Development of an Education Management Information System (EMIS) in Namibia

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1. Background

Before Namibia achieved its independence in 1990, eleven largely autonomous education authorities administered the country's education. Ten of these authorities were part of ethnically based second tier administrations, while one was a department of the central government. The latter department had several co-ordinating functions regarding education, but the other education authorities did not resort under it. The department also administered about one tenth of the country's schools, which had not been allocated to ethnic administrations.

The first year after independence was a transitional year in which the previous education authorities had been transformed into so-called 'regions' administering the same schools as before, but under one new central ministry. From April 1991 onwards, schools were divided into six geographic regions with regional education offices resorting under the ministry. The region with the largest number of schools was later divided into two regions. Delineation of political regions twice resulted in a number of schools being transferred to a different regional office.

As a measure of the size of the system: there were 1 489 schools, 17 085 teachers and 497 418 learners in Namibia in 1998. Due to vast areas of desert and semi-desert, Namibia was sparsely populated with a population of about 1.75 million (1998) living in an area of 824 269 square kilometres, the average population density having been 2.1 persons per square kilometre.

Other aspects of the Namibian education system have been described in other reports in the series of ADEA reviews, and have thus not been repeated here.

2. Introduction

History

The collection and compilation of national education statistics in pre-independence Namibia was a function of the central Division of Statistics, which co-operated closely with the central education department and an education statistical committee appointed by the eleven education authorities. The eleven authorities used a common questionnaire to collect statistics from schools, and the central Division of Statistics compiled annual education statistics reports for the country. Data processing was mainly done manually between 1983 and 1990, and only a small portion of the data was entered into spreadsheets towards the end of the period. The last education statistics report under this dispensation was produced in 1989 (Department of Economic Affairs, 1989.) Ad-hoc requests for statistics normally had to be processed manually. Some information was not published as it was considered to be 'confidential'.

The change of government structures in 1990 and 1991 provided the opportunity for reforming the collection and processing educational statistics. It became necessary to establish a record of existing schools, including their positions, and to provide means of informing the process of expanding the

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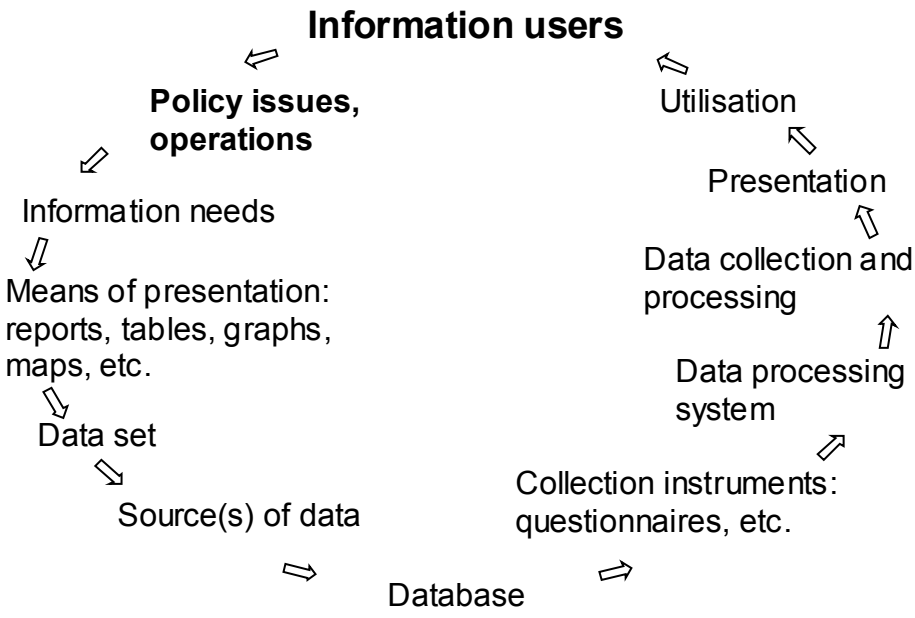
provision of education. The Namibian Education Management Information System (EMIS) which also included a Geographic Information System (GIS) for school mapping were developed against this background. Several factors came together to create a susceptive environment for the development of these systems:

- The Minister, several senior managers, and donors and advisors experienced a need for education statistical information. There was a need for a comprehensive record of schools in each education region, including basic statistics, on the operational level.
- A small group of Namibian staff members of the Ministry was dedicated towards the development of the EMIS and GIS.
- Resources such as funding, technical advice and training opportunities were available.

Although not always consciously perceived by those involved, the development of the EMIS broadly followed an 'information cycle'. As much of the success of the development can be ascribed to this, a brief description of the 'information cycle' needs to be given at this point.

The information cycle

An information system serves its users, requiring these users to be identified as the initial step in the information cycle.



While the arrows in the adjacent figure indicate the direction of the information cycle, feedback to previous steps in the cycle is vital.

The information needs of the users arise out of the policy issues managers address, and the operations and activities users are responsible for. Other reasons for requiring information, such as curiosity, may be added, dependent on which users are catered for.

Information should be presented to the users in appropriate ways and with an appropriate level of aggregation. Specific users often require the same information to be presented in diverse ways to serve different purposes.

Knowing the information needs of the users, the means of presentation to be used, including the level of aggregation, allows the data set required for the information system to be defined. The 'best' sources of data have to be determined, considering accessibility of the source, reliability of the data, costs of collection, etc.

In the development of the Namibian EMIS, the database was designed at this point, that is, before the questionnaires were designed. This order allowed designing a good database not constrained by existing questionnaires, while the questionnaire design benefited from being based on an efficient data structure.

The data processing system comprises various components: computer hardware and software, data entry and verification systems, data processing systems generating the desired outputs of information, and systems giving users access to information.

After the implementation of the design elements mentioned above, data collection, data entry, verification and 'cleaning' follow. Information is then presented to the users, utilising the means decided upon early in the cycle. Users utilising the information closes the cycle. The utilisation of information has often been reported as a major obstacle in the development of information system, and much thought needs to be given to it throughout the information cycle.

In an idealised sense, the development of the Namibian EMIS went through such an information cycle, and the remainder of this report has been organised in the order of the cycle. Reality has not been so ideal: there were mistakes and some components had to be revised repeatedly. At stages the right steps were taken by trial and error. At present, there is still much room for improvement and inclusion of additional essential information. Major promising developments had to be terminated due to a lack of staff and the required competencies.

Overview

After assessing the information needs of the Ministry, initial design of tables to present pertinent information, the identification of the required data set, and development of database structures, a new annual education census (AEC) questionnaire was developed in 1991. Despite pilot-testing the questionnaire, there were still deficiencies that had to be corrected in 1992. The database structures were also improved in 1992, and, apart from some later additions and improvements, this structure and the layout of the questionnaire of the AEC were not changed substantially since 1992. The census date for the AEC was the first Tuesday of August, which was about two-thirds through the school year.

The number of staff a school qualified for in Namibia was based on the enrolment three weeks after schools opened each year. This required the collection of basic education statistics early in the school year, on the 15th school day. Although basic enrolment and staffing figures would have been sufficient, key users within the Ministry required additional information for operational purposes. This resulted in the collection of fairly comprehensive '15th School Day Statistics.' The database and questionnaire for the 15th School Day Statistics were also kept relatively consistent since 1992.

The EMIS Division normally had about five or six professional staff members, including long-term advisors and volunteers since its inception. Two clerks and three data typists handled the entry of all data on computer. The EMIS had two expatriate information technology experts working for it at times.

In mid-1999, the EMIS database used an Oracle 7 Relational Database Management System with a Windows NT operating system. The system had 5Gbyte of disk space. The database server was connected to the Novell NetWare 4 network of the Ministry. There were plans to upgrade the system to Oracle 8 running under Novell NetWare 5 on a new server with a Pentium III processor and 18Gbyte of disk space before the end of 1999.

The development of the EMIS produced several results, which can be summarised under the following headings:

- The existence of an education statistical data set meeting a significant number of the information needs of the users.
- The consistent collection of education statistics in two annual surveys.
- The existence of a well-maintained database of educational data.
- The production of two annual statistical reports based on the 15th School Day Statistics and the AEC.
- The capacity to respond to ad-hoc requests for statistical information.

- A GIS containing the geographic co-ordinates of all schools, other relevant geographical information, and being linked to the EMIS database.
- The capacity to conduct research and special surveys.
- An increasing utilisation of education statistics and other outputs of the EMIS.

3. Evidence of the achievement

3.1 Existence of a data-set meeting information needs

A distinction has been made in this report between the abstract definition of a data set and the actual data collected with questionnaires and stored in a database on computer. This distinction is important: the abstract data set, listing the data items collected, determines what information can be provided after the data has been collected and processed, and determines the contents of the database and the questionnaires. In practice this data set was only recorded as field descriptions of the database and as questions in the questionnaires.

The existence of a good data set is demonstrated by the success achieved in meeting the information needs of the users. An implicit requirement of a good data set is that it must be possible to collect and process the data set with available resources. The data set should contain no redundant data, but no attempt will be made in this report to show the level of success achieved in this respect.

Namibia's Education Statistics reports meet to a considerable extent the information needs of many users: the management and other staff of the Ministry, other ministries, stakeholders in education, academic institutions, the private sector, the broad public, international agencies and institutions, and donors and consultants. Where the reports do not provide the exact information required, it is often possible to extract the information from existing data. The limiting factor tends to be the time required for responding to such ad-hoc requests for information, rather than the data not being available. Another indication of the general adequacy of the data set is a significant decline in the number of special surveys conducted in schools to obtain any but very specialised information.

The data set should allow tracing changes over time. The data set was originally defined in 1991 and improved in 1992. Some items proved to have initially been defined too specific, resulting in complex questions that were answered incompletely, inconsistently, or led to an excessive amount of data to be processed. Particular areas that required adjustment were pupil flow information, teacher qualifications and subject related teacher information. These deficiencies were to a great extent resolved in 1992. Items were also added to the data set after 1992, such as the age distribution of Grade 1 entrants. Apart from some improvements, most of them implemented in 1992, the data set was hardly changed between 1992 and 1998, allowing the calculation of time series for most indicators. The system was designed in a way that allowed time series to be calculated retrospectively in terms of a changed delineation of geographic regions. It was, for example, possible to calculate a time series in 1999 as if the delineation of regions had been the same as in 1999 since 1992.

3.2 Consistent collection of education statistics in two annual surveys

The consistent collection of data is an essential element of a successful EMIS. Important elements are the completeness of collection, the correctness of the data, comparability of data collected in different years, and timeliness of collection.

Copies of the questionnaires and the availability of the data on computer are clear evidence of complete data collection between 1992 and 1998. In all the years between the beginning of 1992 and end of 1998, schools returned all questionnaires but one in the two annual surveys.

Numerous consistency checks built into the questionnaires ensured a high degree of reliability of the data. A sampling survey conducted in 1995 (Voigts, 1998) demonstrated remarkable consistency with results from the AEC conducted two months earlier. Independently of this survey, specific problems were, though, detected in a small number of data items that were difficult to verify.

As mentioned under 3.1 above, the data set remained largely constant since 1992, as did the wording of the questionnaires and dates of data collection. Comparable data was thus collected. There were, though, changes in the schools included in the statistics: the territory of Walvis Bay was included into Namibia in 1994, pre-primary education became the responsibility of the Ministry of Regional and Local Government an Housing in 1994, and vocational schools were transferred to the newly created Ministry of Higher Education, Vocational Training, Science and Technology in 1995.

The time required for the data collection was reasonable in most years and improved with time. In 1997 and 1998, for example, all AEC data had been entered into computer and 'cleaned' within four months after the census date.

3.3 Existence of a well-maintained database of educational data

Only a small portion of the collected education statistical data had been stored in what could be termed a spreadsheet-based database up to 1990.

The development of the EMIS database went through three major stages:

In 1991, major portions of the AEC were processed with the 'Integrated Microcomputer Processing System (IMPS)', a data processing software developed by the United States Bureau of the Census for the processing of population censuses. This software was used on the advice of the consultants supporting the development of the EMIS, but the Namibian staff in the EMIS found that IMPS did not adequately support the data structures. The structure of the EMIS data set required a relational database system, and a new database was thus created using dBase IV. The 1991 AEC data was later converted to dBase. The use of IMPS for processing some of the 1991 data did, though, allow producing basic statistical tables within a short time, which was important at the time to demonstrate that education statistics could be collected and processed on a timely basis.

After using dBase IV for an interim period, the need for a high-end relational database system was experienced. The main reasons were the need for processing speed, robustness against file corruption, and required extensive consistency checking and data integrity. As a result, the EMIS database was moved to an Oracle Relational Database Management System.

The integrity of the EMIS database was secured by a high level of consistency checking at the time of data entry, and by constraints built into the definition of the database. Newly captured data was only added to the main database after additional consistency checking. Usual routines, such as making regular backups of the data, protected the database against hardware failures.

3.4 The production of two annual statistical reports

The first of the two annual censuses of the EMIS, the 15th School Day Statistics, mainly served operational requirements of the Ministry. Much of the value of this census was providing Inspectors and Regional Offices with basic information on their schools. A small report on 15th School Day Statistics was produced annually since 1992. This report could, though, certainly be improved to meet more information needs. The 15th School Day Statistics were used extensively for ad-hoc reports.

The main education statistical report (EMIS, 1996a; EMIS, 1996b; EMIS, 1996c; EMIS, 1997; EMIS, 1998; EMIS, 1999) was mainly based on the AEC, but also contained some information collected on the 15th School Day, such as the numbers and ages of Grade 1 entrants. Results of national examinations and limited adult education statistics were provided by other components of the Ministry for inclusion in the reports. Basic information on higher and vocational training was

also included in these reports, despite not being the responsibility of the Ministry of Basic Education and Culture.

The first of the series of Education Statistics reports was published in 1995, containing 1994 statistics. Reports for 1992 and 1993 were published later, and since 1996, reports on the previous year's statistics were published around the middle of the year. The 1998 Education Statistics report contained 75 tables. In comparison, the last pre-independence report contained 11 tables.

3.5 The capacity to respond to ad-hoc requests for statistical information

Education Statistics reports cannot provide all information for all users for obvious reasons. The capacity to provide specialised information on demand was thus an essential component of an EMIS. The presentation of such information ranged from telephonic responses to special publications (see for example EMIS, 1996d), from a single number to large amounts of information, often provided on computer media.

Numerous special queries done in response to questions from individuals, questions from Members of Parliament, staff members of the Ministry, other ministries, consultants, the private sector, etc. provide ample evidence of the capacity to supply ad-hoc information. The Central Bureau for Statistics obtained all its school statistics from the EMIS. An address list of schools, also containing basic statistics, has been in high demand as it answered various requests for information on the school level.

With all data from the two annual censuses stored in the database, simple queries could be responded to within minutes. Complex queries took longer, as did requests that demanded lavish presentations. Compared to the situation before the development of the EMIS, ad-hoc information was provided within a fraction of the time, especially after good query software had been installed. The complexity of queries possible with computer-based query systems can hardly be compared with what was feasible with a manual system.

The capacity of providing special information was limited by the number of staff members having had the intimate knowledge of the database system. Developments in 1998 were aimed at empowering staff in Regional Offices, and more staff in Head Office, to query the database. While some progress was made in this respect, more needed to be done by mid-1999.

3.6 Development of a Geographic Information System (GIS)

The development of the GIS for school mapping started late in 1991, at a time when this was widely considered extravagant. The GIS did not only contain the co-ordinates of all schools and relevant geographical features, but it incorporated, for example, the 1991 population census on the enumerator area level, that is, at a level dividing the country into more than 2 000 units. The GIS was linked to the EMIS database, implying that all data contained in the database could be presented geographically, if required.

The GIS allowed the EMIS to readily re-allocate schools to different regions with changes of the boundaries of regions, which happened twice since the inception of the EMIS.

Due to a shortage of staff with the necessary competencies, the GIS was used virtually exclusively for school mapping since early 1996. A GIS-based data query system was no longer developed due to this staff shortage.

3.7 The capacity to conduct research and special surveys

The EMIS Division of the Ministry participated on different levels in several research projects since 1992, and also commissioned research. The involvement of the EMIS in the National Learner Baseline Assessment (NLBA) in 1992 (Ministry of Education and Culture, et al. 1994), a sampling survey of basic language and mathematics proficiencies of learners in Grades 4 and 7, was

effectively limited to noting the process. Many discussions with the leading team member and participation in some analyses gave staff in the EMIS Division a thorough insight into the research project.

The most noted commissioned research project was a qualitative study of processes and policies leading to learners failing a grade in the lower primary school phase (Fair, 1994.)

In 1995, the EMIS Division participated in a follow-up survey of the 1992 NLBA survey in Grade 7, then referred to as the National Learner Assessment (NLA) survey. Simultaneously, the EMIS Division led Namibia's participation in the initial project of the Southern Africa Consortium for Monitoring Educational Quality (SACMEQ) (Voigts, 1998). The initial SACMEQ project was a sampling survey relating Grade 6 English Reading Comprehension as measure of educational quality to learner, teacher and school backgrounds with the ultimate aim of informing the educational policy formulation process.

The EMIS Division was taking the lead in Namibia's participation in the second SACMEQ project, while the Ministry seconded the Head of the EMIS Division as Director of the international SACMEQ Co-ordinating Centre. The second SACMEQ project was again a survey of Grade 6 with sufficient overlap in test items and questions in the questionnaires to trace changes since 1995 in those countries, which participated in both studies. Mathematics tests were added to provide a more comprehensive measure of educational quality, the learner, teacher and school questionnaires were improved, and it was envisaged that teachers would be requested to take a test to obtain a measure of teacher subject knowledge. The main survey was scheduled for late 2000.

3.8 Increasing utilisation of education statistics

Concrete evidence of the utilisation of statistics is difficult to obtain. A time-consuming analysis of internal submissions, and of submissions by the Ministry to, for example, the Ministry of Finance could have provided such information. Such a study was not possible to be conducted for the purpose of this report. The extent to which the statistics influenced policy decisions, to which they were utilised for operational purposes and by users outside the Ministry was not measured. There were, though, some concrete indications of an increased use of the statistics:

- The Ministry was in 1998 and 1999 developing a computerised human resources management system. The staff records of school- and hostel-based staff in the EMIS database were utilised in different ways in this process.
- There was an increasing demand for specific statistics from the Director of Planning and Development, and from the Under-secretary for Formal Education, who was responsible among senior decision-makers for the area in which the EMIS had information.
- Claims of ignorance of existing statistics clearly decreased in number over the years.
- Requests from Ministry staff for ad-hoc reports on statistics contained in the Education Statistics reports decreased.
- The EMIS Division was requested to make a presentation to the Ministry of Finance in support of the Ministry's budget submission. The EMIS provided the statistics underlying proposed staffing norms negotiated with teacher unions and submitted to the Public Service Commission.
- There were informal reports from managers that they were consulting the Education Statistics reports regularly, and that many figures they required for their activities were obtained from the reports.
- The number of requests for basic statistics from schools seemed to have reduced drastically since the early nineties.

4. Explaining the success

In this section, factors that contributed to the success under the headings used above have been reported, followed by general factors in section 4.9.

4.1 Existence of a data set meeting information needs

The most important reason for having defined a relevant and effective data set was that the initial steps of the information cycle (see section 2 above) were basically followed:

- Those responsible for the development had a good idea from years of experience who the users were. It later proved beneficial that users on the operational level were included. Apart from being instrumental in the collection of statistics, the use of statistics on the operational level is essential for informing policy issues concerning senior decision-makers.
- With the first step in the information cycle, a common mistake had been avoided in hindsight: the users were not asked, what information they required. An informed decision was rather taken about what information would be useful for the user. Statistics reports from other countries were an important source in this respect. Information is 'useful' if it addresses issues relevant to the users, that is, policy issues concerning decision-makers, and aspects concerning the operations and activities of diverse users. The political changes in the year prior to independence, and the first two years after independence, had highlighted important policy issues in a developing nation undergoing substantial reform. Perhaps more unconsciously than consciously, known policy issues and requirements on the operational level had informed the identification of information needs.

  The claim, that not asking the users about their information needs was the correct method, requires clarification. There was actually some consultation, and there had been consultation in earlier years, but these direct enquiries had only resulted in a short list of requests for information. In general, decision-makers are concerned with policy issues, while they and other users of information are responsible for certain operations and activities. Asking the users about these issues and operations is reasonable. The planner or system analyst has the task to identify the information required for informing or supporting policy decisions and diverse operations, normally in consultation with the users.
- Table shells (tables with column and row headings without any data, also called 'dummy tables') were then designed to establish how the information needs of the users could be satisfied. Determining the data items, which were required for producing the tables, then defined the data set. This step was crucial in the development of a good data set as it ensured that all required data was included, while avoiding the collection of redundant data. Later adjustments were required due to omissions and to inform more policy issues.
- The data set was adjusted according to feedback obtained from subsequent steps in the information cycle, in particular after the design of the database and questionnaires, the pilot survey, and the first census.

After the data set had been refined after the first census, hardly any data items were deleted from the questionnaires in subsequent years. This allowed changes in nearly all data to be monitored.

4.2 Consistent collection of education statistics in two annual surveys

The existing channels of communication and hierarchy were utilised in collecting education statistics: the EMIS sent the questionnaires via the Regional Offices and their Inspectors to schools. School principals returned the forms to the Inspectors who, after checking them, passed the questionnaires on to the Regional Office from where they were sent to the EMIS in Head Office.

While utilising the existing lines of authority was essential in getting high return rates, other factors assumedly also contributed:

- School principals were used to submitting statistics even before independence, and already then typical return rates were about 99 percent of schools.
- As far as possible, the burden on Regional Offices and schools was reduced: Questionnaires were packed in separate envelopes for each school and bundled by inspection circuit at Head Office to facilitate distribution in Regional Offices. The AEC questionnaires were designed to allow school principals to distribute a great deal of the work among teachers: learner information was collected at the class-group level, and only the numbers of male and female learners had to be aggregated to the grade level as a verification mechanism. This avoided the tedious aggregation at the school of, for example, age distribution data. Information changing infrequently, such as the names and addresses of schools, physical facilities data and personal details of teachers, was pre-printed from previous records, only requiring school principals and teachers to update the data. The latter method did demonstrate to respondents that the information they submitted was actually processed, but it also caused some changes not to be indicated by indifferent respondents.
- Training in the completion and checking of the questionnaires was provided to Inspectors in Regional Offices. This training was repeated after several years to reach newly appointed Inspectors and as a refresher for others.
- Head Office kept insisting on questionnaires to be returned, even if somebody had to drive several hundred kilometres to a school and back to collect the questionnaire. If absolutely necessary, somebody from Head Office went to collect questionnaires. Especially in the early years of the EMIS, senior decision-makers gave their full support to actions ensuring the return of questionnaires.
- Insisting on the return of questionnaire required the EMIS to introduce good control mechanisms. The first step upon receipt of questionnaires was its registration in a table in the database containing records of all schools in the country. Outstanding questionnaires could be listed with a simple database query at any moment.

All of these factors contributed towards a ‘culture’ of returning the two annual census questionnaires. Returning the questionnaires became a well-entrenched part of the normal tasks of school principals.

The main mechanisms of ensuring the correctness of the data were numerous consistency checks built into the questionnaires, and holding Inspectors responsible for verifying at least some crucial numbers. The consistency checks mainly consisted of checking the consistency in numbers reported in different tables for males and females. All tables of numbers were designed to include horizontal and vertical totals for verification at data entry. The consistency of grades reported in different tables was verified. Wherever a number of records was submitted, for example separate forms or lines for individual teachers, some critical numbers had to be reported separately to allow cross-checking, such as the number of male and female staff members by post category.

For many years there was little reason for school principals to be dishonest in their reporting. This may change in future with fewer resources becoming available, and with more use being made of the EMIS information for resource allocation. It may thus be necessary in the future to audit the data submitted by schools.

Avoiding changes in the questionnaires, apart from some improvements and essential additions, since 1992 had two major advantages: comparable data was collected over several years, and school principals and Inspectors became well acquainted with the questionnaires, improving the quality of reporting.

4.3 Existence of a well-maintained database of educational data

The data structure of the EMIS database was initially designed after the data set had been defined and before work had started on the questionnaires. Necessary adjustments were made at later stages. Not being constrained by existing questionnaires proved to be very advantageous for the development of the data structures. The questionnaire design then profited from being based on an efficient data structure. In practice, these steps were not purely sequential, and feedback from subsequent steps in the information cycle frequently necessitated the revision of earlier steps.

As was reported in section 3.3 above, the processing of the EMIS data went from IMPS to dBase IV to Oracle. IMPS was not even a relational database system, and it was only used for an interim period, with the data having been converted to dBase later. The EMIS' insistence on migrating to a high-end relational database system, against some external advice, allowed the development of a reliable, stable database providing the required processing speed and being compliant with other software used by the EMIS.

The data entry system was re-developed several times before a user-friendly system with a sufficient degree of consistency checking had been generated. In total, the data entry system for the AEC was developed five times in five different systems: IMPS, dBase, Clipper, Oracle Forms and Oracle Developer 2000. The time required for cleaning the annual AEC data was a good indicator of the success achieved: while data cleaning took six months with the dBase data entry system, this time was reduced gradually to about one week with the latest Oracle-based version.

Constraints introduced into the database definition enforced basic data integrity. For example, learner numbers were entered as males, females and total in all tables. The database did not accept any record where males and females did not add up to the total.

Data entry was done centrally as the relatively small size of the Namibian education system, compared to other countries, allowed two clerks and three data typists to process questionnaires within the time it took Regional Offices to submit them. Central processing ensured that all questionnaires were entered with the extensive consistency checking at the time of data entry implemented by the EMIS.

Normal backup procedures, storing the backup media in a fireproof container, protected the database against hardware failures or other catastrophic events. Adequate security measures were introduced for protecting the hardware. It was also in this respect that substantial progress had been made since the beginning of the EMIS, when data was processed on a computer standing in an office with only rudimentary security measures in place.

4.4 The production of two annual statistical reports

Some initial tables of AEC statistics were produced by the EMIS using the IMPS system. The next series of 'reports' were thick piles of difficult-to-use tables, many of which did not address the needs of potential users. The EMIS staff realised this deficiency and completely re-designed the report, orientating it to the needs of the users, adding explanations and graphs, and spending much attention to the layout. While one staff member, assisted by an information technology consultant and a part-time editor, worked full-time on the development of the new report, other team members contributed their ideas and comments in daily discussions. Much attention was given to details, such as table layout and an user-friendly index guiding the reader to the appropriate tables.

Automating the generation of the tables in the education statistics report to a considerable extent made it possible to publish the reports annually.

The 15th School Day Statistics were mainly collected for operational purposes, and to provide the Ministry with information on the current year, which was in particular necessary for budgeting and resource allocation. As reported earlier, part of the purpose of this census was providing Inspectors and Regional Offices with information on the school level. Reports intended for the internal use of

the Ministry were produced from the 15th School Day Statistics. The generation of the tables in these reports was also automated. Improving the 15th School Day Reports has for several years been a desire, and still needed to be done by mid-1999. The main shortcoming was that too few user needs were met by the report.

4.5 The capacity to respond to ad-hoc requests for statistical information

Having stored all data collected with the two annual censuses since 1992 in a relational database system placed the EMIS in a position to respond to requests for information not contained in the statistical reports.

The relatively intricate database structures of the EMIS demanded a thorough knowledge of these structures and existing relations to query the database. Because of many advantages of the database structures, the challenge was not to change the structures, but to find ways of accessing the database that allowed different people to respond to requests for information.

In the early years of the development of the EMIS, queries were done in dBase, which was relatively easy, but time-consuming, for somebody able to write dBase routines. After the transition to the Oracle database, the EMIS acquired the Q&E query system, which was relatively easy to use, and very powerful for the experienced user. This system still required knowing the structure of the database, the meaning of cryptic table and field names, and the relations that had to be set up between tables. Few staff members of the EMIS became sufficiently conversant with the database structures, but those who did were able to compile quite complex queries, and to provide much of the information users requested within a relatively short time.

Another system, Cognos Improptu, was introduced at a later stage to give users access to the database using common English field and table names, and with the relations between tables having been set up for the users. There remained, though, some problems in getting this system fully operational.

4.6 Development of a Geographic Information System (GIS)

The development of the GIS started at a time when this was internationally considered extravagant. Namibia was in a position where little was known about where the greatest needs existed for additional schools, or for more places in existing schools. The 1991 population census contained relevant information, but this had to be related to school data on a relatively small geographic scale to inform micro planning processes.

The development of the GIS required a high initial investment of working time: the positions of all schools in the country had to be established using Global Positioning Systems (GPS), and maps had to be digitised. The Central Statistics Office had delineated its enumerator areas on diverse maps ranging from sketches on pieces of paper to large aerial photographs. The more than 2 000 enumerator areas had to be digitised by the EMIS Division to relate population census data to school data on a geographical basis. Links had to be established between the GIS and the EMIS database. These prerequisites for setting up a functioning GIS required allocating one staff member for a full year to the task with hardly any concrete outputs to show during the period. Several education officers did weeks of fieldwork to determine the geographical co-ordinates of schools.

The GIS was used for several purposes:

- mapping population and school data on large and small scales to inform macro and micro planning;
- drawing maps of schools for a variety of purposes;
- delineating inspection circuits and school clusters;
- re-allocating schools to regions after changes of boundaries;

- evaluating requests for new schools and extensions to schools.

A GIS-based data query system was developed and had reached a stage where it became a powerful, easy to use tool. The development had, though, to be terminated after the resignation of the staff member who built up the GIS and the end of the contract of the information technology consultant who had developed the query system.

The responsibility for the GIS was later transferred to the education planner responsible for school mapping in the so-called Corporate Planning Division of the Directorate of Planning and Development.

4.7 The capacity to conduct research and special surveys

Two senior staff members of the EMIS, one of whom is no longer with the Division, had a research background, although not in the social sciences. This contributed to the interest that existed in research. The close contact with researchers in the early years of the EMIS, indicated under 3.7 above, certainly contributed to an understanding of educational survey research, and an appreciation for the role of qualitative research.

Participation in the SACMEQ project was the most important single factor developing research competency and understanding in the EMIS. The simultaneous involvement in the NLA study was another important contribution. Other factors were the participation of two staff members in the short course in 'Quantitative Research Methods in Educational Planning' presented by the IIEP in 1996, and courses in statistics and Hierarchical Linear Modelling offered in the Ministry through a USAID-funded project.

4.8 Increasing utilisation of education statistics

The lack of utilisation of education statistics has for a long time been a source of concern and frustration for the EMIS Division. The well-known rule that information had to be relevant, reliable and timely seemed to contribute little to an increasing utilisation, although these requirements are certainly essential preconditions.

The following steps were, for example, taken to improve the use of education statistics:

- As it became evident that the reports of the first years were hardly used, the EMIS Division spent much effort on revising the education statistics reports as described under 4.2 above. Sufficient reports were printed to disseminate them widely to decision-makers, all directorates of the Ministry, Regional Offices, teacher resource centres, libraries, donor and international agencies, academic institutions, other ministries, Namibian representations in foreign countries, foreign diplomatic representations in Namibia, etc.
- Statistics were released in different forms, for example
    - a booklet highlighting crucial policy issues in colour graphics with explanatory texts (EMIS, 1996d);
    - a presentation of posters and a 'slide show' of graphics on computer in the foyer of the Parliament;
    - holding policy dialogues with senior Ministry staff and stakeholders using a computerised model for projecting the expected implications of proposed policy changes;
    - reports on the results of the 1992 NLBA study and the initial SACMEQ project (Ministry of Education and Culture, et al. 1994; and Voigts, 1998); and
    - the presentations of statistics as mentioned under the following bullet.

- Publicity was given annually to the release of the statistical reports and other reports produced by the EMIS, with senior Ministry staff, important stakeholders and the press being invited. Presentations were made of significant and interesting aspects of the statistics, not avoiding problematic tendencies.
- A volunteer working in the EMIS presented popular courses on the utilisation of education statistics in Regional Offices.

While active promotion of the utilisation of education statistics is essential, it should be noted that the provision of education statistics in an environment where such information had been scarce or non-existent in the past, requires a significant change in planning and management approaches before the statistics are utilised.

4.9 General factors contributing to the successful development of the Namibian EMIS

Several factors contributed significantly to the development of the EMIS in general:

A key element of the success of the Namibian EMIS was the support it received, especially in the initial years, from several key decision-makers, including the Minister. Having had a susceptible environment, and enjoying high-level support when demands had to be made on other components of the Ministry, was an essential prerequisite for success. It can hardly be imagined that success could have been achieved otherwise.

The openness of the Ministry regarding its statistics was an important aspect of the conducive environment. This openness was based on the Ministry's policy that education required the involvement of all stakeholders such as parents, teachers, communities, and the private sector. One of the goals of the Ministry was the 'democratic participation' of everybody involved in education, and this implied that the stakeholders had to be informed.

The Namibian EMIS had been fortunate to have had a dedicated team that closely worked together for several years. Apart form the Namibian staff members, the team included a number of foreign consultants and volunteers for shorter periods. These consultants and volunteers made a particularly important contribution, especially regarding the development of the information technology aspects of the EMIS.

The EMIS enjoyed a high degree of freedom in its work, with minimal interference from higher levels of management. This approach was also applied within the Division where feasible. Team members were given as much scope as possible to implement their ideas. The development of the EMIS did require extensive exchanges of ideas among staff members, which normally happened in professional discussions around the coffee table, and hardly in formal meetings. This freedom to implement one's ideas, coupled with critical discussions of these ideas among colleagues contributed much to the innovative development, and it was probably the main factor for retaining competent staff over an extended period. The approach did, though, not suit staff who wanted a clear job description and well-defined tasks.

Sufficient, but not excessive, resources were normally available for computer hardware and software. Although staff members mostly trained themselves in the use of software, staff attended courses in, for example, database administration. There were also short training opportunities in aspects of educational planning at the Harvard Institute for International Development (HIID) and the International Institute for Educational Planning (IIEP).

5. Valuable lessons learned

The following lessons learned should be mentioned:

- Management support is essential in developing an EMIS. Senior decision-makers must feel a need for an EMIS, and they must be prepared to provide their support to create a conducive environment for the development of an EMIS.
- The key steps in the information cycle outlined in the Introduction above must be followed. A common mistake is to start developing an information system designing questionnaires or purchasing a computer system. These are details, which must be attended to **after** the necessary steps to determine the requirements. Managers must be informed that the essential initial steps take a long time during which there will be no tangible output, but that a good result can only be achieved following appropriate design procedures.
- Determining the data set of the EMIS, database design, and implementing procedures to ensure the integrity of the database are key elements, which are easily neglected.
- Appropriate equipment and software is required: the integrity of the Namibian EMIS database and the smooth utilisation of the database would not have been possible without high-end software and a robust computer network.
- Submitting education statistics questionnaires must be an integral part of every school's annual programme, and it should not be allowed under any circumstances that questionnaires are not returned.
- The design of education statistics reports requires a high investment of time and expertise. The presentation of statistics is, though, extremely important to ensure their utilisation. The generation of annual reports should be partially automated to avoid unnecessary repetitive work.
- Statistics are required in different forms of presentation and different levels of aggregation to meet the needs of the users. Diverse presentations are thus required to ensure the utilisation of statistics.
- A continuous critical evaluation of the EMIS is necessary. Components found not to meet their purpose must be improved or replaced, if required. Examples in the Namibian experience were the database system used, the data entry system, and the education statistics reports.
- Geographically presented information can greatly enhance its value, and a GIS is a powerful planning tool. Development of a full GIS requires a high investment of time.

6. Challenges

The greatest deficiencies experienced in the Namibian EMIS were the following areas:

- Adult education;
- Financial information;
- Detailed information on school resources;
- Process and achievement information;
- Information on the external efficiency of the education system;
- Improving access to available information.

These deficiencies should not be considered insurmountable, but they should rather be seen as challenges to be tackled.

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