgets and to recognize library qualifications has led to a relatively large percentage of teachers in the school library obtaining relevant library qualifications. The qualifications held by those teachers who hold the post of teacher-librarian in the responding schools are indicated in the following table:

TABLE 3.8

QUALIFICATIONS OF TEACHER-LIBRARIANS

QUALIFICATION	**Frequency**	**Percentage**
Teacher's Dipl	16	13.6
Teacher's Dipl + Lib Sc Dipl	31	26.3
Teacher's Dipl + SLRCM Dipl	27	22.9
Teacher's Dipl + Degree	10	8.5
Teacher's Dipl + Degree + Lib Dipl	22	18.6
Teacher's Dipl + Degree + SLRCM	10	8.5
No response	2	1.7
Total	**118**	**100%**

The table indicates that 76.3% of the respondents hold approved dual qualifications. Of the remaining respondents 13.6% hold only a teaching qualification and 8.5% hold a teacher's diploma together with a degree. Originally only two diplomas were recognised for categorization purposes i.e. the diplomas from the University of South

Africa and the University of Durban-Westville. The need to train teachers specifically for the school library resource centre led to the structuring of such a course at the Springfield College of Education in 1986. This institution offers the course to selected teachers on a two-year part-time correspondence basis.

The demands made on the teacher-librarian are frequent and varied. The teacher holding the post should have the maturity and experience to cope with the demands made by the staff and students. The following crosstabulation reveals the age and experience of teacher-librarians in secondary school library resource centres:

TABLE 3.9
AGE AND EXPERIENCE OF TEACHER-LIBRARIANS

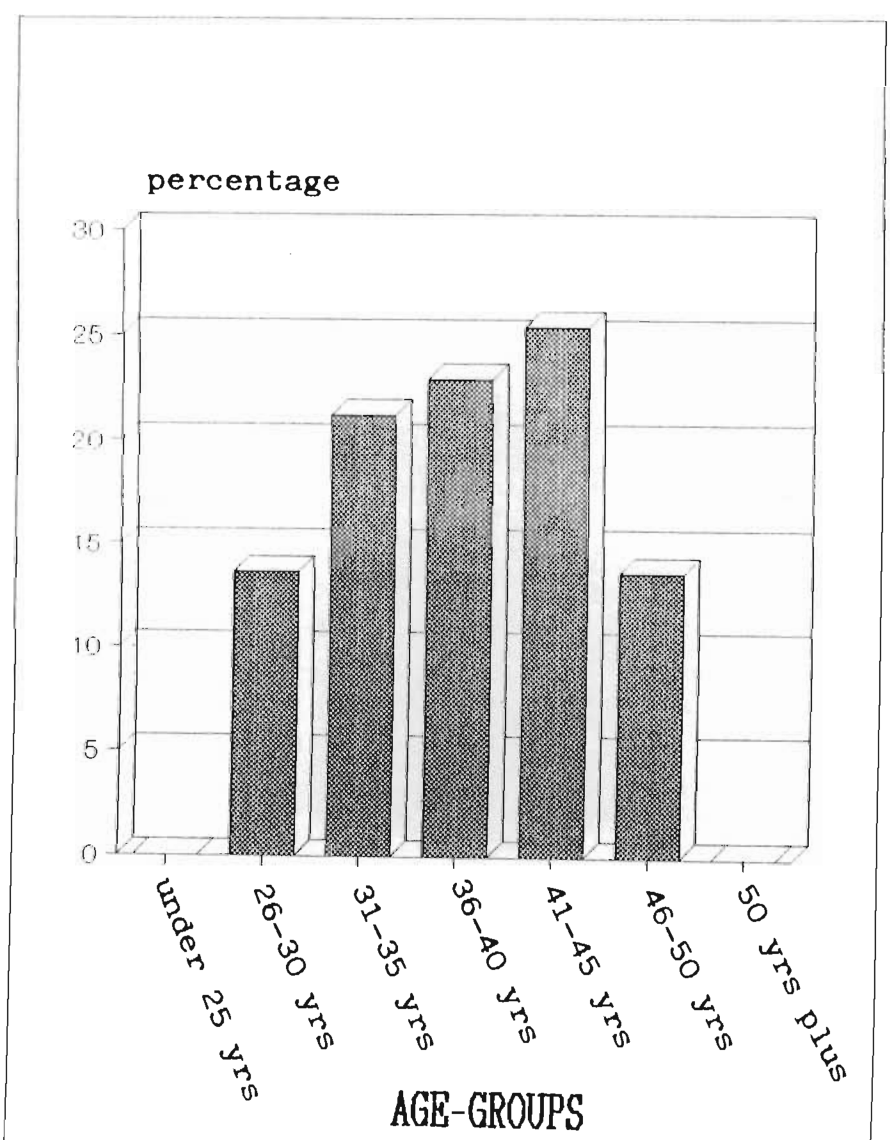
	EXPERIENCE in YEARS				
AGE	**1-5**	**6-10**	**11-15**	**16-20**	**+20**
26-30 yrs	11	5	0	0	0
31-35 yrs	10	13	2	0	0
36-40 yrs	6	12	17	2	0
41-45 yrs	6	14	7	2	1
46-50 yrs	0	6	4	5	1
50 + yrs	0	3	1	0	0
TOTAL	**33**	**53**	**31**	**9**	**2**

Over 90 of the responding teacher-librarians have more than 5 years experience in the library and 80 of these teacher-librarians are over 30 years old.

The following graphs reveal the age and experience of teacher-librarians of the responding schools.

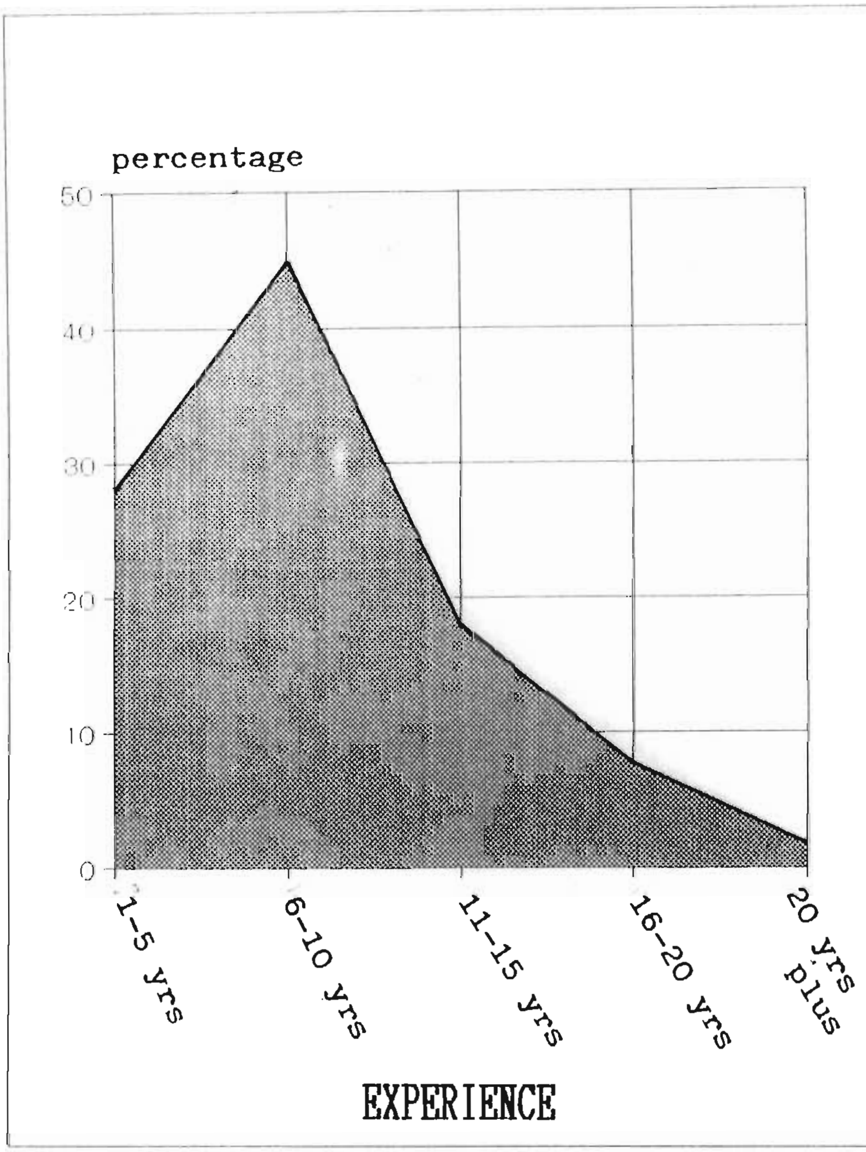
GRAPH 3.7

A Graphic Representation of the Age-Groups of Teacher-Librarians



GRAPH 3.8

Graphic Representation of the Experience of Teacher-Librarians



Over 83.6% of the respondents are over 31 years old, indicating a relatively mature

staff. Moreover, from the point of view of experience, 44.9% of the teacher librarians have between 6-10 years of experience in the library and 27.1% of the respondents have more than 10 years experience indicating a healthy situation as far as maturity and experience are concerned.

From the following table it is apparent that the teacher-librarians have started to think about the importance of the necessity to be computer literate:

TABLE 3.10

COMPUTER COURSES TAKEN BY TEACHER-LIBRARIANS

Courses	**Frequency**	**Percentage**
Computer Science	1	.8
Information Sys	7	5.9
Computer Literacy	21	17.8
None	79	66.9
No response	10	8.5
Total	**118**	**100%**

Approximately 25% of the respondents are computer literate. With the Department's commitment to the provision of computers and computer awareness programmes in schools it is expected that the percentage of teacher-librarians who are computer literate will increase.

3.2.4.2 Administrative Staff

From discussions with teacher-librarians it was established that since May 1983 the senior library subject advisor tacitly agreed to the general clerical staff of the school providing administrative help in the library resource centre with the approval of the principal. One of the clerical assistants would be released from the general office duties for a maximum of 4.75 hours daily. This time would be utilised in the resource centre in assisting the teacher-librarian with routine administrative duties. While these clerical assistants have no library experience it is expected that the teacher-librarian provides on the job training in routine library administration.

3.3 SUPPORTIVE SERVICES

The Education Department has adopted a twin-tiered approach to oversee the continued growth and development of the resource centre. The Educational Technology Services of the

Planning Section of the Education Department was established with a view to providing the necessary planning and policy making for the library resource centre. A Subject Advisory Service was also established to implement policy decisions and also to offer advice and help to teacher-librarians in the management of the resource centres.

3.4 CONCLUSION

It is clearly evident that variable growth has, and is taking place in the various areas of the school library resource centres. Prior to the 60s this growth was relatively nonexistent and from 1966 onwards, with the transfer of Indian Education to the Central Government, gradual growth had taken place up till the late 70s. Thereafter the growth and development of the school library was accelerated. The recognition of specialised library diplomas for categorisation has led to a significant number of teachers obtaining library qualifications. The provision of purpose built library resource centres will cater for the rapidly increasing library holdings of both book and non-book media. This increase in the acquisition of stock is the result of increased funding from the Education Department. With the continued growth and expansion of the library resource centre the need for an effective approach for the timeous location and retrieval of information becomes crucial if the information needs of the user are to be satisfied.

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CHAPTER FOUR

4. THE DEVELOPMENT OF INFORMATION RETRIEVAL IN INDIAN SECONDARY SCHOOL LIBRARY RESOURCE CENTRES

4.1 INTRODUCTION

For years libraries have been the traditional repositories of information and data, and the efficient storage and retrieval of this information has been the goal of librarians. However, this goal has not been apparent in the Indian secondary school libraries. In Chapter Three it was noticed that the libraries in Indian secondary schools experienced phenomenal growth over the last decade. This growth encompassed the physical accommodation requirements of the library resource centre, increases in budgetary requirements and staff development programmes. No concurrent growth and development had taken place in the storage and retrieval requirements in these centres as is apparent in this chapter, where the storage and retrieval methods prescribed by the Library Services of the Education Department for Indian secondary school library resource centres is reviewed.

Prior to 1966, when Indian secondary schools came under the control of the Provincial Education authorities, the storage and retrieval methods employed by the teachers in charge of these libraries reveal that no consistent pattern or method existed in this regard. This situation had resulted primarily as a result of circumstances that prevailed during that period. Both the library inspectors, and teachers in charge of these school libraries lacked suitable school library qualifications. As stated previously in **Chapter Three** it was only from 1978 that these teachers obtained school library qualifications.

It is apparent that those in charge of library services in Indian schools had failed to positively address this issue of adequate storage and effective retrieval by the library patrons. In 1978 some salutory attempts were made to rectify the situation by the publication of an article in the Department's Education Bulletin, number 3 of 1978, which advocated the construction of key cards (1). It was envisaged that these key cards would help the students to unlock the Dewey Decimal notation of the subject cards. However, the success of a key card system presupposes a well compiled classified card catalogue. Up to the early 80s there was a relative hodge podge of catalogue systems in operation in school libraries. This could be attributed chiefly to the lack of professionally trained personnel in the library and also the lack of clear direction from the Department's Library Services. This is notwithstanding the fact that the first fully professionally trained teacher-librarians were appointed in 1978. These teacher-librarians qualified at the University of South Africa and at the University of Durban-Westville. The Unisa students were trained to use the McArdel cataloguing rules while the UDW students learned to apply the Anglo American rules. In effect this meant that even in schools with professionally qualified teacher-librarians there was no standardization in the methodology of cataloguing.

Adding to the problem, for each financial year secondary schools under the control of the House of Delegates are voted a sum of money in the budget to be expended on library resource materials. Each of these schools qualifies for an approved amount based on a per capita system which is reviewed and increased annually. Assuming the per capita amount allowed for the 1989/90 financial year is R10, a school with a full-time equivalent population of 1000 would then receive R10000 for the exclusive purchase of library materials. Once the library order has been executed the librarian catalogues the new stock for use. The quality of the cataloguing depends upon the professionalism and expertise of the teacher-librarian.

The total result of this regular annual purchase was increased library holdings, which in turn resulted in an increase in the number of catalogue cards to be prepared. Apparently the work load of the teacher does not allow for the timeous cataloguing of the resources as an analysis of the responses received in this regard indicate that the catalogue cards of a large percentage of schools are incomplete as illustrated in the following table:

TABLE 4.1

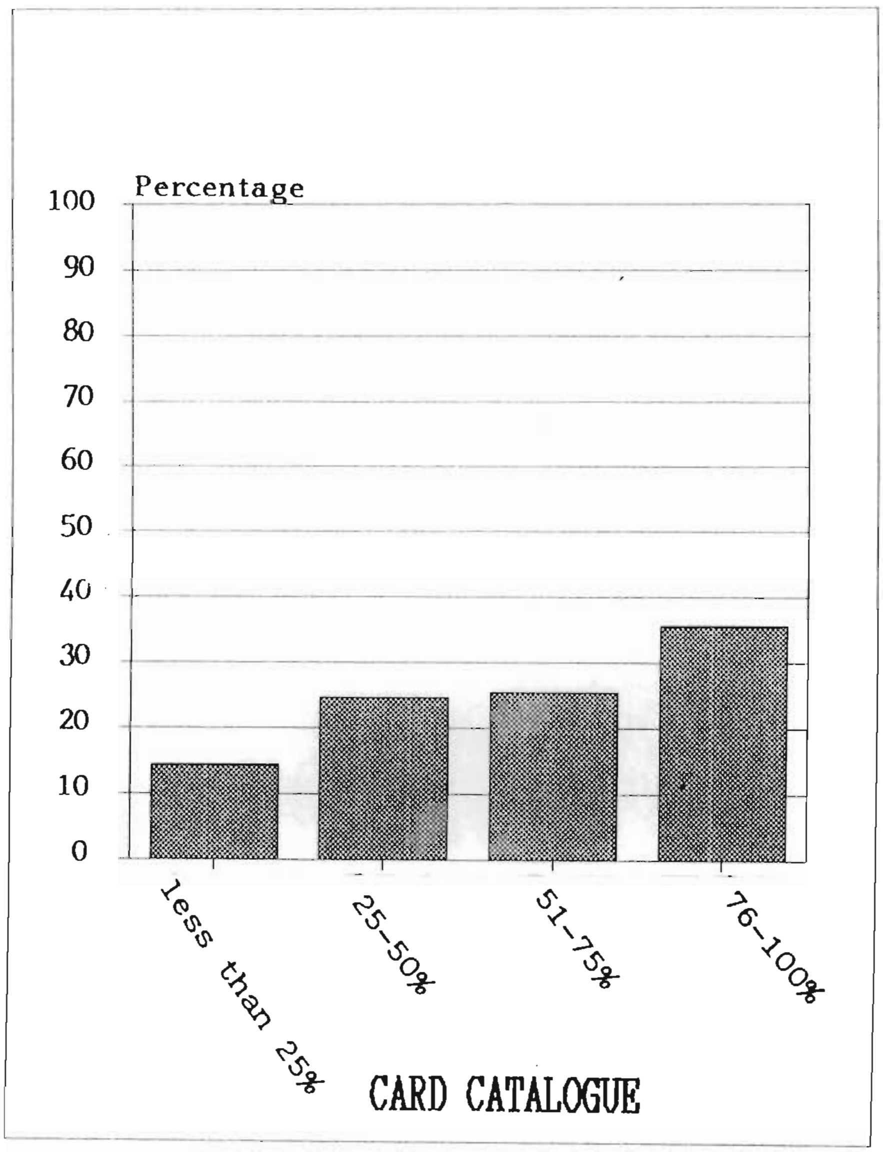
PERCENTAGE OF HOLDINGS CATALOGUED ACCORDING TO THE CONCISE AACR2 RULES

STOCK	Frequency	Percentage
Less than 25%	17	14.4
25-50%	29	24.6
51-75%	30	25.4
76-100%	42	35.6

50% of the respondents indicated that only between 25% and 75% of their holdings were catalogued. Another 14.4% of the respondents had less than 25% of their holdings catalogued. 35.6% of the responding schools had over 76% of their holdings catalogued. These percentages clearly indicate the urgent need for teacher-librarians to update their catalogue cards for their current holdings. If this is not done timeously, additional acquisitions will compound the problem. The variations in the percentage of the library resources that have been catalogued in the responding school library resource centres are illustrated in the following graph:

GRAPH 4.1

Variations in the Completion of the Card Catalogue according to the Concise AACR2 Rules



The graph clearly illustrates the large percentage of school library resource centres that have a major part of their card catalogue incomplete. As indicated by Townsley (3, p4), so much has been made of the phrase "information retrieval" that it is easy to forget that the proper description is information storage and retrieval. Townsley concludes that the object is to store information for retrieval as and when required. In other words the most efficiently designed retrieval system cannot be used to find information successfully if that information has not been adequately stored.

4.2 DEPARTMENTAL RATIONALE FOR INFORMATION RETRIEVAL

In 1978 the article, **Retrieval systems for the school library resource centre: the card catalogue,** in the Department's Education Bulletin, number 3 of 1978, had the following quotation by Jolly:

"No large library can function without an adequate catalogue and in almost every library the use which can be made of the library's resources depends vary largely on the quality of the catalogue" (1, p37).

While teacher-librarians were given guidance on how to index and file these catalogue cards in the article, no positive attempt was made to indicate to the teacher-librarian the requirements for cataloguing. This omission provides an insight into the quality of the card catalogues of most library resource centres during that period. Primarily owing to the dearth of trained teacher-librarians and the lack of clear direction from the Department's Library Services, there was no standard system of cataloguing in the library resource centre. Dependant on the zeal and enthusiasm of the teacher-librarian, a variety of systems were either adopted or adapted in the preparation of the catalogue cards for the library resource centre.

As far as information retrieval was concerned, the teacher-librarian was required to file the author card, title card and subject card separately so that "the library user requiring a book" would be able "to retrieve it expeditiously and effortlessly" (1, p37). In order to "expose" the subject card it became "crucially necessary" to draw a fourth card - a "key card", which constituted an alphabetical index to the classified catalogue. Key cards had become a necessity due to the rapid expansion of information resources which included a wide variety of media in the total holdings of the library resource centre (1, p37).

In 1984 the Education Department's Library Services held three-day orientation courses for teacher-librarians at various centres in the Republic. Among other matters pertaining to the library resource centre, the current requirements for a card catalogue system to facilitate information retrieval was presented to the course delegates. However, there was still an element of confusion as librarians were expressly requested not to discard the existing system if they were drawn up "neatly and accurately" and are in "working order" (2, p48).

Notwithstanding the above, the **CONCISE AACR2** rules were to be "implemented henceforth" (2, p48). It may thus be reasonably assumed that at least two distinct card catalogue and indexing systems exist in school library resource centres viz. the systems in use prior to 1984 and the system based on the AACR2 cataloguing rules in the post-1984 period.

4.3 THE PURPOSE OF CATALOGUING THE LIBRARY RESOURCE CENTRE HOLDINGS

According to the Library Services of the Education Department (2, p48) the library resource centre catalogue is compiled to serve several purposes including the provision of answers to the following questions:

4.3.1 is there a book by a particular author in the library resource centre?

4.3.2 which other titles by this particular author are held in the library?

4.3.3 is there a particular title in the resource centre?

4.3.4 who wrote this particular title and when?

4.3.5 where on the shelves will this particular title be located?

4.3.6 is there any book in the library resource centre on a particular subject?

4.3.7 are there non-book media on a given subject in the library resource centre?

The three-day orientation course handout (2) emphasizes that regardless of the actual location of the resources in the library, it is the catalogue that "exposes" the material to the user.

4.4 THE SITUATION IN THE LIBRARY RESOURCE CENTRE PRIOR TO 1984

Prior to 1984 teacher-librarians used a variety of simplified catalogue entries which were written on the following cards:

* author card
* title card
* subject card

Only the essential details of the book/ resource were indicated on the card itself. The author card which was constructed as the main entry card included the following principal details: author, title, accession number and the Dewey location number.

027.8 VIN

VINK, CM
Media centres.
1988. 159 p. illus.

89/101

Figure 4.1 : Author Card

The title card was a duplicate of the author card with the additional entry of the title written above the name of the author:

027.8 VIN
MEDIA centres.
VINK, CM
Media centres.
1988. 159 p. illus.
89/101

Figure 4.2 : Title Card

The subject card which was to be drawn for non-fiction and reference works was also a duplicate of the author card with the addition of the Dewey number above the name of the author:

027.8 VIN
027.8
VINK, CM
Media centres.
1988. 159 p. illus.
89/101

Figure 4.3 : Subject Card

4.5 THE POST 1984 PERIOD IN THE LIBRARY RESOURCE CENTRE

At the three-day orientation course held for teacher-librarians the Concise AACR2 cataloguing rules were introduced to the course participants. They were informed that while the AACR2 rules were comprehensive in detail regarding the construction of the catalogue, the three levels also permitted "simplified" cataloguing which was suitable for library resource centres at both primary and secondary schools (2, p50).

4.5.1 Classified Card Catalogue

Each library resource centre had to have the following "catalogues filed systematically in the catalogue cabinet/s provided by the Department" (2, p48):

4.5.1.1 alphabetically filed author cards,

4.5.1.2 alphabetically filed title cards,

4.5.1.3 numerically filed subject cards,

4.5.1.4 alphabetically filed key cards.

Using the information on a title page a typical AACR2 first level author card would include the following elements:

027.8 VIN

VINK, CM

Media centres / Carl Max Vink.

2nd ed. London : Butterworth,

1988, 159p.

ISBN 0575 02677 7 89/101

Figure 4.4 : Example of a First Level AACR2 Author Card

However, the teacher librarians were instructed to the effect that these details were to be simplified even further and the following are examples of the types of author, title and subject cards advocated by the Library Services of the Department:

4.5.2 Author Card

027.8 VIN

VINK, CM

Media centres / Carl Max Vink.

1988.

Admin. of library resource centres

89/101

Figure 4.5 : A Simplified AACR2 Author Card

No major differences existed in the required author card and the author card used previously. The title would now include a statement of responsibility that is preceded by a slash e.g. / VINK CM. The physical description has been abbreviated with only the date i.e. 1988 included. A note element that very briefly describes the contents of the book has been added i.e. covers the administration of media centres.

4.5.3 Title Card

```
                                   027.8 VIN
MEDIA centres.
VINK, CM
Media centres / Carl Max Vink.
1988.
Admin. of library resource centres
                               89/101
```

Figure 4.6 : A Simplified AACR2 Title Card

The title card is a duplicate of the main entry author card with the addition of the title above the author's name.

4.5.4 Subject Card

027.8 VIN
027.8
VINK, CM
Media centres / Carl Max Vink
1988.
Admin of library resource centres
89/101

Figure 4.7 : A Simplified AACR2 Subject Card

The subject card is also a duplicate of the main entry author card with the additional detail of the Dewey number added above the author's name.

The bibliographic description of an item which normally consists of eight elements in the AACR2 cataloguing rules:

* full title and statement of responsibility
* edition area
* material area
* publication distribution area
* physical description area
* series area
* note area

* standard number and terms of availability area

have been radically altered for the school library resource centre, with all of the elements being either adapted, ignored or relocated, with the exception of the full title and statement of responsibility area.

The edition of the book is to be generally ignored and only if it is important must it be relocated in the **note** area. The material area is totally ignored. In the publication distribution area only the date of publication in "western style Arabic numerals" is included while the place of publication and the publisher is excluded. The series area is also amalgamated into the **note** area. The standard **ISBN** and the **ISSN** numbers are also ignored. In the note area, which includes the edition area, the physical description area and the series area, the entries are brief.

4.5.5 Periodicals

Subject entry cards are drawn up selectively i.e. for high frequency topics only (2, p54):

PERIODICALS
371.33
USING visuals in the classroom /
CJ Jones.
p. 24 - 26.
In : Tech Trends, v4, no. 6.
P89/201

Figure 4.8 : A Subject Entry Card for Periodicals

4.5.6 Non-book Material

Resources such as slides, overhead transparencies, stripfilms, video and audio cassettes, gramaphone records, charts and cuttings are catalogued in the same manner as books. However, only subject cards are maintained and these cards are interfiled in numerical sequence with the other subject cards. The following cards are examples of non-book resource subject catalogue cards:

SLIDES

551 VOL

551 VOL

VOLCANIC regions

A set of 36 colour slides with

a booklet. 1989.

89/101

Figure 4.9 : Non-book Resource Subject Card: Slides

RECORDS

822.33 SHA

822.33

KING Lear. 1989.

Stereophonic sound.

R89/401

Figure 4.10 : Non-book Resource Subject Card: Record

4.6 RETRIEVAL SYSTEM IN THE LIBRARY RESOURCE CENTRE

According to the Department's Education Bulletin (1, p37) the proliferation of information resources and the inclusion of a wide variety of media or formats that are used to convey knowledge in the library resource centre has necessitated the creation of a single key card array. It was envisaged that this key card will "at a glance, reveal the existence of both the required information and the type of media-both printed and non-printed used to express the information" (2, p37). In order to expose the required subject card the fourth card or key card was necessary because the subjects are arranged numerically from 000 to 999. The library user who is not **au fait** with the Dewey Decimal classification system would, in all probability have, difficulty in using the subject catalogue to its fullest advantage. This problem would be obviated by the key card index. It was expected that the user would first consult the key card array in order to establish the Dewey number of the required topic or subject under scrutiny. This number would lead the user to the appropriate sector in the subject card catalogue. Therefore, the key cards would in effect constitute an alphabetical index to the classified catalogue.

4.6.1 Construction of the Key Card

A 10x04cm rubber stamp with the following details arranged in alphabetical order is used in the library resource centre:

BOOKS		PROJECT FILES	
CASSETTES		RECORDS	
CHARTS		SLIDES	
CUTTINGS		STRIPFILMS	
FILMS		TAPES	
PERIODICALS		TRANSPARENCIES	

Figure 4.11 : Details on a Key Card Rubber Stamp

This rubber stamp is used to make an "exact but neat impression" on the blank side of a **Z21** catalogue card in such a manner that adequate space above the impression is left for typing in the key word or phrase and the relevant Dewey notation e.g. **Birds 598.2.** This side of the key card with the impression is exposed to the library user.

BIRDS 598.2

BOOKS		PROJECT FILES	
CASSETTES		RECORDS	
CHARTS		SLIDES	
CUTTINGS		STRIPFILMS	
FILMS		TAPES	
PERIODICALS		TRANSPARENCIES	

Figure 4.12 : A Key Card

The key word or phrase is that which the teacher-librarian anticipates will be used by the library patron who does not know either the author or the title of the book that he is searching for. This key card will also be consulted if information in the other non-book formats were required as well. The key card or phrase that is used by the librarian in the construction of the key card catalogue is not necessarily the title of a book.

The following key card illustrates the existence of learning media - both book and non-book - on birds in the resource centre:

BIRDS 598.2

BOOKS		PROJECT FILES	
CASSETTES	*	RECORDS	
CHARTS		SLIDES	*
CUTTINGS		STRIPFILMS	*
FILMS		TAPES	
PERIODICALS	*	TRANSPARENCIES	

Figure 4.13 : A Completed Key Card on Birds

The Dewey notation links the key card to the classified subject catalogue where the individual cards are arranged numerically. The library user can now refer to the subject catalogue in order to establish the following bibliographic details of the books on birds in the library resource centre:

4.6.1.1 the precise location of a book on birds e.g. 598.2 LYN.

4.6.1.2 the name of a particular author e.g. Lynette, J.

4.6.1.3 the full title of the book e.g. Birds of prey in Natal.

4.6.1.4 the accession number of the particular book e.g. 89/18.

4.6.1.5 the imprint details e.g. the date of publication and the pagination.

The black dots next to specific items indicates to the user the existence of non-book resources that exist in the library that also contains information on the required topic e.g. slides, audio cassettes, periodical articles and stripfilms. In order to guide the library user to the location of the needed non-book resources the reverse of the card is used to "express the precise unique details of the fugitive media" (1, p39):

Cassette	:	CA 89/101
Periodical	:	P 89/201
Stripfilm	:	ST 89/501
Slides	:	SL 89/301

Figure 4.14 : The Reverse of a Key Card indicating the location of Media on Birds

These details are typed on the reverse side of the card within the ruled lines. When the card is filed with the side indicating the key word or phrase and the rubber stamp impression facing the user, the information on the reverse side, although typed "upside-down", will appear in an easily readable form because the user will look down and behind the back of the card.

The accession number allocated to a book renders it unique to the total holdings of the library resource centre and no two books will carry the same accession number. In the same way all the other formats that are housed in the library will also be similarly itemised. An appropriate code or symbol followed by a system of consecutive numbering is used to individualize each non-book resource. The following codes/symbols have been selected to identify eleven different non-book resources:

4.6.2 CA + consecutive numbering for cassettes
e.g. CA 89 / 19; CA 89 / 20

4.6.3 CH + consecutive numbering for charts
e.g. CH 89 / 33; CH 89 / 34

4.6.4 CU + consecutive numbering for cuttings
e.g. CU 89 / 69; CU 89 / 70

4.6.5 F + consecutive numbering for films
e.g. F 89 / 06; F 89 / 07

4.6.6 PF + consecutive numbering for project files
e.g. PF 89 / 11; PF 89 / 12

4.6.7 R + consecutive numbering for records
e.g. R 89 / 24; R 89 / 25

4.6.8 SL + consecutive numbering for slides
e.g. SL 89 / 45; SL 89 / 46

4.6.9 ST + consecutive numbering for stripfilms
e.g. ST 89 / 75; ST 89 / 76

4.6.10 TA + consecutive numbering for tapes
e.g. TA 89 /25; TA 89 / 16

4.6.11 TR + consecutive numbering for transparencies
e.g. TR 89 / 55; TR 89 / 56

The key catalogue assists the library user to locate all the relevant information sources with the library. It also enables the teacher-librarian to assess the range of the learning resources that are currently available in the library resource centre. It is expected that with this knowledge he can proceed with greater confidence to acquire additional materials in order to systematically eliminate the deficiencies in specific subject areas in the library resource centre (1, p40).

The Education Department views the classified catalogue as the key to the resources contained within the library resource centre, and the teacher librarian is exhorted to strive towards the construction of "a comprehensive yet workable and simple retrieval system" that will positively assist the library patron to locate and retrieve the resources "without frustrating him in his search" (1, p41).

The following table indicates the use of the card catalogue by students of the respondent schools:

TABLE 4.2

USE OF THE CARD CATALOGUE BY STUDENTS

CATEGORY	very good	good	very satisfact.	satisfact.	poor	no response	TOTAL
Non-fiction	10.2	33.9	44.1	5.9	2.5	3.4	**118**
Fiction	8.5	33.9	45.8	5.9	3.4	2.5	**118**
Reference	6.8	30.5	44.1	11.1	3.4	4.2	**118**
Avearge %	8.5	32.7	44.6	7.6	3.1	3.3	**100%**

An analysis of the responses received indicate that the teacher-librarians are not encouraged by the utilisation of the card catalogue by the users for information retrieval. Less than 11% of teacher-librarians have described the use of the catalogue for fiction, non-fiction and reference by students as being very good and over 50% of the teacher-librarians consider that the use is either satisfactory or less than satisfactory. The responses indicating the effectiveness of the card catalogue for information retrieval also portray a similar picture as illustrated in the following table:

TABLE 4.3

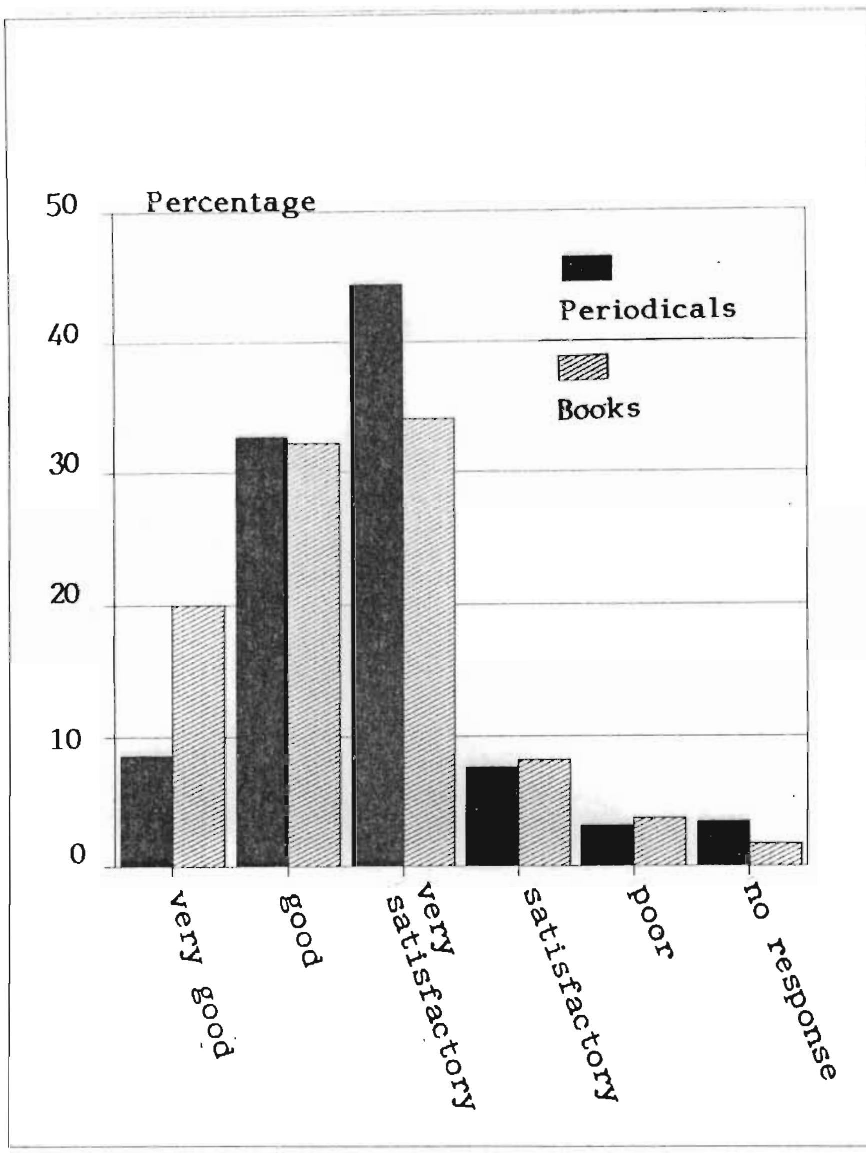
EFFECTIVENESS OF THE CARD CATALOGUE FOR INFORMATION RETRIEVAL

CATEGORY	very good	good	very satisfact.	satisfact.	poor	no response	TOTAL
Non-fiction	21.2	33.1	33.1	7.6	3.4	1.7	**118**
Fiction	21.2	35.6	29.7	8.5	3.4	1.7	**118**
Reference	17.8	28.0	39.8	8.5	4.2	1.7	**118**
Average %	20.0	32.2	34.2	8.2	3.7	1.7	**100%**

Over 40% of the responding teacher-librarians were of the opinion that the present system of information retrieval was either very satisfactory or less than satisfactory. In the following graph the responses on the use of the card catalogue are grouped, averaged and compared with the grouped, average responses on the effectiveness of the card catalogue for information retrieval:

Graph 4.2

Comparison of the Use and Effectiveness of the Card Catalogue



It is apparent from the graph that the respondents consider the use of the card catalogue by the students as less than encouraging. There appears to be a correlation between the use of the card catalogue and the efficiency of the card catalogue as the graph clearly illustrates the inefficiency of the card catalogue, with its key card system, for information retrieval in the school library resource centre. It could be reasonably assumed that the inefficiency of the card catalogue, with its key card system for information retrieval, is a contributing factor for the poor use of the card catalogue by the students. This is further substantiated by an examination of the responses of the teacher-librarian on the effectiveness of the key card system to lead the students to the varied contents of the books in the library resource centre:

TABLE 4.4

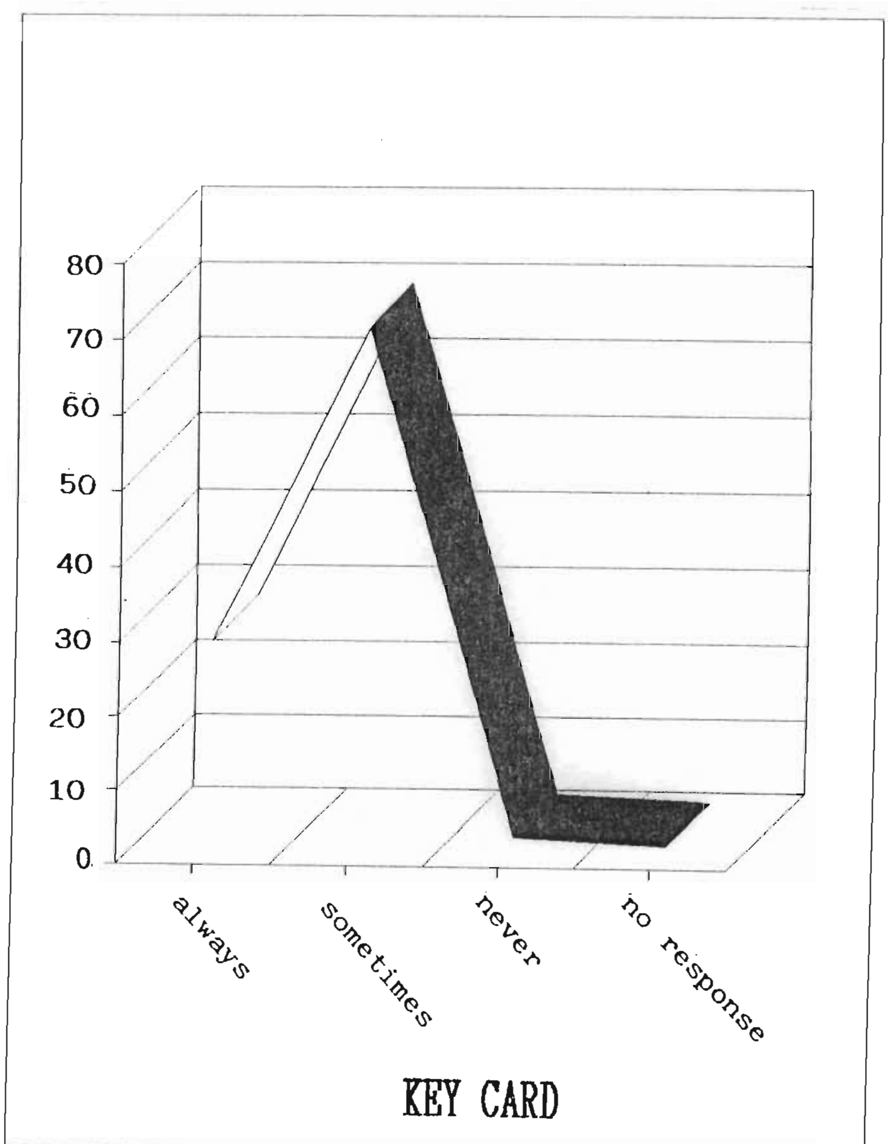
EFFECTIVENESS OF THE KEY CARD IN LEADING STUDENTS TO THE VARIED CONTENTS OF THE BOOK

CATEGORY	Frequency	Percentage
Always	33	28.0
Sometimes	82	69.5
Never	2	1.7
No response	1	.8
Total	**118**	**100%**

Only 28% of the respondents indicated that the key card "always" led the student to the varied content of the book and over 70% indicated that the key "sometimes" or "never" achieved this objective. These differences are clearly illustrated in the following graph:

Graph 4.3

The Effectiveness of the Key Card System



The inefficiency of the storage and retrieval system may also be related to the utilisation of the bookstock and periodical collection. Over 30% of the responding teacher-librarians have noted that the use of the bookstock by their students ranged from between "poor" to "very satisfactory". The percentage of respondents for the utilisation of the periodical collection within this range is even higher at over 40%. Only 15.3% of the teacher-librarians were of the opinion that the use of books by the students were "very good" as reflected in the following table:

TABLE 4.5

UTILISATION OF THE BOOKSTOCK

CATEGORY	**Frequency**	**Percentage**
Very good	18	15.3
Good	61	51.7
Very satisfact	20	16.9
Satisfactory	16	13.6
Poor	1	.8
No response	2	1.7
Total	**118**	**100%**

In the following table it is noticed that an even lower percentage (8.5%) of responding teacher-librarians conclude that the use of the periodical collection as "very good" and over 40% consider the use as either "very satisfactory", "satisfactory" or "poor".

TABLE 4.6

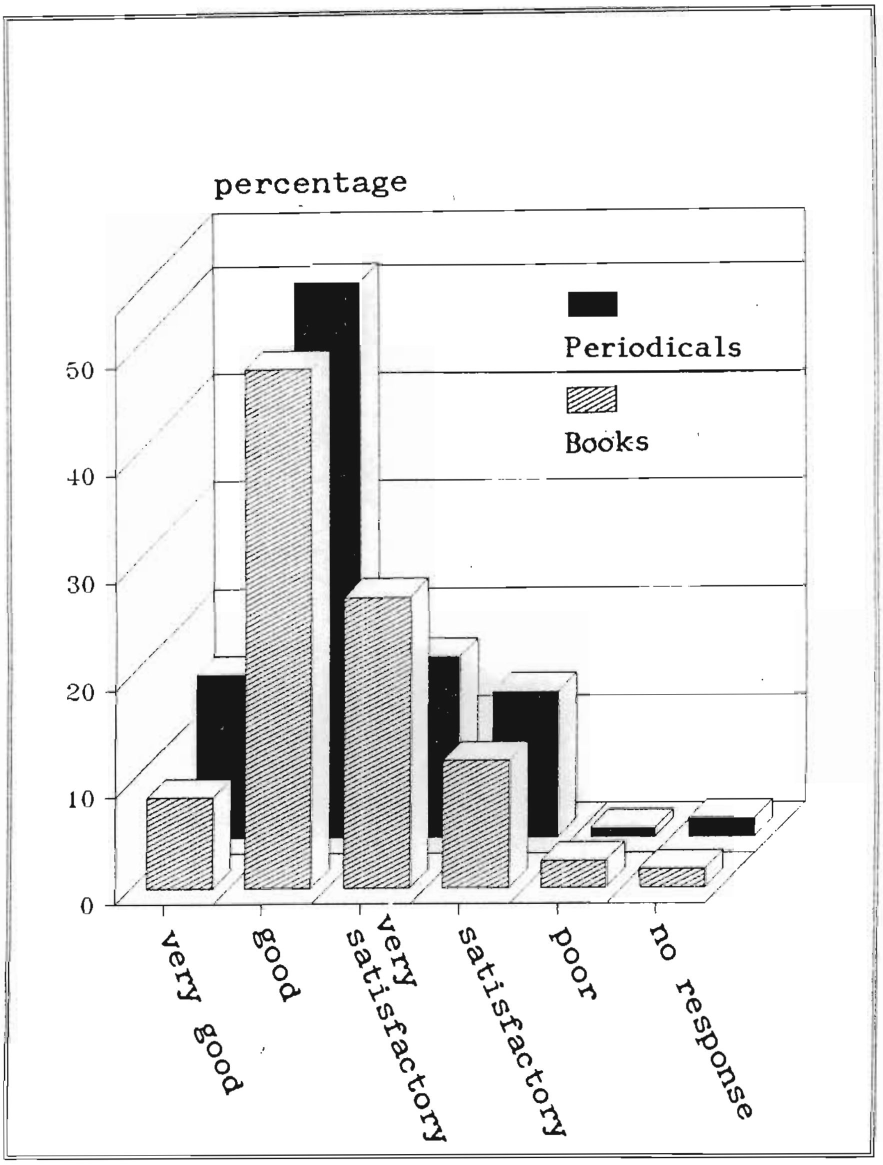
UTILISATION OF THE PERIODICAL COLLECTION

CATEGORY	**Frequency**	Percentage
Very Good	10	8.5
Good	57	48.3
Very satisfact.	32	27.1
Satisfactory	14	11.9
Poor	3	2.5
No response	2	1.7
TOTAL	**118**	**100%**

For comparison purposes the responses for these categories are graphed:

GRAPH 4.4

Utilisation of the Bookstock and Periodical Collections



4.7 USER GUIDANCE IN INFORMATION RETRIEVAL

All students from standard 6 to standard 10 in Indian secondary schools offer library resource education as a non-examination subject. Each class has a thirty-five minute period once a week on library resource education. The library resource education syllabus consists of seventeen separate segments. Each of these segments or sections are repeatedly covered in the various standards. However, with the progression through the higher standards, the topics are covered in greater detail or depth.

It is not necessarily the teacher-librarian who will automatically teach library resource education in the various standards. Of the maximum of forty five, (9x5) thirty-five minute periods available to the teacher librarian in Indian secondary schools to teach library resource education, up to thirty periods are usually set aside for the administration of the library. On the average up to five periods are usually taken as non-teaching periods. In effect the teacher is left with ten periods to teach library resource education. As secondary schools on the average have thirty class units, ten of these classes will be taught by the teacher-librarian. The other twenty periods maybe "farmed" out to other teachers to make up their maximum teaching load.

Thus it may be reasonably assumed that the majority of pupils are taught by teachers who have no professional qualifications in library science or information retrieval in particular. Moreover, the library resource education syllabus has no specific topic for information retrieval **per se,** and the general practice is to teach this aspect on an ad hoc basis e.g. during a lesson on catalogues and classification the library resource education (LRE) teacher may teach the students the practical aspects of locating and retrieving information.

4.8 CONCLUSION

It is evident that through a lack of clear direction to the teacher-librarians on the part of the Education Department, library holdings prior to the 1984 period were inadequately maintained. A variety of cataloguing systems were implemented according to the whims and fancies of the individual teachers who were in charge of the library resource centre. There was a clear lack of standardization and it may be reasonably assumed that information retrieval was far from efficient or successful.

Although attempts were made to address the problem in 1984 through a series of orientation courses on library management to advise teacher-librarians (inter-alia) on the acceptable method of cataloguing, this did not prove to be highly successful. Confusion still exists as the teacher-librarians were advised by the relevant Library Advisors to implement the Concise AACR2 rules, but at the same time were allowed to continue with the existing system if the catalogue cards were neatly drawn and were in working order. Thus a lack of standardization will still be evident in the resource centres.

The system of key cards advocated to facilitate the retrieval of information is ultimately dependent on a well compiled catalogue card system. With the passage of time and the inevitable increase in the holdings of the resource centre the key card system would become inefficient. Students who are exposed more and more to the newer technologies may well baulk at the thought of using a manual system. It is apparent that the present system of information storage and retrieval in school library resource centres do not effectively meet the current needs of the students and it is highly probable that if the status quo prevails, the future needs of the students will also not be satisfied.

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CHAPTER FIVE

5. THE DEVELOPMENT OF MICROCOMPUTER TECHNOLOGY

5.1 INTRODUCTION

It is generally accepted that librarians are constantly searching for ways to improve their services offered to the user. This search for excellence in service may take a variety of forms and will include the utilization of technological innovations whenever and wherever possible. While librarians are not particularly known for their ability to initiate technological trends, they are nevertheless not loath to borrow, adopt or even adapt technological innovations in the library from other sources, including commerce and industry. A classic example of using technology developed for other purposes is the utilisation of computers in the library. However, the utilisation of this technology was generally feasible only to those libraries that had access to funds, for computerisation invariably involved the outlay of large sums of money. Enterprising librarians in these economically sound libraries have used the computer for a variety of tasks/projects in the library. These libraries developed applications in the conventional large computer environment and had sophisticated aids at their disposal, which made it possible to design, code, debug, test and install systems. (6, p77). Operating systems with file management routines for these large systems existed in a tested and serviceable form. Moreover, software which assisted the programmer in testing and debugging programs, were also available, together with high level programming languages that speeded up program creation. Initially the success of these operations was were questionable, as the computer and the programs were not developed for libraries by librarians, but rather by 'outsiders' i.e. computer personnel who did not fully realise the needs of librarians. Librarians also had difficulty in translating these needs effectively to computer personnel. Furthermore, the high cost of obtaining and maintaining a mainframe computer with experienced personnel made the application of computer technology more a dream than a reality for most low-budget libraries.

Nevertheless, the rapid development of computer technology over the past decade from mainframes, through minis to microcomputers, with a corresponding decrease in costs, has reversed the picture. While initially the use of microcomputers by libraries was constrained by both hardware and software limitations, low cost, high performance microcomputers have found their way into libraries, and librarians are now actively involved in the designing of suitable programs for library applications. The need for librarians to translate their requirements to specialised computer personnel gradually diminished as the user friendly software application programs made it possible for librarians to become self-sufficient to a large degree. Grosch (6, p77-78) states that both the hardware and software have "matured to the point where library applications can be developed practically and economically using readily available hardware and system software products". In this regard Sanders (11, p36) concludes that the use of the microcomputer has expanded so rapidly that its use cannot be ignored.

The increased sales of microcomputers has led to the concurrent development of relevant software application packages and these packages include programs for library functions. This is supported by Woods's and Pope's research which has noted that libraries have been identified as potential purchasers and "many library applications programs exist" (15, p45).

The rapid acceptance of microcomputers by education authorities has positively influenced their introduction into Indian secondary schools by the Education Department of the House of Delegates. An overview of the development of microcomputer technology would help to place in perspective the implications of microcomputers for information retrieval in school library resource centres. Martins (8, piv) strongly argues the librarians should understand these technological tools as they apply to library applications in order to retain control of related decisions within the library. She states further that as a vast amount of resources would be allocated to the use of information technology, an outside agency would not make the best or most informed decision in the selection and acquisition of this technology.

5.2 A BRIEF HISTORICAL REVIEW OF RELEVANT COMPUTER TECHNOLOGY

While modern computers were not developed until the 40s, Davis (2, p5) states that some prior important developments included the algebra of logic by George Book, the punched card by Herman Hollerith, and the calculator that was built by Aiken. As early as 1812 Charles Babbage, a professor of mathematics at Cambridge University, devised a machine to automatically perform simple computations that were needed for logarithmic and trigonometric tables. This 'difference engine' was designed to carry a set sequence of operations one at a time. Unfortunately, although Babbage's ideas were brilliant, the technology of his time could not produce a machine to meet his exact specifications.

According to Hickman (7, pv), Babbage is a sad example of the proverb "the best is the enemy of the good", for despite his failures, eight years later he started on his Universal Analytical Engine. Rodwell (10, p11), states that the concept was brilliant. Information was to be input into the machine in the form of data and instructions. The instructions would cause the "machine to arrange itself internally" so that the desired operations could be accomplished at the end. A change in instructions would cause the machine to rearrange itself and carry out a different set of operations. According to Rodwell (10, p2), this concept was the first true computer.

The Harvard Mark 1 was the immediate predecessor of the automatic electronic computer. This huge mechanical calculator was designed in 1937 by Howard Aiken of Harvard University. It was instructed by means of "switches, buttons, wire plugboards and punched tape" (2, p9). The Electronic Numeral Integrator and Calculator **(ENIAC)** is the machine which bridged the gap between mechanical calculations and electronic devices. The **ENIAC** was used mainly for calculating tables and, in the opinion of Davis (2, p9), it is often identified as the first electronic computer.

The Universal Automatic Computer **(UNIVAC)** was the first commercially available computer. **UNIVAC** was put into operation at the United States Bureau of Census in 1951. In 1953 IBM installed its first computer and the IBM 650 was the most popular computer for the next 5 years (2, p10). These computers were often referred to as "first generation computers" and they generally used vacuum tubes, were large, required air conditioning because of the large amount of heat it dissipated, had little internal storage and were relatively slow (2, p11).

5.2.1 The Development of Microcomputer Technology

The search for fast programmable computers for military purposes began during the 1939-1945 war. Although special purpose valves were designed for computer use, the large numbers needed always led to cost, size and heat dissipation problems.

The invention of the transistor led to the replacement of the vacuum tube. The transistor performs the same functions as a vacuum tube, but is considerably smaller, less expensive, generates comparatively very little heat and requires much less power. It now became possible to build a computer which was quite reliable, very quick and convenient to use and most importantly, reasonably priced. The computers of the period 1959-1965 are referred to as "second generation computers" (2, p11). Notwithstanding the fact that these transistorised computers were a great improvement on the older valve machines, much development work still continued. The development of integrated circuits or ICs produced remarkable results. As these ICs used even less electricity than discrete transistors, they were even more economical to run. Furthermore, ICs were smaller and cheaper to produce, thus resulting in the decrease in the size of computers together with a decrease in the market price of the computers. These ICs were described as SSIs - small scale integration. Later these were superseded by MSIs - medium scale integration and LSIs - large scale integration circuits. According to Hickman (7, p6) this had a threefold effect viz: the mainframe machines became more powerful; it was now possible to produce a smaller minicomputer with relatively limited capabilities and finally the LSI resulted in the subsequent development of the microcomputer. These computers were regarded as "third generation computers". Davis (2, p11), is also of the opinion that this constitutes the "third generation of computers". Although the term "fourth generation" is used by some authorities, Davis (2, p12) is of the belief that there is trend away from revolutionary changes of the three generations. Rather there is a more gradual upgrading and improvement of the current generation. Hickman (7, p7), states that the hierarchy of computers could be imagined as a triangle tapering upwards. The broad base consists of microcomputers, then comes the minicomputer and finally, the smallest group numerically is the mainframe computers.

Essentially, microcomputers use an LSI IC (integrated circuit) called a microprocessor. This combines most of the functions central to the concept and operation of a computer. Initially these were four-bit microprocessors. These micro-processors were relatively slow and cumbersome to address the wide range of memory that is required in a general purpose computer system. The solution to this problem appeared in the early 70s in the form of the Intel 8008 eight-bit microprocessor which also required various other "support ICs" to form a complete central processing unit (CPU). Hicks (7, p9) states that even in the eight-bit microprocessor market there are clear signs of maturity and consolidation i.e. the development of the sixteen-bit and thirty two bit-microcomputers. It is with these devices that the microcomputer is beginning to reach the power and complexity levels which were previously the province of the minicomputer. This is illustrated by the increasing compatibility and capability of microcomputers.

The first microcomputers that were built in the 70s operated on 8 bits of data at a time, and even today many microcomputers use 8 bit microprocessors. This means that these chips can only retrieve from storage, manipulate, and process a single 8 bit byte of data at a time. To improve the data handling and addressing capacities an improved chip was introduced in the early 80s. These chips operate on 16 bits of data at a time and they have become the core of the new generation of microcomputers. While an 8 bit microprocessor can manipulate only a single 8 bit byte of data in a given period, a 16 bit chip can handle two similar bytes in the same unit of time. In other words the execution speed of a 16 bit microprocessor may be two or more times faster than that of an 8 bit type in the processing of calculations in short programs. Generally, the 16 bit microprocessor will be faster, though not necessarily twice as fast as an 8 bit processor, in storage and retrieval operations.

These new generation microcomputers utilize a few popular microprocessors e.g. the Intel 8088 and 8086. The 8088 is an 8/16 bit chip in that all operations to and from storage is done 8 bits at a time, but once retrieved it is processed 16 bits at a time. On the other hand the 8086 is a true 16 bit chip i.e. data is both retrieved and processed 16 bits at a time. Both the 8088 and 8086 chips use an expanded built-in address bus with 20 lines that is used to identify about a million separate primary storage locations: 2^{20}=1048576 bytes or 1 megabyte. Other microprocessors like the Motorola 6800 use a 16/32 bit chip which is more powerful than the 8088 or 8086 as it permits a primary storage capacity of up to 16 megabytes. However, progress has not stopped with the 16/32 chips as the Intel 80386 uses a 32/32 bit chip which provides an internal and external data path that is 32 bits wide.

Fewer disk operations are necessary if more data and program segments can be kept in primary storage. Even if a hard drive is used it is much faster to access data located in primary storage. Microprocessors found in IBM compatible XT microcomputers can permit the direct identification of 1 megabyte of primary storage location. Nevertheless, user programs and data are limited to 640K bytes of memory. The remaining storage is reserved for special functions e.g. some locations are reserved for the RAM that stores the image on the computer's visual display unit and some memory is used for the ROM codes that control a hard disk and perform other functions.

5.3 MICROCOMPUTER SYSTEMS

While there are literally hundreds of different microcomputers available on the market, they nevertheless have many features in common. A computer is not a single machine, rather, it may be viewed as a system at the heart of which is the central processing unit.

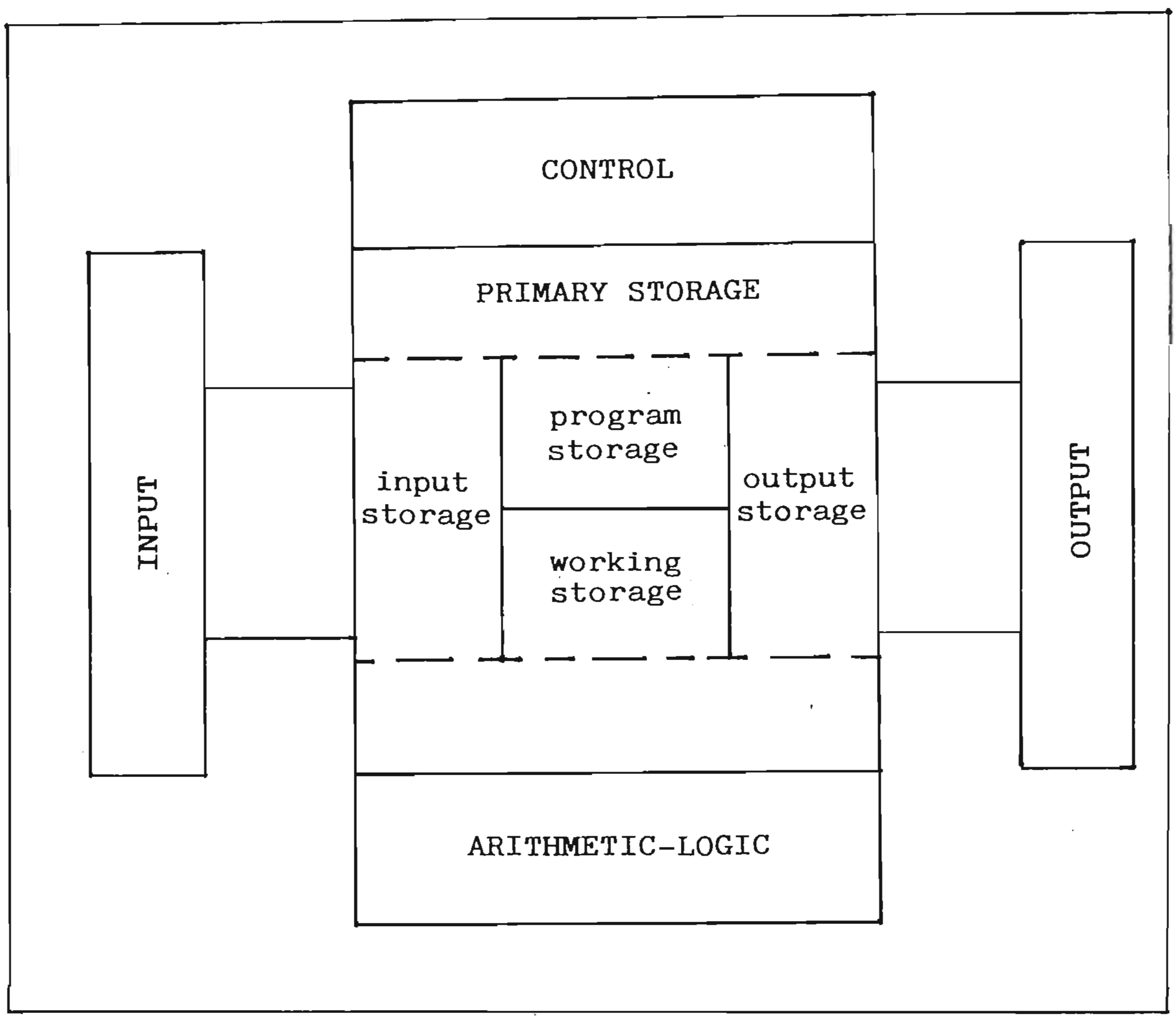

Figure 5.1

The Central Processing Unit

5.3.1 Central Processing Unit

The central processing unit consists of the primary storage, arithmetic logic and control elements. The primary storage or main memory serves four basic functions in that it contains:

* a program storage area that holds the processing instructions.
* an input storage where data is held until it is ready to be processed.
* a working storage space that holds the data that is being processed and the immediate results of such processing.
* an output storage area which holds the finished results of the processing operation until it can be released.

The specific areas of primary storage are not physically fixed in that they may vary from one application to another.

No processing occurs in the primary storage. All calculations are performed, and all comparisons are made in the arithmetic-logic section. The data may move from the primary storage section to the arithmetic-logic unit many times before it is finally processed. Once this processing is complete, the final results are released to an output storage section in the primary storage area and from there to an output device.

The control section does not process data but rather acts as a central nervous system for the other data manipulating components of the computer. The control section maintains order and directs the operation of the entire system by selecting, interpreting and seeing to the execution of program instructions.

The operations of the arithmetic logic unit and the control unit are performed at very high speeds. These operations are synchronized by an electronic clock that emits regularly spaced electric pulses each second. The speed with which an instruction is executed is directly related to the computer's built-in clock speed. This clock speed is measured in megahertz or **MHz**. XT microcomputers usually have clock speeds that range from the standard 4.77Mhz to 16Mhz.

5.3.2 Memory

The computer memory is one of the most vital characteristics of the microcomputer. The more main memory the central processor has, the more complex the programs it can run. The memory capacity is expressed in thousands of bytes or characters. A 64k byte memory can store 64000 characters or to be exact 65536 characters, because memory size is always a multiple of 1024 i.e. 2^{16}. Memory in the microcomputer is made up of special material capable of assuming and remaining in one of two states, electrically speaking. Memory can therefore be viewed as a very large group of micro switches which can be either on or off. If they are set on and off in combinations then the processor can read them as coded characters or bytes. All information in the internal memory of the computer is represented by these on-off combinations that make up binary codes. It is in this part of the microcomputer where the information is stored. This information includes the program and the data on which the program has to work on. The control unit reads the program which is stored in the memory and carries out the instructions one by one.

Memory in microcomputers is classified into two main categories, read only memory and read/write memory. Read only memory is further divided into mask ROMs, programmable ROMs (PROM) and erasable programmable ROMs (EPROM). **ROM**, which is read only memory, cannot be written or changed by the user. In other words ROM is permanent. ROMs are used for high-volume applications, and only after extensive testing has been done, to ensure that data and programs are correct. ROMs are used in the "booting" or starting-up of the computer and for operating the various peripheral devices. The other type of memory is **RAM,** which stands for Random Access Memory. When a program is typed into the computer, or a program is read into memory from the secondary storage, it goes into RAM.

The amount of ROM available is a measure of the facilities available on the computer while the amount of RAM is the measure of the amount of program space available to the user. The more data and program segments that can be kept in the primary memory, the fewer time-consuming disk operations may be necessary as it is faster to access data from the primary storage or main memory. Most IBM pc's and compatibles use a 20-line address bus that permits them to directly identify 1048 million primary storage locations. However, as stated previously, user programs and data are limited to 640K of primary storage and the remaining 384K of memory is set aside for special functions. 256K of this memory is reserved for ROM and 128K is reserved for video memory. Nevertheless, much of the addressable space originally intended for these special functions is not utilised and thus a bank-switched memory technique has been developed that allows users to increase the apparent size of primary storage to as much as 8 megabytes (11, p279).

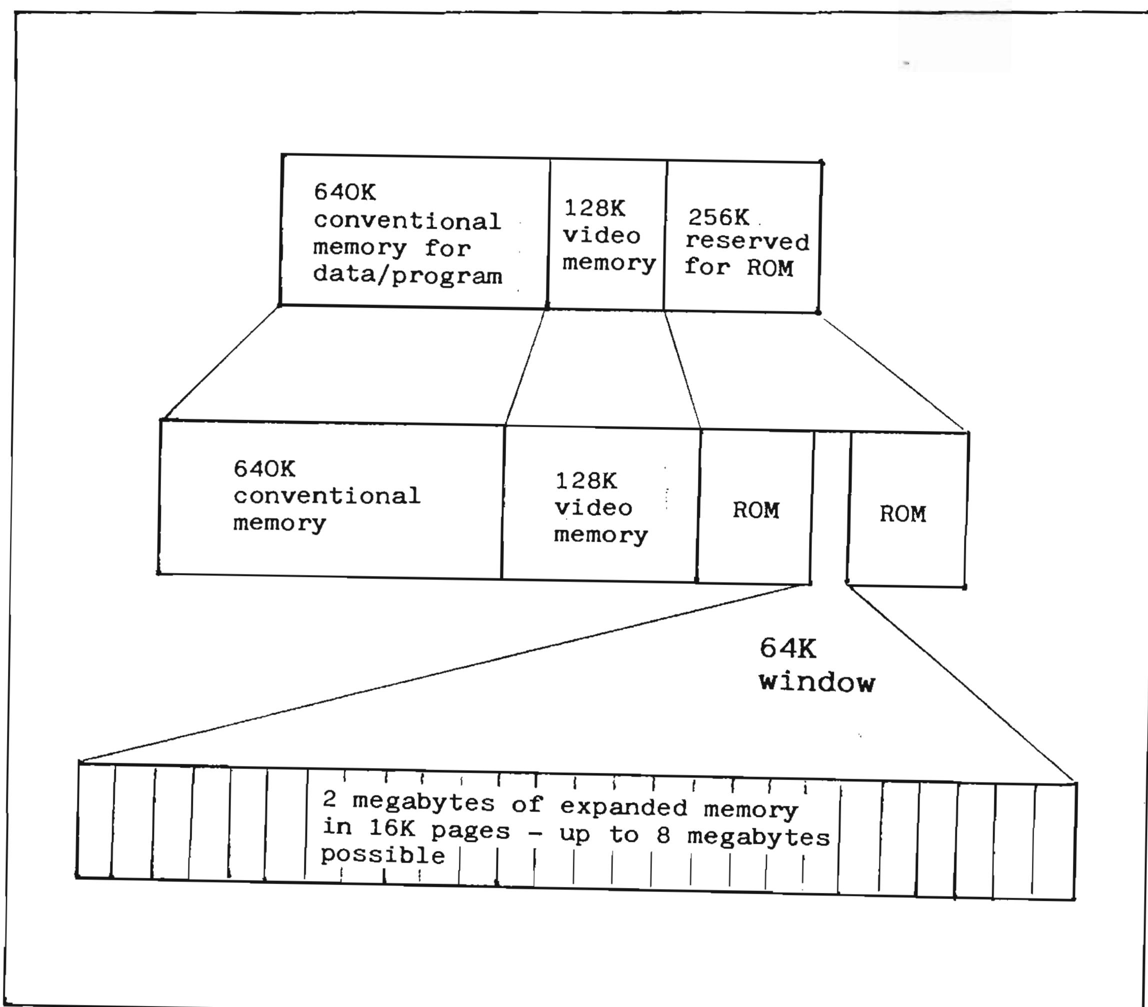

Figure 5.2

A Bank-Switched Memory Technique

As the space reserved for ROM is under-utilised, a 64K byte "window" has been taken from this unused space to support this bank-switched memory technique. Additional banks of RAM chips are mounted on a board that is plugged into the microprocessor and special memory management software divides this additional RAM into 16K byte pages which is accessed through the 64K byte "window", thereby vastly increasing the available main memory.

Modern chip based internal memories in the applications and work areas of a CPU are "volatile" i.e. they forget everything if the power supply is interrupted. They are in constant danger of forgetting since each switch can only hold its condition for a fiftieth of a second (50hz cycle). However, this memory is constantly refreshed automatically as the computer works. In the event of a power failure, the applications program that is being run is lost and so is any work in progress in the works area of the microcomputer. The program which is stored in an outside device (disk) is non-volatile and it can be read back into the processor in a few minutes. Nevertheless, the work in progress is lost, and would have to be done again.

5.3.3 Secondary Storage

Secondary or auxiliary storage supplements the limited primary storage in computer systems and most, if not all computers make use of secondary storage. The essential difference between the external secondary storage and the internal primary storage is one of speed and convenience of retrieval i.e. locating the particular item of stored data that is required. The primary memory storage chips that are used in the central processor have the fastest access time, but relative to other storage devices, they have the smallest storage capacity and the highest cost per bit capacity (11, p228). The way data is organized and processed will determine the type of external storage selected. If the file is organized sequentially and the records need to be updated only periodically, sequential access secondary storage medium is utilized. The data is stored offline from the processor except when loaded on an input device. The storage capacity is virtually unlimited and the storage cost is very low (11, p228). The cheapest form of this sequential-access storage uses the magnetic tape. Programs are sent from the computer to the tape as a series of binary electrical pulses. These signals are recorded by the tape unit as pulses. While information can come off a tape at very high speeds, problems do occur when the data is stored on the tape. The primary problem is that the data is stored sequentially, thus requiring the whole tape to be searched in sequence when looking for specific items of data.

If the need arises for quick and speedy access to any file record, a direct-access storage device **(DASD)** is selected. The data retained in these secondary storage units are online and are available to the processor at all times. Magnetic disk systems, while more expensive than magnetic tape systems, are the most popular medium for direct-access secondary storage. The data is stored on disks made out of plastic and is coated with the same material that is used to coat magnetic tapes. The data is either written to or from the disk by means of a read/write head. This in effect means that the data can be read from any part of the disk randomly, very quickly by the computer. The two kinds of disks utilized by microcomputer systems are hard disks and floppy disks.

Floppy disks, or floppies as they are commonly called resemble 45rpm records. They are flexible plastic disks covered with magnetic recording material which is used to store data from a computer. These disks are kept inside a protective cover and are allowed to spin inside this cover when inserted into the disk drive. Information is read from, or written to disk by means of the read/write head. The data is stored on tracks and each track is divided into sectors. Instead of a spiral recording track like an audio record, the tracks on a floppy are concentric circles which are scanned by the magnetic head. Thus the track can be read in a fraction of a second, rather than requiring the time that a cassette tape takes to spool through the unwanted sections of a program. This therefore obviates the problem of sequential searches, as in the case of magnetic tapes, for direct searches are now possible. According to Ford (3, p68), the primary advantage of disks is their rapid operation: they can enter or store data very much faster than the cassette which is the most primitive alternative available for the microcomputer.

The floppy is easy to use, simple to change, easy to clean and almost unbreakable. The two common sizes used by microcomputers are the 5.25in and the 3.5in disks. The 5.25in disk is called a floppy while the 3.5in disk is called a stiffy because of its firmer physical construction. The 3.5in floppies are individually packaged in a non-bendable plastic case. This hard case has a dust seal and finger proof shutter that opens automatically when the case is inserted into the disk drive. These floppies are slower than hard drives, as most floppies spin at a constant speed of between 300 to 600 revolutions per minute (11, p233). Although they are cheap they are subject to wear and tear as the read and write head actually touches the surface of the disk.

Some microcomputer systems utilize hard disks which incorporate a number of heads on each arm and this therefore limits the distance the arm travels, thereby providing a better access time compared to floppies. Another major advantage of fixed or hard disks as compared to floppy disks is that the fixed disk holds considerably larger amounts of data. These disks also spin much faster at a constant speed from between 2400 revolutions per minute to 4700 revolutions per minute with 3600 revolutions being common (11, p233). Moreover, the read/write head does not touch the disk itself, as it does in a floppy disk, but floats on a cushion of air just above the surface of the disk. Data is read from or written to these disks at a very high speed. The average access time for most hard disk storage system is usually between 10 to 100 milliseconds compared to floppy disk storage systems for which the average time usually ranges from 60 to 600 milliseconds (11, p239). In microcomputers these disk drives usually handle between 10-40 megabytes of data.

5.3.4 Peripheral Devices

Peripheral equipment, as far as microcomputers are concerned, consists of input/output devices that relate to human beings. The most direct contact with the computer by users comes through these input or output devices. Getting information into the computer system essentially means converting information in one form into electric signals that can be recognised by the computer. The most popular method of getting information into a computer is through a keyboard. The keyboard is usually divided into three sections viz an alpha-numeric section for the input of descriptive data; a ten digit numeric keyboard for the input of quantitive data and the section containing the function keys for the input of special commands.

There are also many ways of getting information out of the computer and for the average user the visual display unit **(VDU)** and the printer are the most common. Inputs via the keyboard are displayed on the **VDU.** However this information is lost when the computer is switched off. Furthermore the VDU can only display a limited amount of information at any given moment: usually eighty characters on twenty four-lines. A cathode ray tube (CRT) is used in most visual display units and these screens may be either monochrome or colour.

Printers are the primary output devices that are used to prepare permanent documents. Printers are used to obtain a hard or permanent copy of the screen display. Printers can be grouped into two general classes: impact and non-impact printers. Impact printers, as their name suggests, produce images on paper by means of some mechanism that actually strikes the paper. The three most common mechanisms used by impact printers are dot matrix, daisy wheel and thimble. On most letter quality printers, a hammer fires out of the head and strikes a petal on either a daisy-wheel or a thimble. The petal contains a fully formed individual character. In contrast, the print head of a dot matrix printer contains a set of pins -usually seven, eight or nine - arranged in a stack. As the print head travels across the paper, the pins are fired at the ribbon, leaving an image of the letter on the paper. Dot-matrix printers are usually faster than daisy wheel printers. While they are also usually less expensive, the print quality is not as good as a daisy wheel device.

Non-impact printers produce images without striking the paper. The three most common non-impact printers employ ink jets, lasers or thermal print heads. Non-impact desktop printers that use laser light to produce the dots needed to form the print characters have become popular as microcomputer output devices. A laser printer creates an image on the paper by exposing the surface of an electrostatically sensitive drum to a pattern of high-energy light and applying a toner that adheres to the drum's exposed surface which is then transferred to a sheet of paper. It is similar to xerography, except that it produces an original image. A fixed number of pages is printed each minute, and it makes no difference how many characters are on each page. Pages of single spaced text are produced just as quickly as double spaced text. Thermal printers produce images by applying heat to specially treated paper that darkens where it is heated, or by heating a ribbon that transfers the image to the paper. The thermal print head is similar to a dot matrix print head, but instead of firing the pins, the pins conduct heat to the paper. Unheated pins cause no image. An ink jet printer produces images by spraying an electronically controlled stream of ink onto paper from a print head that travels across the paper. Although a variety of printer types may be connected to the microcomputer system the three commonly used printers are dot matrix, daisy wheel and laser printers.

5.3.5 Programs

There is one other key element to the functioning of a microcomputer viz. a set of instructions, known as a program. Microcomputers can perform burdensome tasks such as choosing, copying, moving, comparing and performing many other non-arithmetic operations. The computer achieves these operations by following the program. The set of instructions that comprises a computer program is complex, intricate and automatic once a work sequence is triggered off. It is the program that ensures that correct actions are taken in the correct sequence. Without a program a microcomputer would do no more than a cheap electronic calculator. When a calculator is used, a figure is selected, then another and so on until the calculator is instructed to add, subtract or multiply these figures by pressing the appropriate key. When this has been done the calculator will do no more until it receives another instruction. It will continue to display the answer until its batteries run down, or until it is instructed to switch off.

While the term "hardware" refers to the computer itself and its related peripheral devices e.g. visual display units, disk drives and printers, the term "software", on the other hand, used in the computer environment, relates to programs. Programs may be divided into two distinct groups: operating systems programs (OS) and application programs. An operating system is an organised collection of software that controls the overall operation of a computer. These complex programs are designed to operate, control and extend the processing capabilities of the computer itself. It enables the system's hardware to load applications programs into the primary memory or storage. Applications programs usually address the processing needs of many users.

5.4 PHASES IN THE DEVELOPMENT OF LIBRARY SYSTEMS

According to Tedd (13, p3) the history of computer based library systems may be divided into three distinct phases viz. the experimental phase, the local systems phase and the co-operative systems phase.

5.4.1 Experimental Phase

In the early 60s several libraries in the UK and the USA began experimenting with the application of computer technology to assist in the processing of information. Many of these systems evolved from punched-card data processing systems. However, the majority of these systems failed because of the following reasons:

* computer technology for that period was not sophisticated.
* librarians were not absolutely definitive in terms of their requirements for computer based systems.
* computer personnel erroneously thought that they knew the librarian's requirements for computer based systems.
* it was believed that all individual systems in a library should be simultaneously converted to utilize computer systems (13, p3).

5.4.2 Local Systems Phase

In the opinion of Tedd (13, p3) it was from the late 60s that librarians have successfully made use of computerized systems as tools in the organizational procedures of libraries.

These systems have been developed locally either in academic libraries, special libraries or public libraries. Some of their reasons for their success include:

* improved computer technology.
* experiences of libraries during the experimental phase have been profitably capitilized on.
* improved communication between librarians and computer personnel.

5.4.3 Co-operative Systems Phase

In the 70s there has been an increase in co-operation and resource sharing by libraries and librarians in the development of computer based systems. In many cases formal library networks have been established e.g. the well known Ohio College Library Centre **(OCLC)** and locally the South African Bibliographic Network **(SABINET)**.

To Tedd's three phases may be added the current phase i.e. the application of microcomputer technology in libraries. A large variety of applications packages are available to libraries and the increase in the use of database management systems have been dramatic. While these packages were first developed to run on mainframes and minicomputers to reduce data redundancy, many packages have been developed for the microcomputer. There are several reasons for the development of these database management systems for the microcomputer. The primary reason that may be attributed to this growth is the improvement in hardware such as larger RAM capacity and the availability of hard disks, both of which have permitted the use of more powerful and more complex programs. These programs have enabled easier, more flexible storage and retrieval of information. The larger storage capacity permits librarians to handle more files while both the increased RAM and hard disks also improve processing speeds. Thus the gain in storage and speed have enabled the creation of larger databases than were previously possible with older programs.

While most programs have menu-driven query facilities, the more sophisticated software supports natural language interface. Information retrieval often requires several complex calculations and librarians only have to specify the conditions, and the system locates the data that meets the specified criteria. As the librarian can select multiple criteria, information retrieval has become more flexible.

5.5 MICROCOMPUTERS IN INDIAN EDUCATION

Early in 1982 the department took a policy decision in respect of introducing microcomputer technology in Indian schools. A teacher-librarian, who at that time was experimenting with various configurations in the school library, was seconded as an Education Planner to the Education Planning Section (Educational Technology Services) in the Education Department. Primarily, his brief was to investigate the introduction of microcomputers in schools. Subsequently in 1983, a departmental work committee on computers was formed. This led to the Department taking positive cognisance of the HSRC recommendations made in the report "Computers in Education and Training" in terms of utilizing computers in education.

In the 1983/4 financial year microcomputers (Commodore 64) were installed in specially redesigned rooms in the two colleges of education - one in Natal and one in Transvaal

(12). The rationale for this step was to train teachers in computer technology so that they could be appointed in selected schools in order to offer computer literacy and computer studies as soon as it was practical. In the 1985/86 financial year three selected secondary schools were supplied with a total of 46 'Commodore 64' microcomputers. According to the Education Department (12), "the equipment was initially supplied so that pupils may be afforded the opportunity to offer computer studies as a seventh subject in the senior secondary school phase".

Schools were also encouraged to purchase microcomputers from their own funds and the Educational Technology Services of the Education Department provided the necessary technical help and advice in the selection of appropriate equipment. The Educational Technology Services arranged workshops and demonstrations for teachers, teacher-librarians and the management staff of the schools. It was hoped that these demonstrations and workshops would break down resistance to the newer technology. Moreover, this also provided the means for the teachers to obtain hands-on experience with microcomputers. In 1986 the Education Department moved away from the purchase of eight bit 'Commodore 64's which was essentially a home computer, and decided as a matter of policy to purchase IBM PC compatible microcomputers. The Education Department negotiated the purchase of IBM compatible machines both for the colleges of education and selected schools where computer studies as well as computer literacy would be offered and in the 1987/88 financial year a total of 1507 microcomputers were installed in secondary schools (12). An average of 11 microcomputers per school were installed in specially redesigned classrooms in these secondary schools. According to the Education Department (12) there are currently 3026 IBM PC compatible microcomputers in secondary schools under the control of the Department. The schools were supplied with 640k twin floppy systems together with a 20 meg hard drive system. It was expected that eventually 27 of these microcomputers were to be installed per room together with a printer on a trolley.

The Education Department had introduced these computers for utilization on two levels: i.e. computer literacy for all schools and computer studies for selected students in secondary schools at the standard eight level in the senior secondary phase. Although attempts were made by the Educational Technology Services to evaluate computer software programs for administration this was not successful.

5.6 COMPUTERS IN THE LIBRARY RESOURCE CENTRE

Whereas the majority of secondary schools have purpose built computer rooms installed with IBM compatible microcomputers, no serious consideration has been given to the utilisation of microcomputer technology in school library resource centres. While no official policy has been made in regards to the provision of computers in library resource centre, these computers could, nevertheless, be utilized in the library by an enterprising teacher-librarian. However, according to the Education Department (13) no positive step has been made by library personnel in Indian secondary schools to utilize microcomputers in the library resource centre.

5.7 CONCLUSION

Although modern microcomputer technology can be traced back to the early 60s, it was only in 1983 that the Department took the innovative step to introduce computers in Indian schools. Timeous steps were taken to switch over to the industry standard of IBM compatible microcomputers. These steps will result in the relatively easy adaptation to the demands of commerce and industry by the students. Nevertheless, as we are now living in what is considered as the information age, the Education Department should seriously consider the application of microcomputer technology in the library resource centre. This consideration is imperative not only for our students to maximise their use of the resource centre but also prepare them to utilize opportunities that are becoming increasingly available in the world outside the environs of the school. According to Tedd (13, p4), many library processes can be reduced to clerical procedures of sorting, filing, distribution of notices etc. While this work is routine and may rightly be considered boring, it is also subject to human error. Computer programs running on the IBM compatible microcomputers in schools can be easily utilized to carry out these routine functions thereby increasing the flow of work through the library.

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CHAPTER SIX

6. THE ROLE OF CATALOGUING AND INDEXING IN INFORMATION RETRIEVAL

6.1 INTRODUCTION

Traditionally the catalogue constituted the primary system for information retrieval in Indian secondary school library resource centres. The catalogue developed from a book catalogue with simplified entries to the present day card catalogue. Although the construction of the card catalogue is now based on the requirements of the Concise AACR2 rules, these rules have been simplified even further. The changes to the catalogue have tended to be of a cosmetic rather than substantive nature, indicating few attempts to improve the bibliographic or subject access for the student. Nevertheless, there is an indication of an awareness by the Education Department of the need for an information retrieval system, for in 1978 the card catalogue was supplemented by a index or key card system to aid information retrieval.

A general survey of the developmental processes of cataloguing and indexing over the years would help to construct a framework to develop strategies for information storage and retrieval through the application of microcomputer technology. The satisfactory storage of information will of necessity precede the retrieval of information. While other methods of information storage may exist, the traditional forms of cataloguing and indexing have laid the foundations for contemporary information retrieval systems.

According to Tedd (37, p1) cataloguing includes the job of describing, recording and displaying details of the holdings of the library. While computers may be used to aid in the production and maintenance of catalogues, the quality of information in the catalogue is still dependent on the cataloguer. This places a greater responsibility on the teacher-librarian to become **au-fait** with general forms of cataloguing and cataloguing principles in order that informed decisions can be made on the development of catalogues in the school library resource centre. This becomes even more apparent if the decision to computerize the information retrieval facility becomes a reality.

Heiliger and Henderson (18, p8) state that the cataloguing function seeks to "describe individual and collective characteristics of the items, the sources of their creation, their physical embodiment, their location and their possible future interest". The essential purpose of cataloguing is to inform users of the existence and character of items held in the library. The task of the cataloguer is to describe an item and indicate its logical place among literally thousands of other items. The description should capture all the relevant data about the item in order to reveal the gist of its contents, appearance and source. This description is written with the user in mind.

Kumar and Kumar (25, p3) also state that the extent of the use of the library resources depends greatly upon the quality of a library catalogue. While a comprehensive catalogue enhances the reputation of the library an incomplete or "poor" catalogue on the other hand, mars the library's reputation, misguides the user, the reference librarian, the book selection expert and the acquisitions librarian (25, p3).

6.2 TRADITIONAL CATALOGUING

According to Fasana (10, pv) the fundamental principles of catalogues have been in evidence in catalogues that have been produced in a variety of mediums for almost three centuries. These principles reveal that they exist independently of any form or medium and cannot be "gainsaid" by technological developments. Doyle (9, p150) is of the opinion that the catalogue is the most important tool available to the librarian in the management of the library's holdings. It is the library's main index to the contents of its collections, as it indicates what material the library holds and also where it may be found. Ranganathan (31, p81) states that "if it is interest in a subject which takes him (the user) to the library, his wants will be better served if the catalogue can spread before him a full, connected panorama of all the materials on his specific subject, all its subdivisions, and all the broader subjects of which it is itself a subdivision ".

This view was also expressed by Cutter when he stated that "the convenience of the public is always to be set before the ease of the cataloguer ..." (quoted by 19, p6). According to Cutter (quoted by 9, p2) the catalogue may be defined as an instrument to achieve the following objectives:

6.2.1 to find a book of which either the author, title or subject is known.

6.2.2 to show what the library has by a given author or a given subject.

6.2.3 to assist in the choice of a book in terms of edition, (bibliographic), or character (literary or topical).

Objective **6.2.1** emphasizes that the library catalogue serves as a finding list for specific documents. Thus, the provision of individual entries for each book is provided. In this way access to a particular item is facilitated through author, title and subject.

Objective **6.2.2** stresses that the library catalogue serves as a finding list for groups of documents, thus a uniform entry for each group is necessitated.

Objective **6.2.3** relates to the description of documents in the catalogue. This description enables the user to differentiate between the various editions of a given document.

At the International Conference on Cataloguing Principles **(Paris Principles)** held in Paris in 1961, it was generally agreed that it was desirable to have international standardization of cataloguing practice. The **Paris Principles** also adopted Cutter's objectives for a bibliographic catalogue, with the exception of subject access. The development of **AACR** rules was a consequence of this meeting. Hunter and Bakewell (21, p40) state that **AACR1** was "overtaken by events" and this led to the development of **AACR2** in 1978.

Librarians usually distinguish between two kinds of cataloguing viz: subject cataloguing and descriptive cataloguing. Descriptive cataloguing is basic and refers to the process of identifying the book and selecting appropriate bibliographic elements for the recording of the item. On the other hand, subject cataloguing will also include the processes of classification and the assignment of subject numbers. Doyle (9, p148) states that no cataloguing is complete until the book is classified. Classification is the systematic placement of the item/book into related subject groupings based on a prearranged subject plan or scheme e.g. the Dewey Decimal Classification Scheme **(DDC)**. Other details on the card will include the name of the author, title, publisher, place and date of publication. The number of pages, maps, illustrations etc are also included wherever applicable.

Locally, cataloguing is usually done according to an elaborate set of rules e.g. the Anglo American Cataloguing Rules **(AACR2)** which fix the format of the recorded information. This ensures uniformity of method, which is important for library automation as it will make it possible for librarians to contribute to, and access from, common data banks.

6.3 PHYSICAL FORMS OF THE CATALOGUE

The physical form of the catalogue is also called the outer form, and can take a variety of formats. The contents of the catalogue is thus made available to the user in a concrete form to facilitate the consultation of catalogue entries.

6.3.1 Book Catalogue

In the beginning of the century the book catalogue was the prevalent form in South Africa and many public libraries issued printed book catalogues e.g. the Natal Society Library (1907). Printed catalogues have, however, lost favour due to the high printing costs and the difficult task of keeping information current. This is notwithstanding the fact that cheaper production techniques have been developed e.g. off-set printing. Nevertheless, some libraries e.g. Rand Afrikaans University library, use computer technology to frequently issue updated versions of their printed book catalogue.

6.3.2 Card Catalogue

The card catalogue was developed from the practice of writing entries on separate pieces of paper which was arranged in a set or prescribed order before being put into place. Fasana (10, p12) is of the opinion that the development of the card catalogue presented a "marvellous" advance. Discrete cards could now be filed in an evolving catalogue as soon after acquisition of an item/document as they could be produced. The problem of keeping the catalogue current was eliminated. Moreover, it was simpler to locate, retrieve and replace cards than it was to alter a printed page. Multiple added entries could be easily made up by librarians, and as all of these added entries are based on duplicates of the main entry, the possibility of transcription errors would be almost completely avoided.

Nowadays, descriptions of the document are usually typed or printed on cards 5x3in or 125x75mm that are internationally accepted. Each entry is typed on a separate card and these cards are arranged in a predetermined order and filed vertically in purpose-made drawers which are held in a catalogue cabinet. These cabinets are also made to a standard size and can accept approximately one thousand individual cards per drawer. Cards are prevented from dropping out or being removed after insertion by means of a metal rod that passes through a hole in the bottom of the card.

A document may be represented by a number of cards, and these cards may be filed in various places in the catalogue. Instead of typing or printing out these cards individually, a master card is made, and from this master a number of duplicate copies are made. The reproduction of these cards may take a variety of forms e.g. photographically or even computer printed. The principal advantage of a card catalogue as compared to a book catalogue is the ease with which new cards could be filed with the existing cards. An added bonus is that incorporations can be easily made to cards processed by central distributing agencies.

6.3.3 Microform Catalogues

Many libraries, e.g. the University of Natal (Pietermaritzburg) library, utilize microform catalogues. A microform catalogue contains cataloguing records in microimage and requires the use of a microform reader for viewing. While the microform catalogue is highly portable its principal disadvantages are the need for a microform reader and the handling of the film or fiche. These catalogue entries may be photographed from the card or book catalogue or may be the result of computer output on microforms **(COM)**.

Microform catalogues assume a variety of medium e.g. microfilm, microcard and microfiche. **COM** is a relatively new method of producing microimage catalogue entries on microfiche or microfilm from machine readable data that is stored in a computer. In the **COM** technique data is read from magnetic tape or disk by the computer and reproduced, character by character, on a cathode ray tube. The characters are then captured photographically not on photographic paper in full size, but rather on microfilm or microfiche in reduced size (33, p96). Some advantages of this technique include:

* **compactness:** a 48x reduction will result in a microfiche containing over 260 A4 pages.

* **speed:** while average line printers operate at 2000 lines per minute the COM recorder can output at over 50000 lines per minute.
* **duplication:** large scale duplication (1000 copies per hour) is easily achieved.
* **distribution:** distribution is facilitated due to the lightweight and compactness of microfiches.

These advantages make **COM** highly suitable for libraries especially where multiple copies of the catalogue are required. **COM** catalogues also provide a cost effective back-up alternative to the card catalogue.

6.4 CATALOGUE ENTRIES

Essential information in the catalogue is similar regardless of the form of the catalogue i.e. book, card or microform. These microforms, cards etc, act as a surrogate of each document in the library. However, a document may have several entries and the entries which describe the document are usually made under the headings of author, title and subject. This will facilitate answers to questions that may be put to the catalogue. The various entries are grouped and arranged into useful sequences such as alphabetical author sequence, alphabetical title sequence, a combination of alphabetical author/title sequence, and alphabetical subject sequence.

6.4.1 Types of Entries

In each of these sequences two categories of cards are usually found i.e. cards with entries and cards without entries. Cards with entries are cards that contain descriptions of the document. Cards without entries are cards that do not contain information about the actual document. Nevertheless, these latter cards form an essential part of the catalogue in order to ensure efficient retrieval of documents and include "see" and "see also" cards.

The **author entry card** is a description of the document under a heading that consists of the name of the author:

612 **PAL**

PALMER, E.

Human bodies / Eve Palmer :

drawings by Norah Pitman.

Johannesburg : Hamlyn, c1986.

325p, : ill.; 30cm.

86/100

Figure 6.1: An Author Card

The **title entry** card is a description of the document headed by the title of the book:

612 **PAL**

HUMAN bodies

PALMER, E.

Human bodies / Eve Palmer :

drawings by Norah Pitman.

Johannesburg : Hamlyn, c1986.

325p, : ill.; 30cm.

86/100

Figure 6.2 : A Title Card

The subject entry card is a description of the document under a heading consisting of one or more words that is a verbal description of the document, or classification symbol that may be a notational expression of the subject e.g. a Dewey Decimal classification number:

612 PAL
612 or Human Physiology
PALMER, E.
Human bodies / Eve Palmer :
drawings by Norah Pitman.
Johannesburg : Hamlyn, c1986.
325p, : ill.; 30cm.
86/100

Figure 6.3 : A Subject Card

Added entries are entries that are additional to the main entry and are made under different headings e.g. editor, illustrator, translator, joint author etc. These added entries are made to satisfy the principle of providing relevant multiple access points to a document.

612 PAL

PITMAN, N.

PALMER, E.

Human bodies / Eve Palmer :

drawings by Norah Pitman.

Johannesburg : Hamlyn, c1986.

325p, : ill.; 30cm.

86/100

Figure 6.4 : An Added Entry Card for Illustrator

A special type of added entry is an analytical entry that is made for a specific, separately recognizable part of a document. An analytical entry may be made for a particular chapter by **author Y** in a book written by **author X.**

Cards without actual bibliographic entries will include **"see"** reference cards, **"see also"** reference cards and subject index cards. The **"see"** reference cards will lead the user from the term which is not used in the cards to those terms that are used in the catalogue. They often give variant forms of an author's name e.g. ROSS, John James - see JOHN-

ROSS, James; or synonymous terms for subjects e.g. wireless - see RADIO.

"See also" references, which usually occur in the alphabetical subject catalogue, refer the user from a particular subject to an allied or related subject which maybe of interest or even be more relevant to the original need e.g. Investment - see also FINANCE.

6.5 TYPES OF CATALOGUES

6.5.1 Author Catalogue

The author catalogue consists of a grouping of all entries under the names of persons or corporate bodies associated with the creation of the intellectual or artistic content of the document. These entries will include main entries under principal author as well as added entries for joint authors, editors, translators, compilers, illustrators etc. The entries are arranged alphabetically according to the predetermined filing factor.

6.5.2 Title Catalogue

The title catalogue includes all entries in which the title appears as the first line on the card. These include title main entries which are made when no author responsibility can be clearly determined, as well as added entries under title. These entries are filed alphabetically. The filing factor is the first word of the title which is not an article.

6.5.3 Author/Title Catalogue

Author and title entries may be interfiled in one alphabetical sequence to constitute the author/title catalogue.

6.5.4 Subject Catalogue

The entries indicating the subject matter of the catalogue are grouped together to constitute a subject catalogue. Two types of subject catalogues may be distinguished: an alphabetical subject catalogue and a classified subject catalogue.

6.5.4.1 Alphabetical Subject Catalogue

Those entries with headings that express the subject matter in words are filed alphabetically in one sequence with the subject heading being the filing factor. A network of references, "see" and "see also", connect the various subject headings and form an indispensable part of this type of subject catalogue. A library using the conventional alphabetical approach to subject cataloguing may utilize the following types of catalogues: an author catalogue, a title catalogue; a combined author/title catalogue and an alphabetical subject catalogue. Alternatively, these entries may be further combined i.e. the various entries may interfiled into one alphabetical sequence that constitutes a dictionary catalogue which consists of the author, title and subject cards, all interfiled alphabetically as in a dictionary.

6.5.4.2 Classified Subject Catalogue

In the classified catalogue, entries in which classification symbols represent the subject matter are systematically filed according to these symbols. The order of the entries will thus correspond with the order of the subjects listed in the schedule of the classification scheme used e.g. the Dewey Decimal Classification Scheme **(DEWEY)**. Moreover the order of the subject entries will usually correspond with the order of the documents on the shelves. The primary difference between the catalogue and shelf sequence is that the document stands only at the main classification number, while the document may be represented in the catalogue by a variety of entries at different classification numbers. It is therefore imperative for this type of catalogue to be supplemented by an alphabetical subject index. This index will refer the user from an expression of the subject in words to the classification symbol representing that subject. The subject index brings together related topics which are separated by the classification scheme. A library may have an alphabetical author catalogue, an alphabetical title catalogue or a combined author/title catalogue, and a classified subject catalogue together with an alphabetical subject index. These types of catalogues are quite common in South African Libraries.

6.5.5 Automated Catalogues

Since the early 60s, when computers were first used to aid in library housekeeping procedures, the catalogue of the library was the first area to undergo conversion to computer based systems (37, p65). In a survey conducted by Bierman (3, p277-297), he found that the reasons given by American librarians for setting up computer based catalogues systems included:

6.5.5.1 To provide access to the complete and up-to-date catalogue from many service points.

6.5.5.2 To provide more and improved access points and search capabilities.

6.5.5.3 To expand the availability of increased resources through the sharing of resources through regional catalogues in order to eliminate or reduce some of their inherent problems of manually produced card catalogues.

Fasana (10, p111) concurs with this view as he states that the "success of automated cataloguing systems have served to bring into greater relief the deficiencies of the (traditional) card catalogues".

The most fundamental dynamic attribute of a computerized system is its ability to modify and reorganize data. However, unless a computer system is also given full responsibility to display the products of these manipulations, its capabilities will be held in check (10, piv). Nevertheless, Fasana (10, piv) is of the opinion that those libraries that have made the commitment to convert to computerized cataloguing systems are now finding that the accrued benefits are beginning to exceed the investments made to achieve them. This is clearly indicated by two developments of the late 60s:

* The successful development of a machine-readable cataloguing service by the Library of Congress (MARC).
* The successful implementation of automated shared cataloguing systems based o that selfsame service as evidenced by OCLC.

Shared cataloguing systems, such as OCLC enable a large number of libraries to make optimal use of LC MARC and more importantly, to create their own machine-readable catalogues without the need to assume the expense and risk of developing their databases.

Even greater ancillary advantages may be derived from the machine-readable files that were developed in the course of using automated cataloguing systems e.g. circulation systems. The stores of bibliographic data can only be fully utilized if the files themselves are made catalogues of library collections, rather than constitute the raw materials for a traditional card catalogue (10, piv).

Avram (1, p2), also believes that the operations of a library are file oriented. Thus, any approach towards the automation of library processes must be based on the improved handling of files. The files must be converted to machine readable form and maintained. Moreover, it must be possible to access these files in a variety of ways both for maintenance and information retrieval.

During the early development of automated library systems, it appeared that bibliographic principles would have to be accommodated by the limitations imposed by computers. However, further developments in software design have shown that computers can in fact be used to support standard bibliographic principles.

After preliminary studies and investigations, the Library of Congress (LC), concluded that "although there were other library procedures which stood to profit from mechanization ...

devising a method of recording bibliographic information in machine-readable form was basic to the solution of other problems". (quoted by 9, p21).

6.5.5.4 The Creation of Machine Readable Data

According to Spaulding (36, pviii), no computerized bibliographic searching will be possible until the catalogue information is in machine-readable form. A machine readable catalogue represents a unit record that can be reproduced under all of the headings specified by its entry elements. A machine readable record, can therefore, be easily used to print an entire card set. Moreover, the computer can be easily programed to manipulate the text contained in that particular record to produce headed cards automatically. If for example the unit is created with a particular call number, or one is added to it prior to the creation of the card, the number can be made to appear on each card in the set.

In order to achieve this level of sophistication, all the information required by each of these functions must be captured when it is created. Further, if individual files and files of records are to be reorganized for different functions by the computer, specific analysis, comprehensible to computer intelligence, must be made of each record. This analysis must be precise, explicit and unambiguous. This careful analysis is required before the record is used rather than while it is being used.

6.5.5.5 Automated Catalogue Cards

A primary virtue of automated catalogues is that they allow a single file of information, once it has been converted into machine readable format, to serve different functions. The file can be reorganized and accessed in a multitude of different ways. This flexibility has been further enhanced by the advent of on-line systems. In other words a single file of information may exist simultaneously and instantaneously in several disparate locations. A record may thus be created only once for use in many related activities. As all the data is entered once (and checked) and automatically reproduced on each card, the possibility of errors is greatly reduced.

Fasana (10, p43) states that **OCLC** is the pre-eminent producer and distributor of computer printed catalogue cards in the USA. He also states that the most effective uses of computing equipment in the support of catalogue maintenance is the development of systems that print catalogue cards on demand.

Catalogue cards produced by a computer can be fairly easily integrated into an existing catalogue as the cards e.g. OCLC come overtyped with headings and call-numbers and are also presorted for filing. Fasana (10, p43), states that using computer produced cards offer a relatively simple way to introduce automation with little risk.

The above process represents the simplest possible card reproduction service. The library provides the processing centre e.g. OCLC with an LC card number for the desired record together with its own call number and the system reproduces the required number of cards needed to complete a card set.

6.6 THE MARC PROJECT

Many early attempts to apply the computer to library problems did not materialize as the size and the complexity of the problem was underestimated (19, pvii). However, one such undertaking which achieved significant results was the **MARC** development which began as a pilot project that involved the Library of Congress and sixteen other participating libraries. **MARC** is an acronym for machine readable cataloguing and was conceived as a result of a need to develop machine readable records in a standard format to facilitate library automation. Libraries that contemplated a computerised cataloguing project faced the daunting task of keyboarding or inputing all the data for the proposed catalogue plus the enormous cost of the exercise. Since 1901 many American libraries had used standard printed catalogue cards that were obtainable from the Library of Congress (33, p73).

The need now arose for a similar service in machine manipulible form that could be used by different computers in different libraries. According to Salmon (33, p5), the

MARC project was initiated to provide a format for cataloguing data that would be machine readable and serve as a national standard. The development of a standard format has brought about an accumulation of an increasingly large computer manipulable bibliographic database. This project was initiated by the Library of Congress **(LC)** with the object of providing a format for cataloguing records that would be machine readable, acceptable as a national cataloguing standard, and also be used interchangeably on all of the different computers that are likely to be used by the various libraries (33, p5). As a result of the pilot project, a new format **MARC 11** was introduced, and this is currently known as **LC MARC.** The main techniques originally used at this time for processing MARC tapes or for the independent conversion of an old catalogue to machine readable form included:

* The use of punched cards, punched paper tape or magnetic tape for off-line input.
* The final output was computer printout both on paper and cards, and photocomposed printing plates from which book catalogues were printed or computer output on microform.

The development of computer technology has resulted in the progression from offline processing to online processing. Online editing allows the results of the editing action to be viewed immediately. Nevertheless the end product of cataloguing are normally produced offline in a batch mode (33, p103). A library can use the whole catalogue provided by MARC and add unique information, such as the library's own call number. Many automated cataloguing projects that were initiated from the early 70s have utilized MARC records to a greater or lesser extent in order to avoid the time and expense of conversion (33, p85).

Although the first MARC formats were produced by LC, MARC-like formats are being utilized in various parts of the world e.g. Canada, Mexico, Britain, France, Sweden, Japan and South Africa. While it was hoped that an international network would be formed for the exchange of bibliographical information the various formats adopted by the countries lacked total standardization. This problem was addressed by the development of a universal machine readable format **(UNIMARC)**. In South Africa The National Library Advisory

Council appointed the Committee on Bibliographic Services to investigate the possibilities of using MARC tapes in the production of catalogues. Acting on the recommendations of the National Library Advisory Council and the results of the surveys conducted by the MARC Working Group, a **SAMARC** format was developed. Since then a **MINI-SAMARC** format has been devised for the input of records in the Union Catalogue.

The success of MARC may be directly related to a strong commitment to adopt standards where they existed, and to work towards the establishment of standards where they did not exist. One of the major benefits of standardization that was fostered by the development of MARC was the movement towards the development of automated catalogues. Locally, **AACR2** and Dewey serve as the most important standards for the development of machine-readable records. Salmon (32, p5) agrees that the success of MARC laid the foundation for advances in the field, that would otherwise have been impossible, and as an international, ever-expanding standard its contribution is only beginning to be exploited.

According to Salmon (33, p106) the largest, best known, and most influential cataloguing system is the Ohio Library College Center (OCLC) which began its online operations in 1971. Its popularity is the result not only of technological expertise but also its efficient shared cataloguing system. It provides a common cataloguing database for searching and consultation by a very large number of libraries. The OCLC system is successful because both the MARC record and the cataloguing record prepared by all member libraries can be displayed on terminals in individual libraries, thus obviating the need for any library, but the first, to catalogue it.

6.7 INDEXING

Prior to the nineteenth century libraries were considered to be merely storehouses of books or information and it was not seen as a function of the library to provide efficient tools for the retrieval of information from its collections. Bradford (4, p13) states that up to 1840 no large library was completely catalogued and "no considerable library had adequate means whereby to ascertain its resources in a particular subject". However, the passage of time, increasing availability of material and increasing literacy of the people caused a need for the retrieval of information from the library collection. In spite of the fact that new collective periodical indexes and abstract journals appeared in rapid succession, the need for an effective means of retrieving information became even more urgent with the continued rapid growth of information.

Although subject analysis of the content of documents had been carried out by means of classification schemes and by means of subject list headings, this was far from satisfactory as the established systems did not make adequate provisions for the addition of new concepts, or even the synthesis of new numbers to express concepts combined in a way not foreseen when the system was constructed. As early as 1945 Bush (5, p101-108) proposed that information retrieval should proceed by the association of ideas, rather than by tracing required items from sub-class to sub-class, through a pre-determined scheme. This view was supported by Taube, when in the 50s he observed that the great bulk of subjects were described by combinations of terms. He objected to the maintaining of a huge subject list and proposed the creation of subjects (at the time of the search) from a much smaller list of subject components. This consequently led to the development of the **Uniterm** system of indexing. According to Lancaster (26, p78-81) this system was popular because of its apparent simplicity and the system's ability to make possible the free combinations of terms at the time of the search, thereby providing unlimited access points to any document indexed in the system. Coordinate indexes avoided the multiple pre-cordinated entries needed for the same number of approaches in a classified or alphabetical subject catalogue. Lancaster (26, p38), states that these manipulative indexes paved the way to the use of data processing equipment in information retrieval.

The information retrieval process should be closely linked to the indexing process. The sole purposing of indexing is for the storage and the subsequent retrieval of the document surrogates, or records which can then be a lead to the documents themselves, and to the information contained therein (18, p38).

Harter (17, p37) agrees with this view as he states that the information retrieval process is closely linked to the process of indexing and the purpose of indexing is for the storage and subsequent retrieval of records which will then lead the searcher to the documents themselves. Harter (17, p38), is also of the opinion that an index record for a document is a concise representation, or surrogate of the document from a particular point of view. Manual literature searching techniques relied on the structure of the printed retrieval tools. While these printed indexes took many forms, they were basically linear devices i.e. the references are arranged in a locked sequence on the printed page. Printed indexes are usually hierarchical in that the citations are presented in a logically arranged series of subject headings and related topical subdivisions. Although coordinate indexes in printed form is extremely helpful in library search, their usefulness is lost when the number of items to be indexed exceeds a few hundred or when the number of terms to be coordinated become too large (13, p13). Gilreath (13, p13) further adds that the physical task of comparing large lists of document tags or the manipulation of large numbers of search items become daunting.

Doyle (9, p291) states that the use of computers for producing alphabetized indexes was the initial form of language processing that experienced widespread application. Key word in context **(KWIC)** is an indexing system that is based on using the key words in the title of document for indexing terminology (23, p162). Normally a title is entered into the computer that is programed with a suitable "kill" or "stop" list which may be described as an anti-thesaurus (8, p53). This list consists of relatively unimportant words and the computer alphabetizes the title under each of the remaining words i.e. words that are not included in the "kill" or "stop" list. The program indexes the title by only its significant keywords. Thus each title can be found under all the significant words that it contains. Katz (23, p164) states that keyword indexing is suited to computer assisted searches in that the user is not tied to a controlled subject heading list but may use "natural language".

In bibliographic databases an index is used to act either as a substitute or as a surrogate for the documents themselves. The indexing process consists of two basic steps before it is added to the database:

* it must be ascertained what the document is **about.**
* the concept must be expressed in the vocabulary of a document description language.

With a given request for information, those documents which are helpful to the request are displayed on the VDU.

According to Sharp (34, p14) coordinate indexing provides for using combinations of terms. This means that if a document is entered in the system with the use of 3 terms, retrieval will be possible if the searcher uses any one of the 3 terms, or any two terms of the 3, or all three of the 3 terms. Moreover, an important advantage of the approach used in coordinate indexing is the fact that the terms contained in a request for information do not have to be stated in any specified order. If the terms used by the searcher are in the system, the relevant documents will be retrieved, regardless of the order in which the terms are stated. This facility makes it unnecessary to provide for separate entries for all permutations of the concepts in the description of the document. Initially, the information needs of the user is analyzed into its constituent facets or concepts and then a language (natural, modified or controlled) is used to express the surrogate.

6.8 THE ROLE OF MICROCOMPUTERS IN CATALOGUING AND INDEXING

Harter (17, p227) states that one of the most significant technological development affecting information retrieval is the development of microcomputers and its subsequent use in online searching. Even if the microcomputer system does not come complete with the necessary hardware and software built-in, it may nevertheless be purchased quite reasonably (17, p27). A variety of software packages are available for online cataloguing. Manufacturers of microcomputer systems are increasingly incorporating modems as standard features (11, p7). According to Hane (quoted by

13, p228), users originally accessed **bulletin boards** to retrieve information. These bulletin boards were operated by user groups and private individuals and allowed microcomputer users to post and receive messages, play games, chat, obtain information and serve as a source for free public domain software. Locally, **Teledata** is becoming popular in this regard. Microcomputers functioning as intelligent terminals can be used not only to input data online, but can also be used to prepare data for later offline transmission, thus saving considerable time and cost.

Libraries have derived substantial benefits from the availability of microcomputer facilities for the online processing of catalogue records. Microcomputers have facilitated the accessibility to central data bases and this has resulted in the effective and efficient use of existing records. Libraries perform online cataloguing on a microcomputer which is linked to a central data base. Catalogue cards may be printed for a record and the record can be added to the library's own secondary storage for the production of COM catalogues etc, as and when required.

The principal advantage of online editing of catalogue cards is that of instant feedback. In the process of editing, the modifications are made to the information displayed on the screen, and the modified or edited record is displayed instantly, thus ensuring that all the necessary modifications have been correctly processed. New records utilize the input process to store cataloguing data in machine readable form in a database. Once the cataloguing information has been identified and organized according to cataloguing rules, the record is then entered or input into the computerized database. The results of the input can be displayed immediately for proof reading and corrections.

Capturing machine readable data for later processing, called downloading, is also possible with the microcomputer. Hendrix (20, p1), states that the availability of comparatively low-cost microcomputers with storage mechanisms has stimulated the practice of downloading which is rapidly becoming an important factor in the field of information retrieval and storage. This view is supported by Foster (11, p5) who is also of the opinion that downloading is an important issue in the field of information storage and retrieval. One of the reasons quoted for this interest is the development of microcomputers both in capacity and performance at an increasingly reduced price. Another reason quoted by him is the growth of software developed for these microcomputers to allow for efficient communication and database handling.

Mortenson (quoted by 10, p6) states that the microcomputer is an ideal tool for information searching and is favoured by many information specialists as well as an increasing number of end-users. A major contributing factor for the popularity of microcomputers is the development of new and less costly storage technology. Floppy disks are now capable of storing almost a million characters at exceedingly low cost. Even the cost of hard-disks which are capable of storing hundreds of millions of characters is becoming increasingly more attractive. Thus downloading via microcomputers is becoming increasingly cost-effective.

According to Foster (11, p6) microcomputers are used in interactive online retrieval systems such as **Dialog,** and also for downloading from online databases holding cataloguing data e.g. **OCLC.**

6.9 CONCLUSION

Information capture and storage i.e. the cataloguing and indexing of information is a prerequisite for information retrieval. Experienced librarians with smaller collections are able to provide suitable service if they are familiar with the needs and wants of their user. However, with the increase in the volume of information it has become increasingly more difficult for the librarian to offer this excellence in service. As the number of users and the volume of information grows, manual methods of cataloguing and indexing which are time-consuming, cumbersome and laborious are inadequate. It is apparent that librarians have been in constant quest for systems of storage that would facilitate easy and quick retrieval. Although expensive, mainframe computers and minicomputers have been extensively used in the creation of databases for cataloguing and indexing. With the advent of sophisticated "third generation" microcomputers and suitable software packages, downloading from catalogue databases is an economic reality. This is a direct result of the relatively low cost, high performance microcomputers. Microcomputers are freely available on the open market with a number of dealers vying for sales. This has led to the establishment of a burgeoning industry with all its relative advantages e.g. research and development, marketing, sales, service software development etc.

The recognition by the Education Department of the need for a more effective system of information retrieval in the library resource centres in Indian secondary schools resulted in the introduction of key card system in 1978. While this decision may have satisfied information retrieval needs at that time, events have however overtaken this decision in terms of both increased growth in the school library resource centre and the increasing demands of the user population. The need for a more effective system is directly related to the increasing sophistication of the user population.

The development of the traditional form of cataloguing from simple book entries to the card catalogue in the school library resource centre should logically continue by taking advantage of the development of computer technology as the success of machine readable catalogues and automated shared cataloguing have already been established. Developments in software design have indicated that computers can support standard bibliographic principles rather than impose limitations on them. Computerisation of the catalogue will ensure that users in the school library resource centre will benefit by having access to a complete and updated catalogue from many service points together with improved access points and search capabilities. The traditional catalogue in the school is available only in one place and accessible only from three points i.e. the author catalogue by author, the title catalogue by title and the subject catalogue by class number located through the "key card". A catalogue in machine-readable form may be printed out in multiple copies in full, or in sectional listings for distribution to heads of departments of the various subjects offered in the school. The complete catalogue could also be made available to "feeder" primary schools in the area. The catalogue may be further interrogated to provide information under a variety of leads e.g. author, title, date of publication, country of origin, publisher, accession number or even by a combination of elements. The machine-readable catalogue can be updated using minimal time in comparison to the considerable amount of effort required for the manual interfiling of a card catalogue.

Notwithstanding the fact that it may not take more than a few minutes to catalogue a modern book, the cumulative savings achieved by all the Indian secondary school library resource centres by the use of centralized cataloguing could be significant. The educational objectives of the school library resource centre is also further enhanced with the expansion and availability of increased resources which is facilitated by the sharing of resources through regional machine-readable catalogues.

In view of the large financial commitment made to school library resource centres and the importance of ensuring that the student is not denied efficient access to the holdings of the centre, it is vital that the catalogue be made more reliable and efficient. Current cataloguing and indexing practices may be gainfully utilized to develop storage and information retrieval techniques using microcomputer technology and this will be discussed in the following chapter.

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CHAPTER SEVEN

7. A FUNCTIONAL APPROACH TO COMPUTERIZED INFORMATION RETRIEVAL

7.1 INTRODUCTION

Information retrieval is concerned with the representation, storage, organization and accessing of information. While in principle no restriction is placed on the type of data handled in information retrieval, in reality a number of items found in ordinary retrieval systems are characterized by an emphasis on narrative information. The data processed by a retrieval system would include books, periodicals, letters, documents of all types, newspaper articles, etc.

In order to facilitate the task of the information user in locating required items of interest, the library provides a variety of auxiliary aids. Individual items that have been acquired are analyzed and appropriate descriptions are chosen to reflect the information content of the item. The item is classified according to established norms and then incorporated into the collection of existing information. Procedures or techniques are then established for both the formulation of requests designed to satisfy the information need and also for comparing these requests with the description of the stored item. These comparisons are made in order to decide which items are appropriate for each query or request. A retrieval or dissemination mechanism is used to convey the information items of potential interest to the users of the information service. This procedure is adopted in school library resource centres where the card catalogue is the principal auxiliary tool used in an information search. One of the effects of increasing information as experienced by school library resource centres is that relevant information may remain uncovered. The traditional approach exemplified by subject classification schemes and the card catalogue, is believed to be too confining (6, p164). While in principle information storage and retrieval seems simple, the problems of information storage and retrieval, nevertheless, have been under scrutiny since 1940 (22, p5). A great deal of thought has been given to the utilisation of computer technology for the rapid and efficient retrieval of information (22, p5). It was believed that with the availability of high speed computers for non-numerical work, computers would be able to "read" an entire document collection to extract the relevant documents. As a computerised information retrieval system can only retrieve information that has been input into the system, it soon became apparent that the use of the natural language of a text caused input and storage problems. The need therefore arose to develop a system to represent the documents so that these representatives or surrogates of the documents could be easily input, stored and manipulated for information retrieval. van Rijsbergen (22, p9) however, states that computers would not give an acceptable retrieval time with a large document set unless some logical structure was imposed upon it. Retrieval systems which adopted a sequential file organisation proved inadequate when a query required a short real-time response. By its very nature, bibliographic files tend to be extremely large, and the increased speed, memory and storage capacity of microcomputers is tempered by this large number of files that have to be manipulated. If the current growth rate is maintained in the school library resource centre it will also be faced with the problem of having to manipulate large files.

Besides exploring new analytical methods, teacher-librarians also need to thoroughly investigate the capabilities of microcomputer technology for information storage and retrieval as these newer techniques are of a more advanced character than those traditionally used for the manual shelving of books and filing documents. This chapter adopts a functional approach to computerised information retrieval, thereby providing teacher-librarians with a fundamental perception of file structures for information retrieval.

7.2 THE EFFECTS OF THE GROWTH IN INFORMATION ON LIBRARY RESOURCE CENTRES

The usefulness or utility value of an information collection is directly related to its currency and completeness. In order to maintain currency new items must be constantly added to the collection, and to make the collection more complete a large proportion of items of potential interest to the user must be included. The development of the collection is further aggravated by the rapid growth in available information. In order to locate a particular item in the total holdings of the school library resource centre, various access mechanisms may be used. These mechanisms are related to the physical or logical organization of the items. In the school library the physical organization is usually controlled by the arrangement of call numbers and in the Republic of South Africa common call numbers used in the libraries are those provided by the Dewy Decimal Classification system. Books placed in order according to these call numbers are clustered on the library shelves by topic area. Books on computers may be assembled under a common call number beginning with **001.6**. However, the same initial call number may be used for other subjects such as data processing, program languages and system analysis. Furthermore, additional information on computers may also appear in other sections of the library e.g. in the **651** and **652** classes. Thus, a student seeking information on a given topic may be required to outguess the teacher-librarian who made the original decision about the placement of the item. In order to make this guessing task easier a logical organization of the item may be superimposed on the physical organization. Books published on computers may be identified by looking in the library title catalogue. Once the appropriate term is found adjacent cards will reveal other books related to this topic that is being sought. These books may belong to various call number locations e.g. **001.64, 651.8, 621.3819, 794, 384.6, 519.4** etc. Given a particular call number the student should be able to locate the item at the designated location on the library shelves provide that the item is not loaned out or missing. Similarly, an examination of the subject catalogue will lead the searcher to the various books on computers available in the library.

The subject catalogue also allows changes to made to the subject terms without actually reshelving the books. In other words the items can be logically reorganized by making appropriate changes to the library catalogue without altering the physical arrangement of the books on the shelves. A variety of different logical organizations can be used to characterize the various information items e.g. the items may be placed in order by author, title, subject, size, date of publication etc. Each logical organization would then correspond to a different set of cards in the card catalogue. For the stored information to be useful the information must be available to the potential user. As early as 1945 the methods for information retrieval were criticized by Vannevar Bush:

"The summation of human experience is being expanded at a prodigious rate and the means we use for threading through the consequent maze to the momentarily important items is the same that was used in the days of the square rigged ships" (quoted by 5, p6).

The existing information problems appear difficult to surmount without the use of sophisticated methodologies for storing, processing and locating, retrieving and transmitting information. The availability of modern information retrieval systems vastly improved the access to stored information collections.

7.3 INFORMATION RETRIEVAL SYSTEMS

In the context that processed information consists of documents, information retrieval, as noted previously, deals with the representation, storage and access to documents. Artandi (1, p21) views document retrieval systems as consisting of four major dimensions: the input into the system; files that are searched; the searching methods and the output of the system. Notwithstanding the fact that these four elements constitute an essential part of an effective system, they are nevertheless subject to differences in emphasis in the various systems.

Input is related to those activities which are concerned with expressing the contents of documents and this involves determining what the document is about and which part of the information content should be stored. It also involves the translation of the content to be stored into the intellectual and physical language of the system. The input information would probably include the natural language text of the document (1, p21). A search request will result in the output of a set of references from the information retrieval system. These references will serve to provide the library patron with information about items of potential interest.

While many different information retrieval systems exist, they nevertheless perform similar functions. Artandi (1, p17) is of the opinion that most retrieval systems are document retrieval systems as they do not provide direct access to the information that is required. Rather, these retrieval systems are designed to retrieve documents which would contain the desired information. In other words the user is one step removed from the actual or precise information that is being sought and the file that is searched consists of document descriptions instead of actual data. These files include card catalogues and printed indexes to books and periodical articles.

The organization of documents for information retrieval is based on the assumption that it is possible to describe the contents of documents by assigning subject tags/labels to them and Artandi (1, p18) assumes that the searching of a file of these tags/labels can serve as a satisfactory substitute for the scanning of the entire information collection. The need to organize these documents is to avoid the scanning of an entire collection to locate required information and also to facilitate the examination of relevant parts of the collection. This view is supported by Harter (9, p31) who states that information retrieval systems do not permit the effective scanning of concepts and ideas directly.

Thus the objective of indexing is to describe documents in clear concise terms. A search of the collection is then reduced to the examination of these terms only. The process of tagging/labelling items to indicate what they are about and where they may be found will vary according to the information retrieval system that is being used. The total number of subject tags that are used constitutes the index language of the retrieval system. The function is the same regardless of whether these tags/labels are natural language terms or notations (1, p19). The effectiveness of the indexing system, will to a great degree, be determined by the effectiveness of the classes that are established in accommodating and screening the information to be organized and the information contained in the search description.

Ironically, while an important characteristic of a file in a computerised information retrieval system is its arrangement, there may be no arrangement (1, p23) i.e. items may be arranged in random order. Items may also be entered into the system in a rigid order. This arrangement is related closely to the searching method for which it was designed as well as to the particular nature of the document representations. The file to be searched may take many forms, but its nature and arrangement are characteristic of systems regardless of the physical forms on which it may be stored. The searching methods will be predetermined to a large degree by the nature of the document representations and by the characteristics of the file. Ultimately the search strategies that are possible will be determined by features built into the system. The question that is put into the system must firstly be formulated in terms of the system's characteristics i.e. it must be translated into the characteristics of the system.

7.4 A FUNCTIONAL APPROACH TO INFORMATION RETRIEVAL

While many different information retrieval systems exist, they all nevertheless perform key functions. All information retrieval systems can be characterized by a set of information items **(INFO)**, a set of requests **(REQ)**, and the use of a mechanism **(INRFORET)** to determine if the information item meets the requirements of the information requests.

Figure 7.1 : A Basic Information Retrieval System

INFORET represents a relationship operator that maps out specific queries to selected items that are stored in the information collection. Theoretically, the relationship between the queries and documents can be obtained by direct comparison as indicated in the above figure. However, the relevance of specific information items to particular requests are not determined directly. The documents or information items are first converted into a special form using an indexing language **(INDXLAN)**. The requests are also converted into a representation consisting of elements from **INDXLAN**.

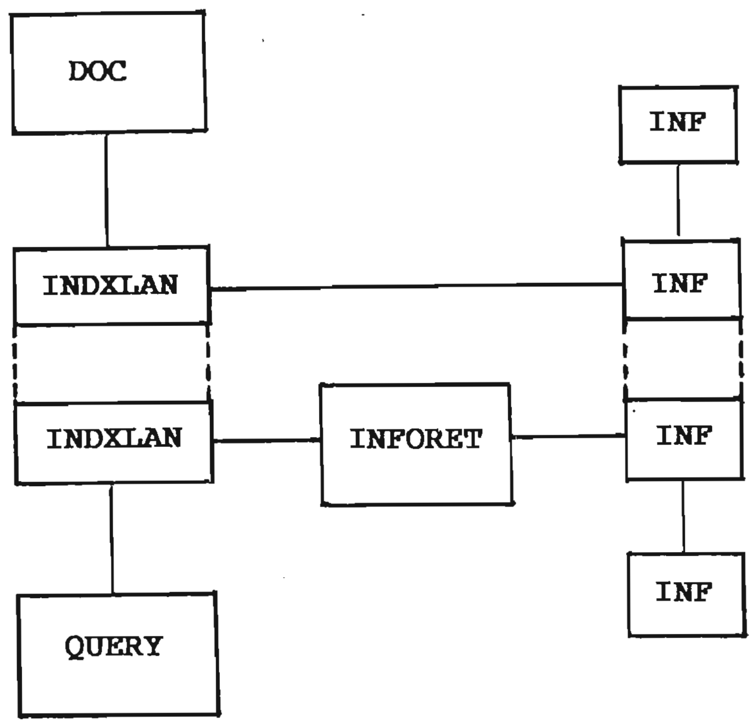

Figure 7.2 : An Information Retrieval System

The techniques for determining which information items should be retrieved in response to a query are based on representations of the requests and information items consisting of elements from the indexing language. **INFORET** is the relation operator that determines the similarity of the various information items to the given requests. **INFORET** may also be considered to be the retrieval function because it identifies the specific items that are to be retrieved.

Generally, the retrieved items will appear in the order in which they were located in the files. Indexing language may be prespecified (controlled) or taken freely from the text of the information items, as well as the information requests (uncontrolled). Whatever type of language is used, the information item is usually assumed to be represented by a list of elements from the indexing language.

Subject indexing is a three stage operation where the text is first scanned to establish its meaning and the content of the information. A decision is then made as to which sections of the document are to be recorded in relation to the objectives of the system. Finally, the document content that has been selected to be recorded is expressed in the language of the system. When no standardized vocabulary is applied, and the terms are not controlled, the indexer merely picks out words from the document and records them without referring to previous indexing decisions. When a controlled vocabulary is utilized the subject content is recorded into the formal standardized language of the system.

7.5 FILE STRUCTURES

Information management systems are concerned with the manipulation of information with the objective of making the information resilient, flexible and adaptable and four useful guidelines identified by Loomis (14, p3), for an information retrieval system, would include:

* the information must be represented and stored so that it may be accessed later.
* the information must be stored so it may be selectively and efficiently accessed.
* the information must be processed and presented so that it effectively supports the environment.
* the information must be protected and managed so that its value is maintained.

When the choice has been made for both the representation of the information item and requests for information, the items represented must be organized into a file structure. The item representation must be collected together and organized in order to ensure both the efficiency and the effectiveness of operations including file searching and file updating. This may be achieved in various ways, as file structures vary in complexity from those with little or no organization to those structures that maintain various explicit relationships between information items. Loomis (14, p265) states that a file is a collection of logically related records and the record is a structure of logically related fields of information. Usually all of the record occurrences on a file are of single format and the records on the file are stored together for some common purpose. A collection of data may be stored in a file simply because it is either too large to fit entirely in the main memory or only a small portion of the collection is accessed by a program at a given time, thus making it uneconomical to store the entire collection in main memory simultaneously. There are several possible mappings of the data to storage and the determination of which option is the most appropriate mapping to use will be based upon how the variable will be manipulated; the range of values that the variable will have and the characteristics of the computer and memory that will process and store the variables (14, p19). Davis (3, p286) is of the opinion that the problems of access are most severe in information retrieval applications and suggests the use of list organisations for file structures.

7.5.1 Linear Lists

A linear list is the simplest example of a file structure as it is literally an unordered collection of information items. As current computer storage devices are largely one-dimensional it becomes necessary for the file items to be searched one at a time on a computer store. The information item sought could be the first item on the file or even the last item on the file. However, on the average an item would be in the middle of the file. Thus on the average (n+1)/2 items must be examined in order to locate a given item. In this case **n** will represent the given number of items in the file. A linear list offers many advantages for information retrieval. New items could be added to the file without the need to alter the order of the existing items in the file, thus obviating the need to make deletions to the file. This provides the advantage of eliminating the file maintenance process.

Notwithstanding above, all the items have to be examined when a request for information is made in order to determine those items that may be retrieved. This has the disadvantage of making the scanning of large files inefficient. If it takes one second to determine whether an information item in a file is appropriate, 83.3 minutes will be utilized to examine a file consisting of 5000 items. Therefore on the average a search for a specific item would take (n+1)/2 minutes = (5000+1)/2 = 41.7 minutes. If the search for a item is reduced to 1/10 of a second per item, then 8.33 minutes would be required to examine the entire file or a corresponding reduction to 4.17 minutes in the total time is achieved on the average for the search of a specific item. It is clearly apparent that the usefulness or effectiveness of a linear list is primarily dependent on the size of the file and also the speed of retrieval. The larger the file with an equivalent retrieval speed would result in a longer search time.

7.5.2 Ordered Sequential Files

Certain fields (portions) of the record that are stored in a file is of special importance for information retrieval e.g. the surname of an author of a book is often used as a principal criterion for locating that specific article. These specific fields that are used to obtain access to the stored records are referred to as keys. A given record may be ordered sequentially according to the value of one of its fields (keys), thus with this key, access to that particular record is obtained. An ordered file consisting of names of books may be ordered alphabetically according to the last name of the author of each book. The linear list in contrast to the ordered sequential file would store the names of books in no specific order.

The addition of new items to a sequential file will require that space be made at the appropriate locations to enter the new items. A new book that needs to be placed in a file must appear at a specific location so that the order of the file is maintained. In other words items have to be moved in order to make room for the specific record or item. In the linear list which is unordered, an item can be simply placed in the next available location.

In order to locate an item in an unordered sequential file it may still be necessary to look at (n+1)/2 items on the average i.e. the search can be started at the beginning of a sequential file and each item is examined individually until the desired item is located. However, the efficiency of searching a sequential file can be increased when the item is ordered by the key values that are used in the file. Through the structuring of data in a binary tree, the search time to a particular record could be reduced significantly over structuring of that data in a linear type file. For a collection of **n** records in a ordered sequential file, the expected average search length of a balanced binary tree is log2n, whereas the average search length of a linear list is (n+1)/2. A binary search can reduce the required number of steps to log2(n+1)/2, resulting in much better performances for larger values of **n**. In a binary search, each comparison removes from further consideration one half of the records remaining on the file. In a file that contains 1023 items it would take 512 steps on the average to locate an item i.e. (n+1)/2 =

(1023 + 1)/2 = 1024/2 = 512 steps. In a binary search ten steps on the average are required to search a file. Loomis (14, p188) is of the opinion that this is good performance compared with sequential searching methods.

In order to use the binary search procedure, the record must be ordered in accordance with its key values and the particular record sought must be specifiable by citing the value of that particular key. In the book title example discussed earlier, the record would be retrieved by citing only the particular author name. Instead of initiating the search at the beginning of the file and proceeding to the end, the record at the middle of the file is examined first. The key value of the middle record is then compared with the key value specified in the search request. If the key values match, then the middle item is the record being sought. However, if the values do not match, it becomes necessary to determine whether the desired key value comes before or after the key value of the middle element in the sequentially ordered file. If the desired key value occurs before the middle element, then the second half of the file, together with the middle element, are ignored. The middle value of the first half of the file is now examined to establish if it is the required item. If this is not the case then it is determined whether the desired key value lies before or after the middle element of the first half of the file. This process is continued until the desired record is obtained. This process is graphically illustrated in the following diagram:

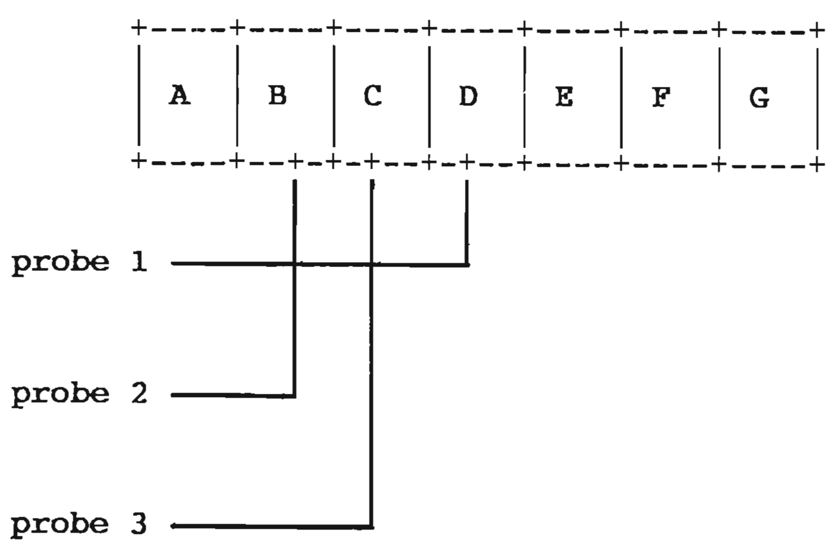

Figure 7.3 : A Binary Search Procedure

If a file consists of seven elements with the key values being **A, B, C, D, E, F,** and **G,** and the search is made for the key value **C,** then the following steps would take place in a binary search:

Item **D** is examined first as it is the middle element of the file. As this is not the required key and **C** falls before **D**, items **D**, **E**, **F** and **G** are ignored. The middle element of the first half of the file is now examined i.e. key value **B** which also proves to be the wrong item. Therefore items **A**, and **B** and are also ignored as **B** falls before **C**. Finally the required item **C** is located. It is therefore noted that in comparison with the item by item search, the binary search is quite efficient. A file of 5000 items that requires a tenth-of -a-second search for each key comparison can be searched in approximately 1.23 seconds. This a tremendous improvement over the 8.33 minutes that were required for a complete linear search and the 4.17 minutes that were required on the average for a linear search. However, in information retrieval many searches are not conducted for specific items of known key values. Moreover, the unique key values that are used to identify the records in an ordered sequential file are sometimes difficult to specify in a search request. Rather, items must be located that appear meaningful in some sense to particular requests. Several different keys are therefore specified to identify potential relevant items, and simple binary searches may no longer prove to be useful in these circumstances.

7.5.3 Inverted Files

Another method to speed up the search for information is to utilize an index which provides access to portions of a file. An index may be constructed by using the first letter of an author's surname for an ordered sequential file. This index will identify the location of records that correspond to the first letter of a particular surname. In **Figure 7.4** it will be noticed that the authors whose surname starts with **T** appear at location number **K**.

location number	AUTHOR	TITLE	TOPIC
1	**Artandi**	An introduction to computers in information science	computer information retrieval
2	**Avril**	Computer data processing	computer data processing
. . .			
i	**Broom**	Data management & file processing	computer data file processing
j	**Simpson**	microcomputers in library automation	microcomputer library automation
k	**Taggart**	Information systems: an introduction to computers	information systems computers
. . .			
n-1	**Wessel**	computer-aided information retrieval	computer information retrieval
n	**Williams**	computerized systems in information services	computer information retrieval

Figure 7.4 : An Ordered Sequential File

Figure 7.5 shows an index that has been constructed for the sequential file in **Figure 7.4:**

A	**1**
B	**i**
.	
.	
.	
T	**j**
.	
.	
.	
W	**n-1**

Figure 7.5 : An Index to a Sequential File

It is possible to use the index to easily find the storage location of records with authors' surnames beginning with a given letter as the search for a particular record now only requires the search of the index and a search of that portion of the file indicated by the index. The number of steps needed on the average to find a specific item is reduced to the number of steps required to search the index, plus (n+1)/2 additional steps for the sequential subfile where **n** is the number of records in that specific sequential segment.

In a sequential file of 50000 records a search for a particular record will require (n+1)/2 or 250,001 steps on the average. Assuming an index file is used and the average number of records in a sub-file beginning with the author's surname is 3125, then the following steps would apply. As the index would then normally consist of 26 entries i.e. one for each letter of the alphabet, the search will then require (26+1)/2 steps to search the index plus (3125+1)/2 steps to search the appropriate records beginning with the given letter, or 1577 steps altogether. The index has facilitated the reduction of the steps by a factor of 16. If the time taken to examine each item was one-tenth-of-a-second, then 2.62 minutes would be utilized for the search. A binary search would further reduce the search time to approximately 1.7 seconds on the average for an indexed sequential file of 50000 items. Indexes are important for computer disk storage as the disk only permits rapid access to consecutive records, but not access to particular regions of the disk. The index may then be used to locate the particular region of the disk which contains the appropriate record for a given query. These records can then be scanned sequentially in contrast to a binary search which requires multiple probes to various parts of the file. When new records are added to the indexed file, both the file and the index must be changed. This major disadvantage becomes less significant if the search process is important and the file has to be updated at infrequent intervals.

If a record carries additional keys such as the authors' surnames as well as selected words from the title that may also be used to gain access to the given record, the index for a single key must be extended to include all the appropriate record keys. An index structure must then be built that would include every value for each key for the records in the file. If several items on each record are part of lists, it may be more effective to extend the idea of the list to set up an index of the different characteristics and start pointers from this list. The data items themselves may be removed from the records on this list because the fact the record is in the list specifies that the data item applies to that record. A non-inverted file can be accessed only through the record key. The individual characteristics could be found only by examining all the records on the file as is indicated in the following figure:

```
        entry based on key  characteristics

----+---+---+---+---+---+---+
key | A | B | C | D | E | F |
----+---+---+---+---+---+---+
 01 |   |   |   |   |   |   |
    +---+---+---+---+---+---+
 02 |   |   |   |   |   |   |
    +---+---+---+---+---+---+
 03 |   |   |   |   |   |   | Fig. 7.6
    +---+---+---+---+---+---+
 04 |   |   |   |   |   |   | A Non-
    +---+---+---+---+---+---+ inverted
 05 |   |   |   |   |   |   | File
----+---+---+---+---+---+---+
```

The inverted file on the other hand approaches the file through the characteristics. This inverts the file to make inquiry access available by characteristics:

```
        entry based on characteristics

----+---+---+---+---+---+
key | 01| 02| 03| 04| 05|
----+---+---+---+---+---+
  A |   |   |   |   |   |
    +---+---+---+---+---+
  B |   |   |   |   |   |
    +---+---+---+---+---+
  C |   |   |   |   |   |
    +---+---+---+---+---+
  D |   |   |   |   |   |
    +---+---+---+---+---+      Fig. 7.7
  E |   |   |   |   |   |
    +---+---+---+---+---+      An Inverted
  F |   |   |   |   |   |      File
----+---+---+---+---+---+
        characteristics
```

A fully inverted file is one in which all data items are in an index. In other words the indexing is by content. The inverted file ensures quick access to the information items because only the index is examined to determine those items which satisfy the search query, rather than the actual file of items. Each data item in the index has a list of pointers to records which have that characteristic. The records themselves do not have pointers because these are found in the index (4, p364). As the inverted index would constitute a file of considerable size, it would be advantageous to build an index to the index to increase the efficiency of the index search. Davis (4 p364) states that as the fully inverted file makes every data item available as a key for information retrieval, it is excellent for information retrieval, especially in cases where the data retrieval requirements cannot be specified in advance.

7.6 NEED FOR THE CREATION OF A DATABASE

The objectives of a file organization are to provide a means for locating records for processing, selection or retrieval and to facilitate file creation and maintenance. Loomis (14, p440) states that a file oriented data processing system is one in which data files are designed to support the processing requirements of application programs. However, with file processing, each file is considered to exist independently (12, p2). The typical approach to file design has been to set up a separate file for each data processing application or task. While this provides a satisfactory file for that specific application, it nevertheless leads to the creation of several files with the same or similar data which must be separately maintained and which are not necessarily compatible. This arrangement of data files makes it difficult to obtain an answer to any enquiry which crosses the lines between the application and it also makes it difficult to correlate and integrate data across application programs. The ability of information systems to respond effectively to requests that cross traditional file and application boundaries is becoming increasingly important (14, p441). Loomis (14, p440) supports the notion that data duplication is not "attractive" as it causes update inconsistency problems as well as wasting storage space.

An approach to avoid the problems of update inconsistencies and integration difficulties that is encountered with file orientation is to adopt a database orientation (9, p441). This view is supported by Davis (4, p349) who is of the opinion that an alternative solution is an organization-wide data file or database as it is commonly known. Kroenke (12, p1) is of the opinion that database processing is more economical and the users of the database can be more efficient and effective, as more can be accomplished within a fixed period of time. He also states that database processing enables more information to be produced from a given amount of data, for data is merely recorded facts or figures while information is knowledge gained by the processing of this data (12, p3). A database is a collection of logically related data that supports shared access by multiple users and is protected and maintained in order to retain its value over a given period of time. Whereas a file contains data about one type of entity e.g. book titles, a database will contain data about multiple types of entities e.g. authors, subjects etc, and information about how the entities are logically related to each other. Data is integrated and multiple access paths are provided through the data. The database records can be processed in a wide variety of ways as records can be accessed sequentially within a file, randomly by a value or field or by relationship to other records (12, p12).

Database technology allows the library data to be processed as an integrated whole, thus reducing artificiality imposed by separate files for separate applications. This results in the elimination or reduction of data duplication. This elimination of duplication saves file space and to some extent can reduce processing requirements (12, p3). The most serious problem of data duplication is that it can lead to a lack of data integrity. If author data is recorded in two files, it is possible to change the data in one file but not in the other, thus data items disagree with one another. Substantial design work is necessary in file organizations utilizing the database approach (4, p349). This work includes the making of a central definition of all data to be stored, processed or retrieved and also the organization of data so that it can be used for both routine production runs e.g. the printing of book catalogues and also for enquiries.

An important tool for implementing the database orientation is a database management system (**DBMS**). The **DBMS** acts as an interface between application programs and the data that they process as indicated in the following figure:

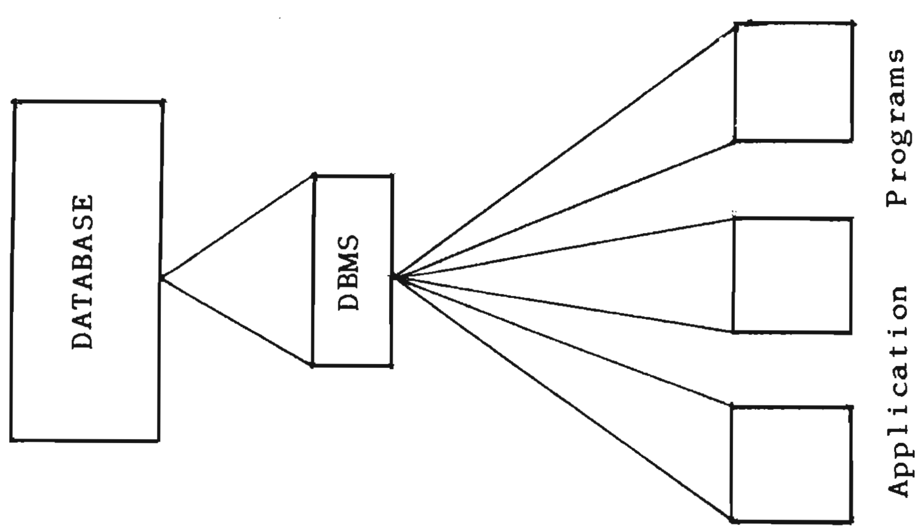

Figure 7.8 : A Database Management System

A DBMS provides the facilities for defining, representing and storing data so that they can be accessed later, as well as organizing the data so that they can be selectively and efficiently accessed (14, p442).

In conclusion the objective of data based systems are user-oriented and the files are therefore structured to increase user control over the "creation of, maintenance of, and access to data" (4, p349). Databases require large storage capacities and the trend in file design in advanced data processing systems is to a hierarchy of storage devices (4, p350). The hierarchy of devices allows the system to take advantage of each hierarchy and yet provide extensive storage.

7.7 IMPLICATIONS FOR THE LIBRARY RESOURCE CENTRE

In **Chapter Four** it was indicated that the information retrieval needs of the Education Department (House of Delegates) was not complex. It was expected by the Department that the current system of cataloguing and key cards would provide an adequate means or method to realize the objectives of the Education Department in this regard. These objectives may be summarized as follows:

* the location of a book by author.
* the location of a book by title.
* the location of a book by subject.
* the availability of non-book media on a particular subject.

While precedents have indicated that sophisticated computer technology could meet all these objectives, in the school library resource centre various restrictions had to be considered. The primary constraint was economics. The "per school" cost factor of installing a computer system is comparatively low while the total cost factor to the Department could be very high. If on the average the cost of providing conventional (minicomputers) computerized information retrieval services amounted to fifty thousand rands, then the total cost of providing the services to all 136 secondary schools would run into millions of Rand.

The increasing capabilities of microcomputers, together with the decreasing cost, have seen their introduction in secondary schools for both computer literacy and computer studies.

This is in keeping with Falk's (6, p7) observation that microcomputers are rapidly moving into every area of application where large computers were previously used. All secondary schools in Indian Education are provided with IBM compatible microcomputers with at least one 40 megabyte hard drive. This provides a cost effective solution to budgetary constraints of allocating computers in the library. Thus, this computer system could be advantageously used in the library on an interim basis. This is in line with Falk's (6, p7) view that microcomputers seem to be ideal vehicles for the storage and retrieval of information. Moreover, the microcomputer system would offer students in the library resource centre a more effective facility to retrieve information through multiple access points. These multiple access points far supersedes the Department's requirements for information retrieval.

7.7.1 Indexing Language

In the sixties Maron and Kuhns pinpointed a major problem associated with information retrieval and this was the identification of the contents of documents (quoted by 6, p1). Harter (9, p22) rightly states that information retrieval relies on language to carry out three major functions viz. language is to represent the content of the document; the information problems of the user are represented in terms of language and language is also used to interact with the computer to carry out search and retrieval functions. He concludes (9, p24) that careful consideration of the vocabulary used to represent a search problem or topic is "crucial for information retrieval". Thus an important prerequisite for computerized information retrieval in the school library resource centre is the assigning of appropriate labels or tags to documents in order to facilitate the searching of files.

The school librarian has a choice between the use of a natural language or a controlled vocabulary for the development of an indexing language. It may appear that a natural language index would be appropriate for school library resource centres as it easy to construct and implement and further, should pose no problem for the student. However, on closer examination many problems become apparent.

Indian secondary schools are located in three of the four provinces viz. Natal, Transvaal and the Cape Province. Whereas Natal students speak English exclusively, the students in the Cape and the Transvaal feel more comfortable speaking Afrikaans. This preference for language usage creates obvious problems. There is also a strange application of regionalized terminology for specific items e.g. in Natal a cold drink is referred to as "mineral", in Transvaal it is a "cool-drink", and in the Cape it is a "soft-drink". Natal students would request for a "tumbler" of water while Transvaalers ask for a "glass" of water. Students in Natal enjoy Simba "chips" and Transvaal students enjoy Simba "crisps". These differences in the expression of items and ideas become evident and problematic with the movement of both teachers and students from one Province to another. It is a condition of appointment that Indian teachers may be transferred to any school in any of the three aforementioned Provinces as the need arises. Teachers may also request for transfers to other schools in the Provinces because of personal reasons. For various reasons student movement also takes place.

From the foregoing it becomes apparent that these transferred teachers and students will be disadvantaged in their search for information as far as natural language usage is concerned. Harter (9, p31) states that if a search formulation is constructed such that it fails to include all relevant synonyms for the concept, some information items may not be retrieved. The words and phrases used in the formulation of the requests will not match some of the words and phrases that describe the concept in the database e.g. "wireless" "radio" and "hi-fi". Moreover in natural language there are many ways to describe a given object or idea. In order to locate as many items as possible on a given request it becomes necessary to anticipate all possible words and phrases that might be used to express the request.

Harter (9, p41) is of the opinion that the use of a controlled vocabulary for information retrieval can solve these problems to a large degree. A simple form of vocabulary control is the use of descriptors as listed and described in a thesaurus (9, p42). This is a controlled vocabulary that is usually derived from a dynamic growing document collection. Many of the problems associated with natural language i.e. homographs, synonyms etc are negated by the structure of the thesaurus as the functions of the thesaurus are to define and list both valid and invalid elements of the vocabulary and also to reveal the relationships among the valid terms. Harter (9, p57) advocates the use a controlled vocabulary if the information seeker "wants to carry out a limited search that retrieves a few, highly useful items, and excludes the retrieval of peripheral materials. This advice is relevant in terms of the information retrieval requirements of the Education Department.

7.7.2 Bibliographic Databases

Bibliographic databases contain representations of existing sources of data, information or knowledge and they refer the user to other more complete sources (9, p6). In other words the records in bibliographic databases contain facts about the intellectual content and physical characteristics of the information item. Bibliographic records are comprised of data fields and subfields and each field or subfield would represent a specific attribute or characteristic. The characteristics that are selected for representation are those thought to be of greatest potential use for the solution of the user's information problems. The fields that convey subject information would include author names, titles, subject headings and descriptors. It is apparent that the bibliographic database would ideally accommodate the Department's requirements for information retrieval in school library resource centres.

Of the three database file structures (linear, ordered sequential and inverted files) described in **section 7.4** it would appear that the inverted file structure would suit a bibliographic database for school library resource centres. The linear list would be unacceptable especially as the response time would increase as the file size increases with the expected rapid growth of information. The ordered sequential file would also be not favoured as it would restrict the number of access points to a particular information item.

An inverted file ensures speedy access to the information items as the index alone is examined to determine those items which will satisfy the search request, rather than the actual file of items. Moreover, the index is sequentially ordered by the key values. The following example illustrates a search made of the index to locate computers in order to retrieve all the information items dealing with microcomputers and information retrieval:

ITEM	AUTHOR	TITLE	TOPIC
1	**Artandi**	An introduction to computers in information science	computers information retrieval
2	**Davis**	Computer data processing	computer data processing
3	**Loomis**	Data management & file processing	computer data file processing
4	**Simpson**	microcomputers in library automation	microcomputer library automation
5	**Taggart**	Information systems: an introduction to computers	information systems computers

Figure 7.9 : A Sequentially Ordered File

Related Information Items

computers	1	2	3		5
information	1				5
retrieval	1				
data		2	3		
library				4	
microcomput.				4	

Topic

Figure 7.10 : An Inverted File indicating Related Information Items

In order to locate all the information items dealing with this topic, a search is made of the index to locate "microcomputers" and "information retrieval". Items 1, 4 and 5 are then identified as resources for retrieval in the example in **Figure 7.10.** Individual records do not have to be examined to determine their actual key values, because that information is already contained in the index.

The addition of new items to the file is time-consuming as the new item must be placed not only in the main file, but the index entries relating to this item must also be updated at the same time. Nevertheless, the new resource may be placed at the end of the file or wherever convenient. The principal disadvantage of the inverted file in file updating, when new records are added to the database, is diminished because of the existing purchasing policy of the Education Department. The Education Department requires school library resource centres to purchase library materials annually and not on an as-you-need basis. The allocated amount is made in March each year and teacher-librarians are expected to place their library order immediately thereafter. Thus file updating can be done once a year when these orders have been filled.

Falk (6, p19) states that the setting up and maintenance of a computer based catalogue is a straight forward file management task that could be easily performed by a general purpose microcomputer file and database management software. There are also a number of software packages that are specially designed for maintaining library catalogues on microcomputers. Online bibliographic services provided by specialized services and book suppliers cover over 90% of all catalogued library items (6, p19). Items whose bibliographic descriptions are available from such services can be easily downloaded with available software. The MARC style records can be displayed on the microcomputer screen, edited as desired, stored in the memory and later searched and printed.

Nevertheless, for the most efficient transfer of these bibliographic records, the software should present the bibliographic records in the format normally used by the library in its cataloguing. As the available format is not what Indian school library resource centres require, (refer to **Chapter Four)** the amount of keyboard editing needed to change or correct the bibliographic details would wipe out the advantage gained by downloading. This view is supported by Falk (6, p20) who states that it might be just as easy to enter the bibliographic description from "scratch", directly from the item itself. He is of the opinion that a possible solution is the modification of the software application program. However, this suggestion is not entirely valid as this modification may introduce bugs into the other functions of the package.

The most accurate way to catalogue the items is through a prepared display format, a fill-in-the-blanks screen, that provides a space for each descriptive item that the library resource centre intends to catalogue (6, p20).

While it is desirable to have multiple terminals to accommodate concurrent users, security considerations are important. The primary security concern is that students and teachers who access catalogue information, should not be able, even accidently, to alter the catalogue file. Falk (6, p21) rightly concludes that only authorized personnel who are adding to or revising catalogue records should be allowed to write into the catalogue files. This is easily achieved by limiting access to these files by way of confidential passwords in order to gain writing-access. In concurrent use of these files data collision can occur and records can be defaced or destroyed. These concurrent-user collisions can be handled by software locking procedures that are built into the system (6, p22).

In the school library resource centre costs would preclude the provision of multiple terminals for student use The existing size of the school library resource centre also mitigates against multiple terminals. The queing for access to a terminal by students and staff could be minimized by the provision of multiple hardcopies of the catalogue file.

7.8 CONCLUSION

The information retrieval environment is complex and it is necessary for the teacher-librarian to understand the context in which information retrieval systems operate and be **au fait** with the various types of existing information systems. Information growth has resulted in the need for sophisticated technology to cope with increasing storage and retrieval problems. Large economically viable libraries have made use of expensive computer and software facilities to contain and harness these problems. The rapid "leap-frog" development of microcomputer technology and a corresponding reduction in production costs has offered the smaller budget conscious library resource centre an alternative cost-effective solution to the dilemma. Nevertheless, the microcomputer still has limitations especially in regard to the handling of bibliographic files for information retrieval as these files tend to be extremely large. A solution to this dilema is to structure the files in such way so as to facilitate the most efficient manipulation of these files by the microcomputer. The rapid growth in the holdings of the school library resource centre will naturally result in larger bibliographic files which need to be manipulated by microcomputers that have limitations in terms of speed, memory and storage capacity as compared to the larger mini and main frame computers. This places a greater responsibility on the teacher-librarian to become **au fait** with relevant newer analytical methods as well as the extent and limitations of microcomputer technology.

Files for the storage of data can be structured in various ways e.g. linear files, ordered sequential files and inverted files. Differences in the organisation of files used for information retrieval play a major role in the retrieval process as this organisation influences the efficiency of the search and retrieval. The teacher-librarian has the option of selecting that file structure which would cater for the storage and speedy retrieval of data. This selection would be influenced by the relative file's ability to efficiently store the data to allow for its subsequent retrieval in an acceptable response time. These files then have to be organised into a database which caters for the integration of the files. This integration of files will support both easier access and multiple access to information items in the school library resource centre. Unnecessary duplication of the files is also avoided. Through a database management system (DBMS) the database offers the teacher-librarian added opportunities to manipulate files for information retrieval. An inverted file structure appears to be eminently suitable for a bibliographic database in the school library resource centre as the inverted file ensures speeder access to the information items as compared to the linear list where the response time is increased as additional items are added to the file. Furthermore, the increased access points offered by the inverted file as compared to the ordered sequential file, supersedes the Education Department's requirements for access points to documents in the library resource centre Computerisation makes it is possible to efficiently and speedily retrieve items by a larger number of specified terms than just by author, title and subject.

The existing system of information retrieval in the school library resource centre may be subject to criticism as it does not by all account provide for the speedy and effective answers to the questions posed in sections 4.3.1 to 4.3.3. These questions which may be summarised as:

* the location of a book by author,
* the location of a book by title,
* the location of a book by subject,
* the availability of non-book media on a particular subject,

impose the least demands on an information retrieval system. The problem is further compounded by a lack of standardization of the card catalogue in the school library resource centre. The problems of standardization can be minimised, if not avoided altogether, by the utilisation of a singular software application package by all the library resource centres in Indian secondary schools.

The need to assign appropriate labels or tags to documents is a primary consideration in these resource centres because of the particular preference of language by the users. The differences in the preference of terms for items underline the need for a controlled vocabulary for information retrieval as a possible solution to the problems posed by language. A controlled vocabulary or thesaurus lists both valid and invalid elements of the vocabulary as well as revealing the relationship among the valid terms, thereby providing a possible answer to the language problem of indexing in the school library resource centre.

The teacher-librarian also has a choice in the selection of an index language as a means to convert the information data into acceptable terms for manipulation by the microcomputer. The choice of an indexing language must be seen against the utilization of the retrieval services by all the pupils in all the secondary schools regardless of regional location. With this broad view in mind the selection of a controlled vocabulary will minimize the likelihood of information items in a search being missed due to the language preferences of pupils.

Conversion of the card catalogue in the school library resource centre can be facilitated through a prepared display format i.e. a fill-in-the-blank-screen, that is available on software packages that are specially designed for maintaining library catalogues on microcomputers.

Finally, computers are already playing an important role in many library and information situations, and Doyle suggests that librarians, educators, engineers and others engaged in the information field should acquire a basic common source of knowledge that would enable them to develop workable solutions jointly (6, p166). In this regard, teacher-librarians in particular, would need a level of intellectual and technical briefing that would help them to harness microcomputer technology for the library resource centre. They should not only react to what is proposed by others, but should also actively and critically investigate opportunities to computerise their own service functions.

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CHAPTER EIGHT

8. A CONCEPTUAL FRAMEWORK FOR MICROCOMPUTER INFORMATION RETRIEVAL IN THE LIBRARY RESOURCE CENTRE

8.1 INTRODUCTION

This chapter is intended to provide a framework that can be used by Indian secondary school library resource centres that plan to provide computerized information retrieval facilities. The results of the questionnaire and the historical background presented in earlier chapters, as well as the considerations of microcomputer and information science concepts outlined, form the basis for the framework developed in this chapter. The traditional library in these schools has developed into the present day library resource centre. It is envisaged by the Education Department that these library resource centres provide a multifarious service. Both the informational and recreational needs of the students and staff are considered. The library resource centre stocks a variety of media including fiction and non-fiction books, periodicals, audio-media, videocassettes, charts, transparencies, project files, newspaper cuttings and slides to cater for these needs. In providing this framework for planning it must be noted that these guidelines do not offer specific answers, but rather raise a number of considerations and suggest a sequence of action that must be ensue if it is decided to institute microcomputer based information retrieval. The general considerations presented in this chapter will need modification to suit local circumstances on timing, budget requirements, publicity etc., since they are directed toward Indian school libraries in general and not toward individual schools.

Keenan (14, p1) identified three universal phases in the establishment of computerised information retrieval services viz:

* planning phase
* implementation phase
* operational phase

These phases may be incorporated into a systems model that will illustrate the relationship between the various factors that make up the model:

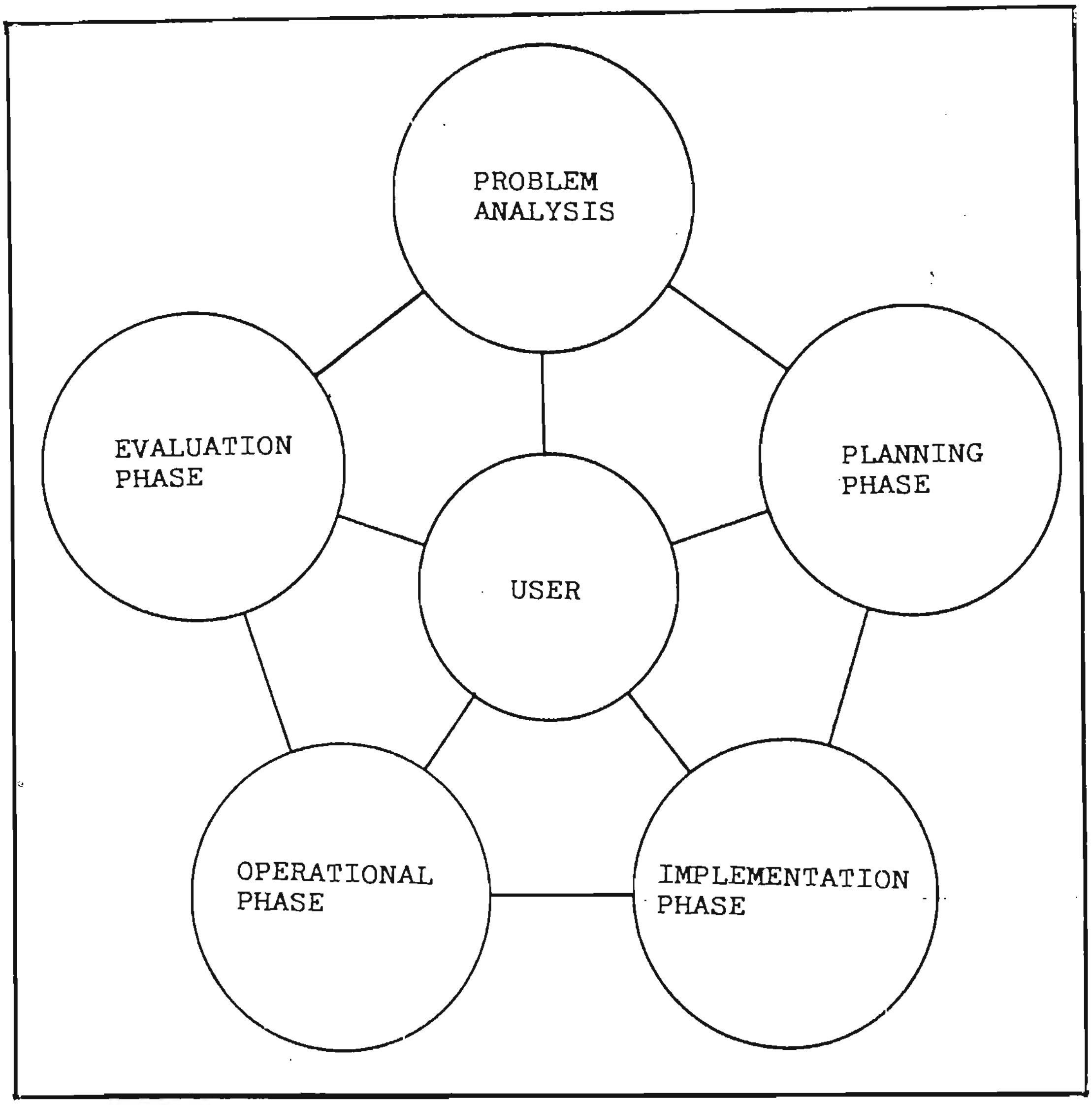


Figure 8.1 : A Systems Model for Information Retrieval

The planning phase will be preceded by an analysis of the problems of information retrieval as currently experienced or will be experienced in the future by the library resource centre. These problems will centre around the growth of information and the expectancy of the users in terms of improved retrieval of the information resources. The analysis should reveal any shortcomings in the applicable procedures that are followed, and a needs assessment of the users would indicate their preference for a more effective information retrieval system.

In the planning phase the teacher-librarian centre has to decide on the type and scope of information retrieval service that the library resource centre wishes to provide. These ideas should be discussed with the school library committee for approval. Once the Library Services of the Education Department has been informed of the intention to offer a computerised information retrieval service the teacher-librarian has to decide on various factors that would affect the implementation of this decision. These factors would include inter-alia: establishment of objectives, hardware, software, databases, staff selection and training, publicity and promotion of the service, environment, manuals, stationery, costs, funding etc. Keenan (14, p3) believes that the new service must be seen as a valuable extension of the existing services and resources already provided and the staff must be made aware of the probable impact of the new service and its capabilities. She states further that the new service will only succeed if the whole staff is aware of the service and management is fully committed to its aims.

The implementation phase, which follows on the planning phase would show in detail the sequence of events that takes place within a specified period (14, p4). The equipment that is selected must be ordered, installed and tested. Discussions concerning the quality of service in terms of the system that is selected, maintenance contracts and support tools must be initiated.

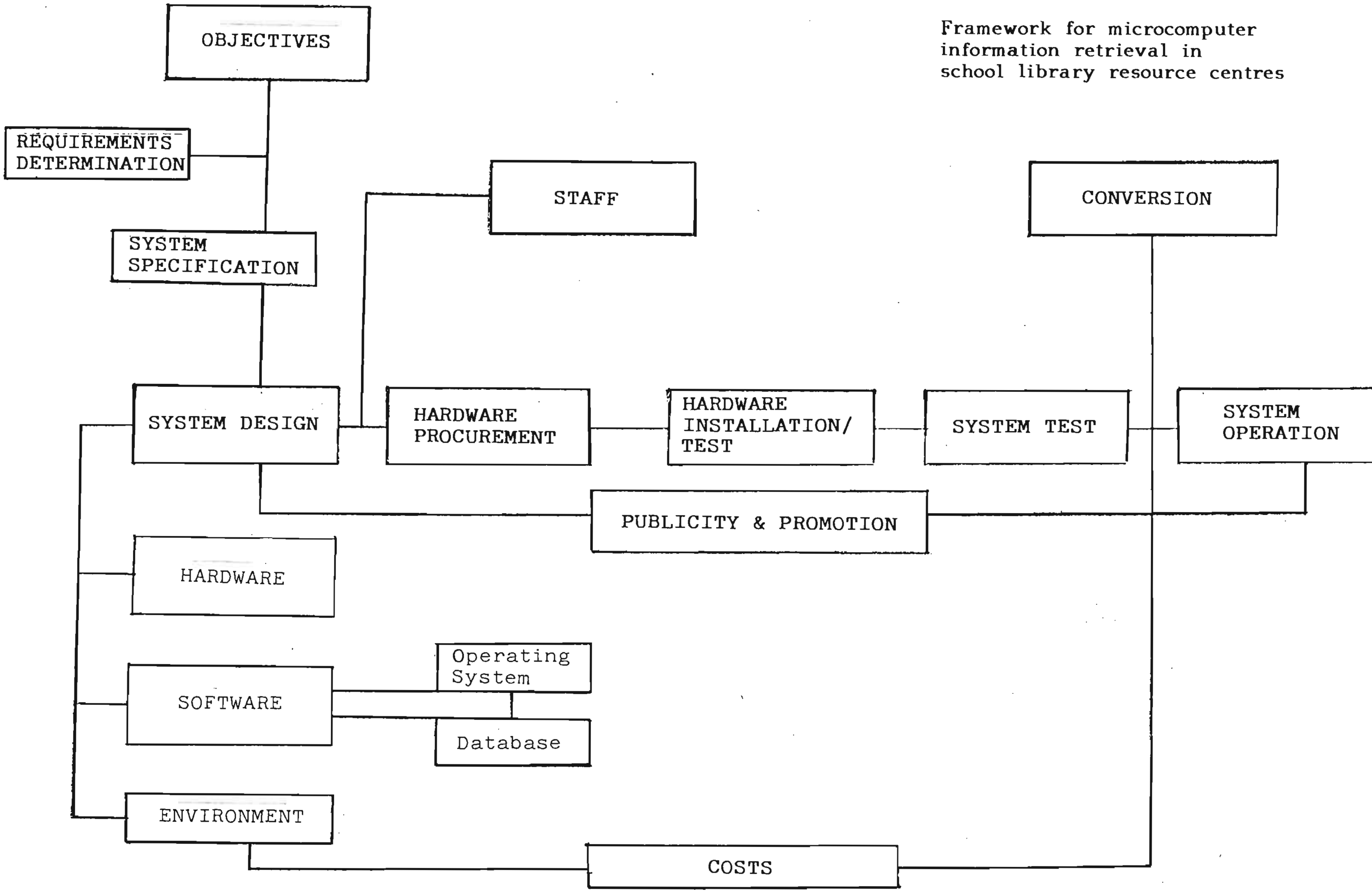
The operational phase will be closely linked to the evaluation phase. Consideration must be given to assessing or evaluating the information retrieval service in terms of effectiveness, user requirements etc. Underpinning all these phases is user satisfaction in the service, and if at any one of the phases it becomes apparent that user requirements are undermined, then corrective action must be taken to rectify the problem. The trouble could be an incorrect analysis of the problem, inadequate planning, unsuitable objectives, improper implementation etc.

8.2 PLANNING PHASE

The planning phase would involve the working out in broad outline the things that need to be done and the method for doing them to accomplish the objectives set for the computerisation of the information retrieval function. Planning would serve to form the foundation of an efficient, economical, and effective service. The planning phase lends itself to the development of a model or framework for the institution of microcomputer based information retrieval. Lefkovitz's model (16, p183) has been adapted to suit an information system implementation process in the school library resource centre. This model had to adapted, as it presupposes a large library information system with its own budget. The Indian school library resource centre, on the other hand, caters for a limited number of patrons (the average student population in Indian secondary schools is under 1000 students) and operates on a limited budget which may or may not be supplemented by the Education Department.

Fig. 8.2

Framework for microcomputer information retrieval in school library resource centres



The planning phase is identified as that phase which starts with the initial conception of the new facility and its place in the structure of the services offered by the library resource centre. Keenan (14, p3) suggests that it would be necessary to establish a planning team made up of senior staff members who would operate as a management group for the new service. In the Indian school library resource centre this team would include either the principal or the senior deputy principal of the school, the teacher librarian, a senior computer studies teacher and additional heads of department who are sympathetic towards the establishment of microcomputers for information retrieval. This management team should engage in a preliminary study or systems analysis of the context in which the system is to be used. Systems analysis is aimed at describing and formalising the system in which the advantages of the microcomputer may be optimally utilised to achieve the tasks which the system is required to perform (10, p11). Woods and Phillips (39, p11) argue that the responsibility for setting up a new automated system in the library should rest on a systems analysist. While this argument is sound it may not be feasible in the school library resource centre for various reasons. This task could probably be adequately shouldered by the teacher-librarian who would be aware of the information retrieval requirements of the system and the senior computer studies teacher who would understand the system's capabilities.

Two fundamental priorities need the attention of the management team. System objectives must be established so that the aims of the school library resource centre may be successfully accomplished. Secondly, specific tasks which the system is required to perform must be detailed.

8.2.1 Systems Objectives

The school library resource centre provides a service to a specified set of users i.e. the staff and the students of the school. Henley (10, p13) is of the opinion that unless the library provides the kind of service demanded by its clientele it loses its "ratio essendi". In other words the library system must give priority to user orientation and needs. Henley (10, p13) claims that one of the chief advantages of a computer-based system is that it makes the creation of a user orientated service even easier, and introduces a dynamic element which enables the user to assist in tailoring the system to his own particular needs. In this regard King (quoted by 4p, 13) summarized the advantages of the use of the computer as "focusing of the services of the library on the individual user for the optimal satisfaction of ... needs". He concludes that a computerised system should place the full resources of the library at the "immediate disposal" of the user. It is clearly evident that the paramount system objective which computerisation sets out to achieve are the objectives of the user. In this regard two distinct groups as users of the system may be defined viz. the students and the teachers who require the services of the system and the library staff who control the system and enter new information. Each of these groups will have different requirements and consequently will expect the system to perform different tasks. Henley (10, p13), nevertheless states that their opinion of the system will depend on similar factors. It would be expected that the computerised system would achieve improved standards of performance or perform functions not possible with a conventional system. While computerisation may not significantly improve the standard of many existing library facilities, it nevertheless injects into the system a desirable "consistency and accuracy when masses of information are to be stored, arranged and retrieved" (10, p13).

Henley (10, p14) identified four desirable requirements from a computerised service:

* elimination of the drudgery of pure clerical work. The computer must lighten the load of the library staff and not merely shift it into another direction.
* elimination of errors. The detection of errors is crucial to the system.
* consistency. Inconsistencies within the system must be detected and eliminated.
* speed of response to queries. The computer should access files more quickly thus providing an improved service in terms of the speed involved in satisfying requests.

8.2.1.1 Library User Requirements

Users of the school library resource centre are the staff of the school and the students. While each of these groups will expect a different kind of service from the resource centre, information retrieval will be common to both groups. Users expect the information they seek to be readily accessible and that the library provides aids to assist them in locating this information. Thus accessions to the system must be classified in such a way so as to ensure that the user can find them if they are relevant to his requests for information. The school library resource centres now classifies these resources according to the 11th abridged edition of the Dewey Decimal Classification system and uses the Concise AACR2 rules to catalogue the items.

The teachers on the staff may also be concerned about recent information in their field and as such may additionally require a current awareness service. Whatever method or technique is used to allow the computer to match users's requests for information can also be used to provide an SDI (selected dissemination of information) service on a permanent basis to the staff.

8.2.1.2 Library Staff Requirements

Library staff would expect a computer based system to decrease and not increase their work load. Information has to be punched in once into the computer in order to produce different lists and also to produce catalogue cards as necessary. The computer also allows the catalogue to be accessed through computer orientated files. The storage of information in the system thus allows a greater part of the traditional functions of the library staff to be managed by the computer.

8.2.2 Requirements Determination

As the primary objective of the computerisation process is to provide a more effective and efficient retrieval service, it is necessary to establish the exact extent of the service. A thorough examination of the Education Department's prerequisite for an information retrieval system in the school library resource centre will be the point of departure for determining requirements.

A bibliographic information retrieval system that can be accessed through author, title and subject headings is specified by the Education Department, and this would be the minimum access points in a computerised information retrieval system. The required system of key cards could be replaced by a controlled index vocabulary. From the users' point of view a suitable response time must constitute the system, with a minimum time lag between the request for bibliographic information and the delivery of such information. Falk (5, p22) states that the maximum tolerable response time is about two to three seconds. The program should provide for easy browsing through the catalogue and also provide for queries based on combinations of record characteristics (9, p23) The program must also support various screen displays and printed lists including author, title and subject lists, and printed forms of the catalogues that may be used when access to the computer is not available.

An over-riding factor that must be constantly borne in mind is the user friendliness of the system. The user must not be intimidated by the system, for the success or failure of the computerisation project will ultimately depend on the users' acceptance of the system.

8.2.3 Systems Specification

Systems specification will specify all the functions that the new system must perform in such a way that all of the requirements will be satisfactorily met (16, p182). If it is apparent that the system will be expensive Lefkovitz (16, p182) suggests that it would be advisable to generate a series of systems specifications with different performance levels. A cost/performance analysis could be sanctioned to help the management team to decide on the most appropriate specification for the given requirements.

8.2.4 Systems Design

Systems design will be influenced by a variety of factors including systems requirements, hardware considerations, available software and environment. The design of the system will take cognisance of the available technology and possible future enhancements as well as future requirements.

8.2.4.1 Hardware

Careful thought must be given to the equipment and programs necessary to implement the system, and the problems peculiar to the particular application under consideration

(10, p19). This view is supported by Keenan (14, p24) who states that equipment selection must be linked to perceived needs. It is important to realize the different capabilities of different microcomputers (37, p33). The smaller microcomputers may not support the sophisticated complexities expected of the larger machines. Woods and Pope (37, p33) emphasize the need for libraries to develop or select microcomputers that meet their individual needs. They add that it is essential to establish whether the specific microcomputer and its peripherals will support the capabilities desired. Thus in order to make appropriate choices it is imperative that the management team accepts the responsibility of knowing what the various systems can and cannot achieve. A wider range of peripheral equipment is available for microcomputers as compared to mini and mainframe computers. This is mainly because the architecture of microcomputers make it easier to connect the peripherals. The equipment used must be compatible in order that all the peripheral components e.g. printer, monitor etc can be used in conjunction. If the equipment already installed in the school is to be used in conjunction with other equipment that has to be purchased, compatibility must be considered.

The library environment imposes peculiar restrictions upon the system. Large files of information will need to be stored and retrieved at frequent intervals. Random access is thus necessary because of the time taken to carry out input/output operations, and the delay in scanning the large file of records. This therefore makes it possible to go directly to a file or set of files once it has been established whereabouts on the storage device the files are kept, unlike magnetic tape, where a whole set of files have to be read in order to locate a single item.

Another problem imposed by library applications is the need of library staff to consult, add or delete files at the same time that the library user is working with the system. While the need for multiple accessing to accommodate concurrent user becomes evident, security considerations are important. The primary security concern is that students and teachers who access the bibliographic information, should not be able, even accidently, to alter the catalogue file. Falk (5, p21) rightly maintains that only authorized personnel who are adding to, or revising catalogue records should be able to write into the catalogue records. This can be achieved by limiting access to these files by way of confidential pass-words in order to gain writing-access. While this may be primarily a software function the design of the system must enhance this facility. Burton (2, p46) states that the rapid pace of microcomputer development had produced a bewildering array of systems and suggests that a basic microcomputer system be purchased and added to as the need arises rather than buying the biggest system that could be afforded. The following basic microcomputer configuration in **Figure 8.3** will be evident in the application for information retrieval in a library resource centre :

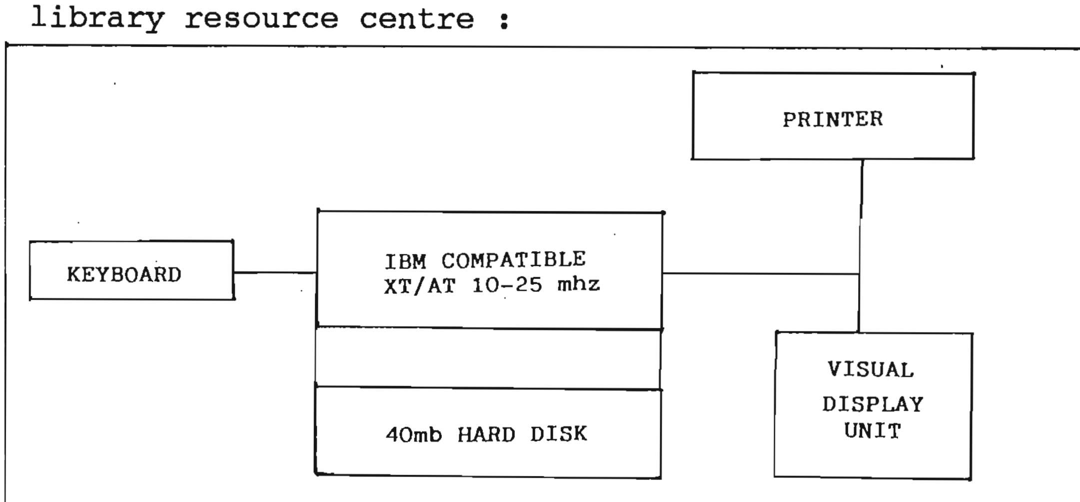


Figure 8.3 : A Basic Hardware Configuration

8.2.4.1.1 Hardware Configuration

The system configuration and computer size that is most suitable for a particular library will depend on the volume of transaction activity (37, p34). Peak loads must be considered at the initial phase as the software developed for a particular microcomputer may not be transferable to a larger system when the need arises (37, p34).

School library resource centres that are considering installing a bibliographic information retrieval system on a microcomputer will need to choose the following basic equipment : central processing unit, hard disk, printer and visual display unit.

8.2.4.1.2 Central Processing Units

Sanders (28, p161) is of the opinion that the heart of any computer hardware system is its processor unit. A number of factors determine the performance characteristics of all microcomputer systems. The microprocessor chip design will determine the data handling and addressing capability of the system (28, p274). In general, a 16 bit microprocessor will be faster than an 8 bit microprocessor.

The instruction and execution cycles are synchronized by a specific number of electric pulses that are produced by an electronic clock that is built into the processor. The speed of the clock is directly related to the speed with which an instruction is executed. According to Sanders (28, p177) most microcomputers function between 2 to 16mhz while the newer chips can operate up to 25mhz. While microcomputers come in many shapes and sizes the 16 bit microcomputers are built around a few popular microprocessors e.g. Zilog's Z8000 and the Intel 8088. It would be advisable to select a microcomputer that contains a chip that has been tried and tested in the market. The IBM PC which is considered as a standard, uses an Intel 8088 chip.

The memory capacity of most microcomputers are either 256K, 512K or 640K. If desired this primary memory can be increased to 8mb by using the bank-switched memory technique. Processing speeds are enhanced if more data and program segments can be kept in primary storage. Thus it is sound to choose the microcomputer system with the highest memory capacity. However, the best way of establishing these points is by locating other users and ascertaining whether they are satisfied with the performance of a particular processing unit.

8.2.4.1.3 Hard Disks

Disk storage is a necessary supplement to the internal core storage when very large files have to be manipulated. Information retrieval systems which supports the indexing and search of very large files involve repeated data transfers between disk storage and internal computer store storage where the processing takes place. (20, p109). Heeks (9, p97) rightly states that a most important point is to ensure that there is adequate space for all the records. Therefore, due considerations must be given to future increases of the records in terms of record storage.

An examination of randomly selected catalogue cards in the school library resource centre will indicate that an allocation of two hundred bytes will be more than sufficient to cater for the total number of characters that are found on a bibliographic card in the library resource centre. As a kilobyte is approximately 1000 bytes (1024 bytes) or about five catalogue cards, one megabyte will be equivalent to approximately 5000 catalogue cards. A 40 megabyte hard disk will translate into approximately 200000 catalogue cards. However, Woods and Pope (37, p35) state that the indexes required to support typical library access to bibliographic information would also need storage. If 20 megabytes are used for the storage of indexes the balance of 20 megabytes would be sufficient for the storage of approximately 100000 catalogue cards.

In **Chapter 3** it was noted that the average bookstock of a secondary school library resource centre is currently under 6000 books. If on the average each of these books require 4 catalogue cards, then a total of 24000 cards plus an additional 6000 cards for non-book material will have to be accommodated on the database. Assuming even a high growth of 15% of the stock in the library, future needs will still be catered for in the system.

8.2.4.1.4 Visual Display Units

Visual display units or monitors are available in the popular 12 or 14 inch sizes in either monochrome or colour. It is preferable to select a monochrome monitor as the colour units are quite expensive and would normally need servicing more often than the monochrome monitors. The monochrome monitors are available in white, amber or green and personal preferences would influence their selection. Nevertheless, these units must be also tried and tested before they are selected.

8.2.4.1.5 Printers

The selection of a printer represents a compromise among three principle variables: price, speed and print quality. Speed and quality are proportional to price i.e. improved performance costs more. On the other hand speed and quality are usually inversely proportional to each other i.e. it is usual to expect good quality at low speeds and poor quality at high speeds. This is notwithstanding the developments in printer technology.

The choice of a printer would depend on various factors which would include: speed, print quality, reliability, price and noise. Speed of the printer would be determined by the volume of print traffic. In the library resource centre the major print traffic would be the printing of hardcopies of the bibliographic cards. As library purchases are executed on a yearly, rather than on a continuous basis, the computer form catalogue would be updated on a yearly basis, thus limiting the print traffic.

Advances in technology have greatly improved the quality of dot-matrix printers to such an extent that it is possible to generate near-letter quality print at a reduced price. It is generally accepted that dot matrix-printers are usually more robust and reliable than other impact printers. While all impact printers make a noise, the dot-matrix printer tends to make more noise than the other printers. Nevertheless, it is evident that a good quality dot-matix printer would adequately cater for the needs of the school library resource centre.

8.2.4.2 Software

Lodder (17, p41) states that two types of software are utilised in computerised systems i.e. systems software and applications software. Systems software controls and supervises the processing which takes place within the computer and also provides general-purpose processing capabilities. While systems software is quite complex and usually the responsibility of specialist programmers and analysists (17, p41), the teacher-librarian would nevertheless need to be more self-sufficient as he is concerned with microcomputer systems which are run on operating systems.

An operating system (OS) is an organized collection of software that controls the overall operation of a computer (28, p28). The operating system allows the systems hardware to work with the applications program. It enables the user to load application programs into primary storage and serves these programs by handling the "houeskeeping chores" required to move data. (28, p28). Sanders (28, p28) states also that it functions in many other transparent ways, unseen by the user, that makes it easier to use the system.

The selection of an OS system is relatively simple (28, p96) as microcomputer systems generally use an operating system developed by a particular software house. Of the various operating systems available e.g. Unix, Pick, PCDos/MSDos it would be advisable to select from the 'de facto' standard of PCDos/MSDos in the library resource centre for obvious reasons. This operating system is used on the widely available 16 bit micro-computers such as the IBM pcs and their compatibles. The popularity of MSDos is due to the fact it was selected by IBM for use with their earlier computers. After this selection by IBM, a very large number of other hardware manufacturers also selected it as a standard operating program. Most software vendors have followed suit and have written programs that would be supported by MSDos (28, p458).

Sanders (28, p90) classifies the applications software into two general categories i.e. custom-made programs and pre-written software packages. Custom-made programs are usually designed to meet the specific needs of individuals and/or organizations while pre-written packages typically address the processing needs of a variety of users. Two major disadvantages of custom-made programs are that they are usually expensive and may be riddled with "bugs" if the programmer is not competent.

At least four choices are available for selection as the library resource centre system:

* turnkey systems
* adopting a system from another library
* a custom-made program
* utilisation of a database management system.

A **turnkey system** is one which has been designed, programmed and tested and then offered for sale or lease by a vendor to a library, ready to be installed and operated. These packages or off-the-shelf systems usually include the required hardware, systems software and all the necessary documentation such as operating and procedure manuals. Most turnkey vendors contract to install and maintain the hardware and software, and also train the library staff to operate the system. The advantages of using a turnkey system in the library resource centre would include the immediacy of installation, while the need for designing, programming and testing would be largely obviated. One of the major disadvantages is the cost of the service. The library resource centre would be contributing towards a portion of the vendor's development and marketing costs as well the company's expected profits. Another disadvantage is that turnkey systems are designed for general rather than specific applications in order to cater for as broad a market as possible. Therefore it may have undesirable features which must be accepted by the library resource centre or on the other hand may not include desired features. This would have the effect of forcing the library resource centre of comprising on its needs. While pre-written programs may not entirely satisfy the needs of the library resource centre it is however, possible to persuade the vendors to adapt or modify the program to a degree. This means that the needs of the library resource centre would need to be adjusted to the capability of the program. The library resource centre must first identify suitable packages that will meet its processing needs. Software reviews, magazine advertisements and demonstrations will help in the identifying process.

The library resource centre could duplicate and adapt a computer based information retrieval system from another library for local installation and operation. The advantage in duplication can eliminate the costly and time consuming designing, programming and testing of the system. However, the borrowed system would reflect the idiosyncrasies of the original library which may be different from those of the school library resource centre. The library resource centre must also have the necessary expertise to adapt the applications software to its own hardware configuration.

Whereas it may appear it would be most advantageous to develop a program locally from scratch so that the system could be designed to meet the exact needs of the library, it is nevertheless most difficult and time consuming. The school library must have access to computer and systems specialists to design, program and test the installation as it is generally beyond the capability of a layman or enthusiast. A cost-effective solution is to use a reputable database management system as these systems can, and have been used for producing in-house library information retrieval systems (3, p75)

8.2.4.2.1 Database Management Systems

Software application packages that have possible utility value in information retrieval may be roughly divided into three classes: Data management systems, text retrieval systems and database management systems. Pieska (23, p208) is of the opinion that data management systems are unsuitable for library applications because of the limitations concerning the structure of the database, inadequate search capabilities and poor output facilities. She concludes that text retrieval packages as being rigid and adapt poorly to changes. This view is supported by Ashford (quoted by 14, p208). On the other hand she considers that database management packages as being flexible and more appropriate in a library environment. Sanders (28, p419) also concludes that database management packages are more flexible and more powerful than file management programs, and rank among the most popular of microcomputer software products.

Burton (2, p44) maintains that there is a great deal of suitable software available for library application and many database management programs will carry out information retrieval on suitably structured records. Falk (5, p19) also states that the setting up and maintaining a computer based catalogue is a straight forward file management task that could be easily performed by the kind of general purpose microcomputer file and database management software.

The application of microcomputer technology in the school library resource centre will of necessity involve the utilisation of a database. Woods and Pope (37, p35) point out that database files can vary tremendously in format, size and use and consequently is a major determinant of the size of the system that will be required. Larger and more complex databases need to be supported by larger computers that can support very large files with complex retrieval indexes. Nevertheless, any given system will only be able to support a maximum amount of data. Record size is determined by the number of fields to be supported and it would be advisable to keep the number of fields low even though the fields themselves may be large (37, p36). Burton (2, p44) is also of the opinion that many programs have a maximum record size and it would be necessary to consider which will allow to maintain the records required by the library resource centre. Linked to the number of records is the number of fields that the database can support. For the school library resource centre this factor should not be problematic as under ten fields would be required. A smaller number of fields require lower software overheads especially if all the fields are indexed (overhead is the proportion of internal memory that is used to store the program itself and increased overheads will result in lower available storage for data manipulation). These fields may be either fixed length or variable length. With variable length record formats the field is the exact length of the value it contains but will result in higher software overhead as the beginning and ending of each field must be identified and stored. Although fixed length fields may result in truncating it is nevertheless easier to program, and according to Woods and Pope (37, p36) microcomputers are best suited to applications that can adapt to fixed length fields.

The record structure has an influence on the selection of microcomputer systems because the record structure governs the number of fields available (37, p36). For information retrieval several of these fields are usually indexed. The database program must be able to identify each of the various elements of the record e.g. author, title, subject etc. The number of access points to the database of information is determined by the application, and for information retrieval in the school library resource centre the database record may be retrieved by author, title, subject term and key words as required by the Education Department.

Heeks (9, p161) concludes that one of the most important rules with software is to try the program out first before committing to purchase and Rorvig (26, p40) states that software purchased as a package must be compatible with both the operational system and the microcomputer system.

8.2.4.3 Environment

While mainframe and mini computers are usually housed in special computer rooms with air-conditioning, microcomputers on the other hand do not need any air conditioning or special environment (11, p16). Nevertheless a controlled office environment is required i.e. an environment that would be comfortable to an office worker.

Microcomputers would usually require a 15amp single phase power supply, preferably connected through an uninterrupted power supply unit (UPS). The extra costs incurred in the UPS unit would be well justified especially as the power requirements of computers may be considered as an "Achilles heel". An interruption in the electricity supply or a large drop in the voltage may cause memory loss in the central processing unit resulting in many lost hours of manpower. The terminal stands and chairs must be designed with ergonomics in mind as the user must feel comfortable and at ease when communicating with the system. Adequate precautions must be taken to fix up the power and connecting cables such that the user would avoid tripping over them.

8.2.5 Staff Selection

One of the most important factors in the selection of staff will be the motivation of the individual staff member to work with the new technology (14, p28). A staff member who is well motivated is more likely to be interested in computerisation than one who is not well motivated. Keenan (14, p28) is of the opinion that recent entrants in to the profession may know more about the newer technologies than established staff who will be more familiar with conventional methods of information retrieval. Furthermore, there may be a tendency on the part of established staff to ignore or distrust computer-based services. The new service will require a certain amount of administrative work and this factor will also need to be taken into account when deliberating staff selection. Staff consideration will therefore include selection procedures, training, service provision time, and service housekeeping time (14, p28).

Keenan advises that a minimum of two people be selected as this gives better coverage in terms of duty rotas. More importantly, two heads are better than one in the initial stages of the implementation of the programme.

8.2.5.1 Training of Staff

Once the decision has been made to computerize information retrieval, it is imperative that staff training starts immediately. A number of possibilities exist for the initial training of the selected staff. The suppliers of the hardware usually offer introductory courses and various interactive software tutorial programs are available off--the-shelf. Courses are offered by The CSIR as well as by some library schools e.g. the University of South Africa. Keenan (14, 29) suggests that the staff be booked early onto these training courses if they are to develop their skills timeously for the implementation of the new service. Timing of the initial training should be closely connected to the installation of the equipment in the library resource centre as the effectiveness of the training programme will be enhanced if the practice sessions are reinforced on own equipment after the formal training session. The school must provide additional time for the staff to become familiar with the equipment as practice is the best way to learn after the basic training is complete. This belief is echoed by system suppliers who stress that there is no substitute for "hands-on-experience" (14, p30). Having gained experience and confidence these trained staff members can be encouraged to train the other staff members on the establishment. This strategy has the added benefit of saving costs in the training of additional personnel. With continuing technological change and the development of new systems the need for updating in training is paramount. Library staff members should be encouraged to join and participate in the activities of online user groups. Every effort should be made to encourage and ensure that staff members promote their services with their colleagues.

8.2.6 Promotions and Publicity

The timing of promotions campaigns to publicise the new service can be critical according to Keenan (14, p34). The initial planning for the service will have identified the target group as consisting primarily of the students, who will make up the largest number, and the staff of the school. Publicity efforts should be aimed at these groups timeously i.e. at least a few weeks before the service becomes available (14, p34) and after the service is implemented efforts should be intensified during the early months in order to attract these groups to see and use the service, thus indirectly promoting the sustained use of the service. These publicity exercises could include talks to individuals as well as groups, posters, leaflets, handouts and demonstrations. All hand-outs should be clearly written, avoiding jargon. Posters advertising the service should be clearly displayed in the library resource centre together with other permanent notices giving details of the service. Talks to individuals and groups can be given by the staff who will be involved in the running of the service as they will be **au fait** with the system and will be better qualified to answer questions relating to the programme. Full advantage must be taken of the library resource education periods on the school time-table for the various classes as this will provide an ideal opportunity for addressing a captive audience. Further, this will ensure that the entire school population is informed of the new project.

Demonstration searches should be used as much as possible as they are far the best way of showing what the programme can do (14, p35). Search inquiries may be requested in advance so that these may be tested before the demonstration session. Keenan (14, p36) states that it is advisable to also have sample searches planned in advance, thus ensuring that the demonstration is successful. Moreover, these pre-planned searches must cater for the interests of the various groups in order that they may identify with the new service.

8.2.7 Costs

Although Hyman and Wallis (11, p5) state that it is difficult to accurately estimate the cost of hardware and software because of the changes in price, it is nevertheless remains an important pre-requisite factor upon which is dependant the successful implementation of the project. They conclude that it is crucial to establish how much a facility will cost in order to decide if it is worthwhile (11, p12). Keenan (14, p12) identifies the cost factors involved in the setting up and running of a computerised information retrieval system as capital costs and unique costs. Capital costs are equipment costs and the unique costs are one-off costs. To these fixed costs may be added recurring standing costs and recurring running costs.

Capital costs occur once in the establishment of the service and the most important of these is the purchase of suitable equipment. Capital expenditure will depend upon he exact configuration of the system and this in turn will depend on the extent of the service to be provided by the library resource centre. Other capital expenditure would include the provision of, or alteration of present accommodation. Unique one-off costs would include initial staff-training. Recurring standing costs would include the annual subscriptions for updates to the database supplier and continued staff training and updating. As the staff become experienced they will require updating in their skills as well as training in new systems and databases as these becomes available. Recurring running costs would include electricity, paper, printer ribbons, floppy disks etc.

Finally, ancillary costs that are directly related to the provision of a computerised information retrieval service needs attention. These would include the provision of support tools such as system manuals, software manuals, thesauri, subject heading lists etc. There will also be a need for special forms to facilitate record keeping.

Hyman and Wallis (11, p2) state that prices are changing so quickly and so often and for so many reasons that it is difficult to forecast future trends in the pricing structure. The constant fluctuation of the value of the Rand against the American dollar usually causes the price of imported equipment to go up in price, and manufacturers' may reserve the right to pass this additional cost on to the purchaser even after the contract is signed. The committee in charge of the purchasing should include an escalation clause in the contract which would protect their interests. Inflation also affects the value of the Rand and it would be advantageous to finalise the purchase of the equipment as soon as possible after a decision has been made in order to avoid possible increases in the price.

8.3 IMPLEMENTATION PHASE

In the implementation phase the hardware is procured, installed and tested. Further tests are concluded with the applications software, and if these tests are positive, steps are taken to convert the existing card catalogue into machine readable data.

8.3.1 Hardware Procurement

Equipment may be purchased, rented, leased or available equipment in the school may be used. If the equipment is to be purchased, advantage should be taken of the Education Department's Rand for Rand policy whereby the Education Department would subsidise approved purchases on a fifty-fifty basis. Before finalising an order for equipment it is necessary to establish the date when the supplier will install the equipment as a delay in delivery would cause serious problems in starting the retrieval service (14, p25). Other factors that need consideration would include the reputation of the supplier, the supplier's ability to provide an after-sales service and technical support.

8.3.2 Hardware Installation and Test

The supplier of the hardware should be responsible for the initial setting-up of the equipment in order to obviate the problems of system malfunction. It would be advisable to "soak-test" the equipment i.e. keeping the equipment switched on for at least 48 hours. This strategy usually shows up latent and patent defects that must be attended to by the supplier/s of the service.

8.3.3 Systems Test

After the files have been partially or fully constructed, the hardware installed and tested, a complete system test must be made (16, p182). The equipment should moreover, also be tested with the applicable software program in order to eliminate the existent "bugs" if necessary. The selected and trained staff-members should of necessity participate in this testing programme in order to minimise and eliminate the teething problems that may be experienced. After a period of final system testing it may be utilized for full system operation and use.

8.3.4 Conversions

The methodology of the conversion of the catalogue cards into data suitable for input into the system would depend on various factors. The principal factors would be the number of items to be input into the system and the design of the system. If downloading is selected as a method of conversion then the design of the system must facilitate this method.

Online bibliographic services provided by specialized services and book suppliers cover

over 90% of all catalogued library items (5, p19). Items whose bibliographic descriptions are available from such services can be easily downloaded with available software. The **MARC** style records can be displayed on the microcomputer screen, edited as desired, stored in the memory and later searched and printed.

Nevertheless, for the most efficient transfer of these bibliographic records, the software should present the bibliographic records in the format normally used by the library in its cataloguing. As the available **MARC** format is not what Indian school library resource centres require, the amount of keyboard editing needed to change or correct the bibliographic details will wipe out the advantage gained by downloading (5, p20). According to Falk (5, p20) it might be just as easy to enter the bibliographic description from "scratch", directly from the item itself. Falk (5, p20) states that a possible solution is the modification of the software application program. However, this modification may introduce bugs into the package.

The most accurate way to catalogue the items is through a prepared display format, a fill-in-the-blanks screen, that provides a space for each descriptive item that the library resource centre intends to catalogue (5, p20).

8.4 OPERATIONAL PHASE

This is the final phase when the system goes into full operation. The success of this phase is primarily dependent upon the thoroughness of the planning phase. It is during this period that the system would be operating under normal conditions and it is highly probable that unforeseen problems may arise. Decisive steps must be immediately taken to rectify these problems so that the transition from manual retrieval to computerised retrieval is least traumatic to the user. A positive response by management to these problems would help ensure the acceptance of the new service by both the students and the teachers. It would be necessary to continue with the promotion of the service until management is satisfied the user population is utilising the service to its maximum benefit.

8.4.1 Systems Maintenance

The quality of the maintenance and support of the system will determine the continued efficiency of the service. To this end it is important to negotiate service contracts not only with the supplier of the equipment, but also the software vendor. Updates to the software package that has been supplied must be timeously incorporated into the system to take full advantage of the enhancements.

8.5 CONCLUSION

It is evident that the application of microcomputer technology for information retrieval would necessitate thorough planning prior to the implementation of the service. Each individual aspect, as indicated in the framework, would require careful attention to detail. The time allocation of the planning and execution of the various steps would depend upon the individual circumstances of each school library resource centre and the success of each phase would be dependant upon the success of the previous phase. For each phase there are various options to be considered and the selection of a particular option would be linked primarily to the needs and the finances of the school.

The problem analysis phase in the systems model for information retrieval would, in all likelihood, reveal deficiencies in the information retrieval system as applicable in library resource centres in Indian secondary schools in South Africa and a needs assessment survey would further reveal the users' preference for a more effective system. Having informed the Library Services of the Education

Department of the decision to offer computerised information retrieval facilities to the staff and pupils, the planning committee or management team would use a model to facilitate the various processes in the planning phase of the computerised service. Systems objectives and specific tasks which the system is required to perform in the school library resource centre are two basic priorities that need the consideration of the planning team.

The users of the school library resource centre are mainly the students and the staff of the school. While the information retrieval function will be common to both these groups, the staff may additionally require a current awareness service or selected dissemination of information service **(SDI)**.

In order to make the appropriate choice in terms of systems design it is necessary for the management team to take the responsibility of knowing what the various systems can and cannot do as the school library environment imposes peculiar constraints upon the system. These constraints would include large bibliographic files that need to be manipulated and the need by library resource centre staff to add or delete files that are being consulted by users.

Of the four systems available for selection, it appears that the choice of a database management system appears to be most advantageous in the school library resource centre as database management packages are not only more flexible and more powerful, but also relatively less costly. Database management packages rank among the most popular of microcomputer software products.

Relatively minimum alterations and modifications to the school library resource centre are required to provide a suitable environment for the installation of a microcomputer system as these systems do not require a specialised environment.

The success of the computerised service in the library resource centre will depend to a large degree upon the cooperation, interest and enthusiasm of the staff who manage and operate it, and it thus becomes necessary for the management team to include a well-planned, and well-executed orientation and training programme for the staff. School library resource centre staff need to be trained in advance in order to develop their skills timeously for the implementation of the new service. These staff members may also assist in promoting and publicising the new computerised service by offering workshops and demonstrations to both the students and the staff of the school.

The system implementation phase and the operational phase require the installation, activation, evaluation and acceptance of the system being developed for the school library resource centre. Staff and student satisfaction in the service is paramount, and if it becomes apparent that this satisfaction is wanting, the management team must act quickly and decisively by taking appropriate steps to rectify the situation, thereby facilitating the success of the project.

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CHAPTER NINE

9. CONCLUSION AND RECOMMENDATIONS

The intent of this study was to demonstrate the growth and development of library resource centres in South African Indian Secondary schools and examine the possibilities for the application of microcomputer technology in bibliographic information retrieval in these schools.

The schools are functioning in a changing technological environment and are responding to an extent to these changes. The Education Department has instituted both a computer literacy programme and a computer study course in its secondary schools. To support this initiative the Department has embarked on a project to install IBM compatible microcomputer systems in secondary schools. Over 80% of Indian secondary schools have these microcomputers installed in specially designed computer rooms. However, responses from the Education Department have indicated that no computers are being used for information retrieval in the library resource centre.

Various factors have contributed to a situation in which it has become increasingly clear that the traditional methods for handling the volume of information are inadequate. Together with the increasing amounts of information there is a corresponding increase in the degree of specialisation. Henley (2, p1) states that "more and more people are learning more and more about less and less..." and the library is expected to satisfy their demand for specialised information. He adds that the net result is that the librarian "who is that traditional repository of documentary wisdom, knows less and less about more and more". The true brunt of increasing demands thus falls on his information storage and retrieval system.

9.1 FINDINGS OF THE STUDY

The Education Department has realised the need for the provision of adequate library facilities in schools. This realization has led to a revised building programme, increased budget for library purchases and the recognition of library qualifications for the improved categorisation of teacher-librarians.

9.1.1 Improved Library Accommodation

The Department has embarked on a revised building programme to include all new secondary schools with proper library resource centres and also to upgrade libraries in existing schools to library resource centres. This programme has resulted in purpose built library resource centres in over 70% of the responding schools. Accommodation requirements have been reviewed twice since 1966 and the floor space has been increased in each instance. Furniture and fittings have also been upgraded. Limited storage space has been provided for non-book media. "Wet" study carrels i.e. carrels with electrical power points have been installed in the newer library resource centres to facilitate the use of specific non-book media e.g. audio-cassettes. However, no provision has been made for the installation of computers and peripheral equipment. It is apparent that a computerisation programme for the library resource centre has not been envisaged, as the Department has not considered the physical environment for the installation of computer systems in the school library resource centre in terms of its future building planning programme.

9.1.2 Increased Budget

The amount budgeted for the purchase of library materials is reviewed annually and both the per capita and basic amounts have steadily increased over the last ten years. The average percentage increase in the budgeted amount over this period is 38.17%. The increases in the budget has led to a consequent increase in the total holdings of the library as more funds were expended on these purchases. While the average opening bookstock was 921 books in the responding libraries, the current average bookstock in these school is 5940 books, with a high bookstock of over 10000 books and a low bookstock of between 1000 and 2000 books. The non-book resources have also shown a high degree of acceptability and growth in the library resource centres. Over 90% of the respondents have indicated that their library resource centres possess tapes, slides, transparencies, project files, audio-media, newspaper cuttings and videocassettes. The increased holdings of the library in terms of both the bookstock and non-book material clearly indicate the growth of the library in terms of its total holdings.

9.1.3 Staff

The growth and development of the library has prompted the Department to recognise the need for qualified staff to administer the library resource centres so that a professional service could be offered. The Department encouraged teachers to obtain school library qualifications by recognising these qualifications for regrading purposes and salary increases. Over and above the courses offered by the universities of South Africa, Natal and Durban-Westville, a two-year part-time correspondence course in resource centre management has been implemented at the Springfield College of Education in order to further accelerate the training of teacher-librarians. These steps have resulted in over 75% of secondary school library resource centres being staffed by personnel with dual qualifications i.e. a professional teaching diploma and a school library diploma or a resource centre management diploma. A number of these teachers are also graduates. In October 1984 a number of these teacher-librarians were appointed to the post of Head of Department: Library Resource Centre Management in terms of the requirements of Circular Minute CD of 1984 (3).

Many of the larger secondary school library resource centres have the exclusive services of a part-time clerk for approximately 4.75 hours per school day. The other schools may utilise the general clerical staff on the establishment for certain library administrative duties with the consent of the principal. A number of these part-time school clerks in the greater Durban area have enrolled for a diploma in library science at the local technikon with a view to obtaining relevant library qualifications. In view of the above factors it may be thus concluded that real growth and development in budget, accommodation, library holdings and staff has taken place in Indian secondary school libraries.

9.1.4 Information Retrieval in Indian Secondary School Library Resource Centres

While the Education Department has adequately catered for the growth of the library in terms of accommodation, budget and staff, it has nevertheless, failed to consider the consequences of the constantly increasing library holdings and the sophisticated needs of the student and teaching population in terms of their requirements for bibliographic information retrieval. Prior to 1984 teachers in charge of school libraries implemented a pot-pourri of cataloguing methods primarily due to a lack of clear direction from the Education Department's Library Services. While attempts were made in 1984 to address this issue, no clear-cut policy was established and it may be safely concluded that a lack of standardization would still be evident in the school library resource centres.

The Library Services of the Education Department has adopted a relatively simplistic approach towards information retrieval. While it has advocated the use of the Concise AACR2 rules for cataloguing, these rules have been further simplified for the school library resource centre card catalogue. It is normal practice for the teacher-librarians to place priority on the cataloguing of the books. The various cards viz. author card, title card and subject card have to be typed before it is filed. While this in itself is a time-consuming process, it is further excaberated by the time and effort that is required to file these cards once they have been typed. A system of key cards (index) has been introduced to help locate the various items in the library resource centre. As the cataloguing of the holdings received a higher priority, the indexing is usually left to a later date after the cataloguing cards have been completed. Responses have indicated that this practice, generally, has resulted in incomplete indexes which in turn creates the propensity to develop into an unsatisfactory or inefficient retrieval system. The efficiency of the key card system advocated by the Library Services would gradually diminish with an increase in the total holdings of the library.

Moreover, as mentioned previously, the student and teacher population are also exposed to a changing technological environment. The net result is that they are becoming more demanding for a modern and efficient retrieval service. If the status quo is allowed to remain, the possibilities of providing an efficient service that would satisfy user needs would not be realized.

9.1.5 The Development of Microcomputer Technology

It is generally accepted that computers can, and are, playing a meaningful role in library applications. However, due to high costs this technology was generally not available to the smaller libraries and school resource centres that operated on relatively limited budgets. For computerised information retrieval, a large number of files have to be manipulated in order to access the required data. Initially, the efficient manipulation of these files were only supported by main frame computers and larger capacity mini-computers as microcomputers lacked the required memory capacity, storage and speed to execute the file handling procedures. Rapid developments in microcomputer technology have however, changed the scenario to such an extent that it is difficult to distinguish the dividing line between mini-computers and microcomputers. The new generation 16 bit microcomputers that can operate between 10-25mhz offer a cost effective solution to their larger more expensive counterparts. Advances in technology have not only increased the speed, memory and storage capacity of microcomputers but also reduced the cost of systems to such an extent that it is now possible for smaller institutions to acquire a system for the library, even with the limited funds at their disposal. The technology also makes it possible for the system to expand as the need arises. It is evident that microcomputer technology offers a suitable alternative solution to cost conscious libraries that desire to offer a computerised bibliographic information retrieval service. Heeks's (1, p3) studies of time-cost comparison have indicated that a computerized service is more efficient and more cost-effective in most situations.

9.1.6 Microcomputers for Cataloguing and Indexing

The cataloguing and indexing of information is a prerequisite for information retrieval. The traditional forms of cataloguing and indexing have laid the foundations for contemporary information retrieval systems. In other words computerised bibliographic information retrieval systems are based on the traditional card catalogues and indexes. Mainframe computers and minicomputers have been used extensively in the creation of databases for cataloguing and indexing largely due to the very large sum of data that had to be stored.
A major contributing factor for the use of microcomputers for cataloguing has been the development of new and less costly storage technology. Hard disks which are capable of storing literally hundreds of millions of characters make microcomputers an ideal tool

for less costly information storage and retrieval. With suitable software packages it is possible to either download from catalogue databases or create local databases for individual needs.

The files for the storage of data can be structured in a variety of ways e.g. linear files, list files etc. The teacher-librarian's option of selecting a file structure would be dependant upon the file's ability to efficiently store the data to allow for its subsequent retrieval in an acceptable response time. In order to maximise the utility of these files it is necessary to organise the files into a database which will support not only easier access, but will also avoid unnecessary duplication of the files.

While it is clearly evident that microcomputer technology may be gainfully applied for information retrieval in the school library resource centre, it is nevertheless necessary to plan thoroughly for the conversion from a manual to a computerised system in order to ensure successful implementation. Due consideration must be given to the various phase outlined in the procedural framework.

9.2 RECOMMENDATIONS

9.2.1 Recommendations based on the Responses to the Questionnaire

An evaluation of the analysis of the responses to the questionnaire by the teacher-librarians establish the basis for the following recommendations:

9.2.1.1 Accommodation

While it is recognised that substantial progress has been achieved in the provision of updated library facilities in many Indian secondary Indian schools, the need nevertheless exists for the urgent upgrading of all secondary school library resource centres to cater for the provision of computerised information retrieval facilities. Closely coupled with the need for physical changes is the need for an attitudinal change in respect to the library resource centre itself. On the average, secondary schools have approximately thirty class units and each of these class units offer library resource education once weekly. Because of "room loading" difficulties, almost without exception the centre is used as an extension of the classroom i.e. library resource education lessons are taught within the library resource centre. This means that the information retrieval facilities are not available for the greater part of the normal school day as the library resource centre is used for teaching purposes, thus creating the impression that the library is a "converted classroom". The library must be seen as an information centre and as such must be freely accessible to the user if its primary function for the retrieval of information is to be served. It is thus recommended that the library resource centre not be used as a classroom unless it is absolutely necessary that a particular library resource education lesson need to be taught in the centre i.e. the use of the library resource centre as a classroom should be the exception rather than the rule.

9.2.1.2 **Budgets**

Notwithstanding the fact that library budget has increased substantially over the last decade, in real terms this growth has been severely limited by the ravages of inflation and the weak Rand against the American dollar i.e. the purchasing power of the Rand has diminished considerably over the last decade.

In order to maintain an equitable growth rate in real terms it is recommended that the school library resource centres endeavour to supplement the Education Department's library allocation by all means at their disposal.

9.2.1.3 Library Holdings

The opening bookstock of the libraries is low and the number of years taken to build up the stock is quite high. Consequently the users of the library resource centre are denied the privilege of accessing a well-stocked library. In order to alleviate this problem it is recommended that school library resource centres share their resources on a local basis. This may be facilitated by exchanging and circulating printed copies of bibliographies to all the schools in the area. As periodicals are prohibitively expensive, photocopies of the content pages could also be made available to participating schools. This local sharing of resources could be the forerunner to regional and national sharing by means of computer networks and tele-communication systems.

9.2.1.4 Staffing

Qualified staff are an important pre-requisite for the proper functioning of school library resource centres. The successful implementation of a computerised information retrieval service will of necessity require the staff to be qualified and experienced in computer technology. While the responses to the questionnaire reveal that 25% of the teacher-librarians are computer literate it is recommended that urgent steps be taken to ensure that all the teacher-librarians are computer literate. These steps would include attendance of courses offered by computer software and hardware distributors and Departmental workshops offered at the Teachers' Centres and Colleges of Education. The Media Resources Society of the professional teachers' association could also arrange for workshops and demonstrations for the teacher-librarians in this regard. The onus rests upon the teacher-librarians themselves to grasp every opportunity to become computer literate in order to be in an advantageous position when a computerised information retrieval service is implemented.

The switchover to a computerised service will require sustained, concerted effort by both the professional and administrative staff in the library resource centre. It is therefore recommended that all secondary school library resource centres are allocated full-time clerks or library assistants to assist with the computerisation programme.

9.2.1.5 The Card Catalogue

An analysis of the response to the section on the card catalogue in the questionnaire reveal that the percentage of library holdings that are not catalogued according to the Concise **AACR2** Rules is high. It also appears that there is a direct relationship between this fact and the relatively poor use of the card catalogue for information retrieval by the users. As the complete holdings will of necessity need to be eventually fully catalogued, it is recommended that the catalogue details be converted directly into machine readable data as this will avoid duplication of effort. Moreover, the establishment of a central database, not unlike **OCLC**, will not only alleviate the backlog of cataloguing but will help to eliminate it.

The majority of respondents had indicated that the present card catalogue system does not lead them to the varied contents of the book. It is therefore recommended that the selected information retrieval database package for the library resource centre cater for a minimum of ten additional key words that could be used to access a document, either as individual terms or in combination of terms.

Heeks (1, p1) rightly states that if computerisation is to be carried out, then it should be done sooner, rather than later. If the computerisation process is started when the number of resources are relatively small it can evolve and be modified easily as and when required. By adopting an "evolutionary" approach to information retrieval, the system can be matched to specific needs.

Improvements in software design would include the need for programs to be given a more spatial, more pictorial basis in order to provide the same level of memory cues and spatial manipulation that a manual index has. Programs should also provide greater flexibility and user control over sorting, indexing and output format.

9.2.2 Recommendations on the Role of the Education Department

The Education Department can play a major role in the development of computerised services in Indian school library resource centres. It can co-ordinate the introduction of computerised bibliographic information retrieval in schools, thereby ensuring both standardization and the success of the project:

9.2.2.1 The Education Department must ensure that the Library Services Section clearly lays down its requirements for information retrieval. While these requirements must facilitate their conversion into a microcomputer based bibliographic information retrieval system, the possibilities of a smooth and easy integration into a national information retrieval programme must not be overlooked.

9.2.2.2 Guidelines for the evaluation, selection and purchase of hardware by the schools could be drawn up by the Education Department. These guidelines could take into account possible national norms that may be instituted by the central Government.

9.2.2.3 The Department's "Rand for Rand" policy could be gainfully employed to encourage the schools to seriously take account of these guidelines. In other words those schools that purchase hardware according to the laid down guidelines should freely qualify for funds from the Education Department. This policy would ensure, among other things, that the specifications of the hardware purchased would conform to specified norms and the compatibility of the equipment purchased.

9.2.2.4 The Department could ensure that the purchase price of the hardware is competitive by using the Tender Board facilities, or Board of Trade Certificates that exempt customs duties. Because of the "Rand for Rand" policy both the Department and the schools would benefit from the reduced price.

9.2.2.5 The Department's building and upgrading programmes must be revised to cater for the installation of microcomputer systems in the school library resource centres. While the older library resource centres can be renovated and refurbished for the provision of the new service, the library resource centres for the new schools should be completely redesigned to provide for, and take full advantage of, a computerised service and also allow for future development and growth.

9.2.2.6 Preliminary workshops could be organised on a local, regional and provincial level for all those concerned with the implementation of the new service i.e. principals, teacher-librarians, the computer studies teacher and the library clerical staff. The need for standardization by the schools could be emphasized at these workshops. These workshops would further expose the school personnel to the available hardware and software. Workshop participants would have an ideal opportunity to evaluate both the hardware and software, and their feedback would help the Education Department to make appropriate recommendations, as user satisfaction would play a primary role in the acceptance and success or rejection of the project.

9.2.3 Recommendations on the Role of the Colleges of Education

Two colleges of education for teacher training are supported financially by the Education Department viz: the Springfield College of

Education and the Transvaal College of Education. Both these institutions offer a four year programme that leads to an education diploma. A compulsory component of the diploma is a course in Educational Technology which is offered over four years. It is recommended that a short intensive course in basic computerised bibliographic information retrieval be incorporated into the Educational Technology course. As all the students have to offer Educational Technology, this step would ensure that new teachers entering the profession would have a head-start in the school. Their prior training in the college could result in a ripple effect in the schools, if advantage is taken of their knowledge, as they could in turn offer workshops in computerised bibliographic information in the schools where they are appointed.

9.2.4 Suggestions for Further Study

Henley (2, p29) states that criticisms of computerised information retrieval will apply to any information retrieval system and as such illustrates the problems facing every librarian. It is important that any experiments performed are guided along the right lines and their results properly and scientifically measured. Only in this way can the suitability of the computer for information retrieval be established. A plethora of problems are involved in organising a collection of material in such a way that retrieval is most efficient. It is necessary to distinguish those problems that are common to any retrieval situation, from those which are peculiar to, or created by computerisation. Areas that may be suitable for further study include:

9.2.4.1 Cost-Effectiveness of Computerisation

Individual school library resource centres must calculate the value of a microcomputer system and the facilities provided by it. It is of paramount importance to establish the cost of such a system and to make a decision if this expenditure is justified. It must be established that the system would allow the library resource centre to do something that could otherwise not be done and this would be worth the cost.

9.2.4.2 Studies on Microcomputers and DBMS Bibliographic Information Retrieval

Several microcomputer manufacturers and other software houses provide database management system packages (DBMS). Many of these could be modified or adapted for use on microcomputers as a basis for bibliographic information retrieval systems. File handling systems may also need investigating, especially those providing index sequential disk access. Although they are less sophisticated than DBMS systems the file access routines may prove to be useful for less complex bibliographic information retrieval systems. For obvious reasons the cost of setting up a database on an information retrieval system could be very much greater than on a conventional system. Consideration should be given to the cost of back-file conversion and to determine how essential this conversion really is. Further studies should concentrate on the most efficient way of loading existing secondary information onto a microcomputer.

9.2.4.3 The Different Roles of Microcomputers in Bibliographic Information Retrieval Systems

Computers have been utilised for distributed intelligence systems and it appears that opportunities exist for distributed bibliographic information retrieval on microcomputers. Further studies could examine the way this information could be distributed, the possible problems that could arise from school library resource centres being spread over a large area, the cost of the system and the ways and means that could be utilised to update the database systems.

9.2.4.4 Microcomputers and Integrated Functions

As a result of the development of microcomputer technology the possibilities for integrated multi-functional systems appear to be positively encouraging. The possibilities of using a one-function information retrieval package as a point of departure for the development of an integrated systems needs to be explored. Another possible alternative is to link together a range of packages to cover all the requirements of a school library resource centre.

9.2.4.5 Networking

A major area of future development will use telecommunications technology to establish links to, and from, the library resource centre. The establishment of computer facilities for a library would provide a sound basis for such links with the greater world. The need therefore exists to bridge the gap between computer systems designed to serve in-house requirements and those intended to provide intelligent communications. The microcomputer provides an opportunity for the school library resource centre to be part of a broader electronic network. Many off-the-shelf successful versions of local area networks **(LAN)** are available for the IBM PCs and compatibles. While networks have produced fruitful results, the need for further investigations nevertheless exists. Three types of networks need to be investigated:

* a network that provides easier access for remote users to the library's own services.

* a network with other school library resource centres in the immediate vicinity with a view to sharing resources.

* a network to provide links with major regional, national and possible international organisations.

9.2.4.6 Compact Disk (CD) ROM

The CD ROM's exceptionally high storage capacity make it an ideal replacement for microfiche and reference sources as one 12cm plastic disk can store information equal to almost 250000 pages of text. The growing number of databases appearing on CD ROM and the increasing number of CD ROM users have the implication that the CD ROM merits investigation for school library resource information retrieval requirements.

9.2.5 Concluding Remarks

In March 1958, Bauer wrote in the Wilson Library Bulletin:

"Documentation is in great vogue among those gentle souls who wish to add to the confusion of knowledge, and documentalists have endeavoured, with indifferent success, to change their vocation into a profession by inventing a jargon replete with such absurd phrases as retrieval of information, trope indexing, uniterm, correlative indexing, non-manipulative index, and co-ordinate indexing."
(Quoted by 2, p2)

It is hoped that this study will help to dissipate any existent overt hostility to the computerisation of school library resource information retrieval systems. If the microcomputer is to effectively fulfil a role in resource centre work, its enormous potential and limitations must be properly understood, for the microcomputer, in terms of its cheapness, accessibility and communications facility, makes it eminently suitable for bibliographic information retrieval systems, especially for the school library resource centre which would not normally consider the use of a computer because of the high cost/expense involved.

9.3 CHAPTER BIBLIOGRAPHY

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PLEASE CROSS ☒ **THE APPROPRIATE BLOCK**

PERSONAL DETAILS

1. Indicate your sex:

Male	☐	01
Female	☐	02

2. Into which **ONE** of the following age groups do you fall:

20-25	☐	01
26-30	☐	02
31-35	☐	03
36-40	☐	04
41-45	☐	05
46-50	☐	06
over 50	☐	07

3. Which **ONE** of the following qualification categories applies to you:

Teachers' diploma	☐	01
Teachers' diploma + Library diploma	☐	02
Teachers' diploma + SLRCM diploma	☐	03
Teachers' diploma + degree	☐	04
Teachers' diploma + degree + Library diploma	☐	05
Teachers' diploma + degree + SLRCM diploma	☐	06

4. Have you taken any of the following courses in relation to computers:

Computer science	☐	01
Information systems	☐	02
Datametrics	☐	03
Computer literacy	☐	04
Other (specify)	☐	05

5. Indicate your experience as a teacher-librarian:

1-5 years	☐	01
6-10 years	☐	02
11-15 years	☐	03
16-20 years	☐	04
More than 20 years	☐	05

LIBRARY RESOURCE CENTRE HISTORY

6. In which year was your school opened? 19☐☐ 01

7. The current student full-time equivalent roll in your school is:

Less than 400	☐	01
400-500	☐	02
501-600	☐	03
601-700	☐	04
701-800	☐	05
801-900	☐	06
901-1000	☐	07
Over 1000	☐	08
	☐	09

8. Indicate the **ORIGINAL** accommodation of the library i.e. where was the library located on the opening of the school:

Caretakers' quarters	☐	01
Storeroom/stockroom	☐	02
Classroom	☐	03
Multi-purpose room	☐	04
Purpose built resource centre	☐	05
Other (specify)	☐	06

9. Indicate the **PRESENT** accommodation of the library:

Caretakers' quarters	☐	01
Storeroom/stockroom	☐	02
Classroom	☐	03
Multi-purpose room	☐	04
Purpose built resource centre	☐	05
Other (specify)	☐	06

LIBRARY HOLDINGS

10. Indicate the library bookstock on the **OPENING** of the school:

Less than 500 books	☐	01
500-1000 books	☐	02
1001-1500 books	☐	03
1501-2000 books	☐	04
2001-2500 books	☐	05
2501-3000 books	☐	06
More than 3000 books	☐	07

11. Indicate the **PRESENT** library bookstock:

1000-2000	☐	01
2001-3000	☐	02
3001-4000	☐	03
4001-5000	☐	04
5001-6000	☐	05
6001-7000	☐	06
7001-8000	☐	07
8001-9000	☐	08
9001-10000	☐	09
More than 10000	☐	10

12. Indicate the **TOTAL** number of periodicals you currently receive in the library:

Less than 5	☐	01
5-10	☐	02
11-15	☐	03
16-20	☐	04
More than 20	☐	05

13. Indicate which of the following items are held in your library resource centre:

Slides/stripfilms	☐	01
Transparencies	☐	02
Pictures/posters	☐	03
Newspaper cuttings/project files	☐	04
Audio tapes/records	☐	05
Videocassettes/films	☐	06
Other (specify)	☐	07

CARD CATALOGUE

14. What percentage of your library holdings are catalogued according to the Concise AACR2 Rules:

Less than 25%	☐	01
25%-50%	☐	02
51%-75%	☐	03
76%-100%	☐	04

15. How would you describe the use of the card catalogue by your students:

	non fiction	fiction	reference	
Very good	☐	☐	☐	01
Good	☐	☐	☐	02
Satisfactory	☐	☐	☐	03
Poor	☐	☐	☐	04
Very poor	☐	☐	☐	05

16. In your opinion how **effective** is the card catalogue for **information retrieval:**

	non fiction	fiction	reference	
Very good	☐	☐	☐	01
Good	☐	☐	☐	02
Undecided	☐	☐	☐	03
Poor	☐	☐	☐	04
Very Poor	☐	☐	☐	05

17. Does the present system of key cards **effectively** lead the student to the **varied contents** of the book

Always	☐	01
Sometimes	☐	02
Never	☐	03

18. Based on your circulation statistics how would you describe the utilization of your bookstock:

Very good	☐	01
Good	☐	02
Very satisfactory	☐	03
Satisfactory	☐	04
Poor	☐	05

19. How would you describe the utilization of your periodical collection:

Very good	☐	01
Good	☐	02
Very satisfactory	☐	03
Satisfactory	☐	04
Poor	☐	05

20. Which of the following microcomputers are installed in your school:

Commodore 64	☐	01
Apple	☐	02
IBM PC compatible with twin floppy drives	☐	03
IBM PC compatible with hard drive	☐	04
Other (specify).............................	☐	05

** **Please check that you have not skipped any questions.**

** **Enclose and return completed questionnaire in the postage paid envelope that has been provided.**

SPRINGFIELD COLLEGE OF EDUCATION
Private Bag
DORMERTON
4015

01 February 1990

Dear Principal

I am researching the application of microcomputer technology for information retrieval in library resource centres through the University of Natal.

I am sure that you are aware of the implications of such a study for the future planning and development of the resource centre. Therefore I should be grateful if you would kindly arrange for your teacher-librarian to complete the attached questionnaire.

Departmental permission to administer the questionnaire to teacher-librarians has been obtained and all responses will be be used for statistical comparisons only.

I should be grateful if would ensure that your Teacher-Librarian completes the questionnaire fully and returns it in the attached self-addressed, postage paid envelope by **15 February 1990.**

Thank you for your help.

Yours faithfully

G. Govender

SPRINGFIELD COLLEGE OF EDUCATION
Private Bag
DORMERTON
4015

01 February 1990

Dear Colleague

I am researching the application of microcomputer technology for information retrieval in library resource centres.

I am sure that you are aware of the implications of such a study for the future planning and development of the resource centre. Therefore I should be grateful if you would kindly complete the attached questionnaire.

While Departmental permission to administer the questionnaire to teacher-librarians has been obtained <u>I wish to assure you that your response will be confidential and will be used for statistical comparisons only</u>.

I should be grateful if would ensure that all the details are fully and correctly completed and returned in the attached self-addressed, postage paid envelope by **15 February 1990.**

Thank you for your help.

Yours faithfully

G. Govender

SPRINGFIELD COLLEGE OF EDUCATION
Private Bag
DORMERTON
4015

21 February 1990

Dear Principal

RESEARCH QUESTIONNAIRE : MICROCOMPUTERS IN THE LRC

At the beginning of February I forwarded you a questionnaire, together with a self-addressed postage paid envelope, to be completed by your Teacher-Librarian.

While most of the questionnaires have been returned, I have however, not as yet received the completed questionnaire from your Teacher-Librarian. The response from your school will facilitate the successful completion of the research.

Another copy of the questionnaire is enclosed and I would appreciate it if you would ensure that it is completed by your Teacher-Librarian and forwarded to me as soon as possible.

Thank you for your co-operation.

Yours sincerely

G. Govender

PLEASE CROSS ☒ THE APPROPRIATE BLOCK

PERSONAL DETAILS

1. Indicate your sex:

male ☐

female ☐

2. Into which of the following age groups do you fall:

20-25 ☐

26-30 ☐

31-35 ☐

36-40 ☐

41-45 ☐

46-50 ☐

over 50 ☐

3. Which one of the following qualification categories applies to you:

Teachers' diploma ☐

Teachers' diploma + degree ☐

Teachers' diploma + SLRCM diploma ☐

Teachers' diploma + library diploma ☐

Teachers' dipploma + degree+ library diploma ☐

Teachers' diploma + degree + SLRCM diploma ☐

4. Do you hold any of the following courses in relation to computers:

computer science ☐☐

information systems ☐☐

datametrics ☐☐

computer literacy ☐☐

Other (specify) .... ☐☐

5. Indicate your experience as a teacher-librarian:

1-3 years ☐☐

4-6 years ☐☐

7-9 years ☐☐

10-12 years ☐☐

13-15 years ☐☐

16-19 years ☐☐

Over 20 years ☐☐

6. In which year was your school opened? 19☐☐☐

LRC HISTORY

7. The current student roll in your school is:

Less than 400 ☐☐

400-500 ☐☐

501-600 ☐☐

601-700 ☐☐

701-800 ☐☐

801-900 ☐☐

901-1000 ☐☐

Over 1000 ☐☐

8. Indicate the **ORIGINAL** accommodation of the library i.e. where was the library located on the opening of the school:

classroom

caretaker's quarters

multi-purpose room

purpose built resource centre

Other (specify) ....

9. Indicate the **PRESENT** accommodation of the library:

classroom

caretaker's quarters

pulti-purpose room

purpose built resource centre

Other (specify) ....

LIBRARY HOLDINGS

10. Indicate the library bookstock on the **OPENING** of the school:

Less than 500

500-1000

1001-2000

2001-3000

More than 3000 books

11. Indicate the **PRESENT** bookstock:

less than 1000 ☐☐
1000-2000 ☐☐
2001-3000 ☐☐
3001-4000 ☐☐
4001-5000 ☐☐
5001-6000 ☐☐
6001-7000 ☐☐
7001-8000 ☐☐
8001-9000 ☐☐
9001-10000 ☐☐
more than 10000 ☐☐

12. Indicate the **TOTAL** number of periodicals you receive in the library:

nil ☐☐
1-5 ☐☐
6-10 ☐☐
15-20 ☐☐
more than 20 ☐☐

13. Indicate your stock of non-book material:

slides ☐☐
transparencies ☐☐
pictures/posters ☐☐
newspaper cuttings/project files ☐☐
audio tapes ☐☐
videocassettes ☐☐

CARD CATALOGUE

14. How would you describe your card catalogue:

up to date

75% complete

50% complete

25% complete

less than 25% complete

15. How would you describe the use of the card catalogue by your students:

	very good	good	satisfactory	poor
fiction				
non-fiction				
reference				

16. In your opinion how **effective** is the card catalogue for information retrieval in your LRC:

very good

good

satisfactory

poor

17. Does the present system of key cards **effectively** lead the student to the **varied contents** of the book

always

sometimes

never

18. Based on your circulation statistics how would you describe the utilization of your bookstock:

good

satisfactory

poor

19. How would you describe the utilization of your periodical collection:

good

satisfactory

poor

20. Which of the following microcomputers are in your school:

Commodore 64

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