An Approach to Data Aggregation for Educational Planning in Nigeria

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Abstract— **Nigeria, with an estimated population of over 170 million is regarded as the sixth most populous nation in the world, after China, India, USA, Indonesia and Brazil. An estimated figure of over 55% of this population is made up of children and youth of school age. Planning and developing adequate educational facilities and resources to cater for this ever-increasing population pose serious challenges to government and education providers. It is observed that the decay in the Nigerian education system is largely attributable to lack of planning as a result of inaccurate or complete unavailability of relevant data. This obvious failure of government and its agencies to plan for education, provide needed facilities and enforce standards has given rise to influx of private, mostly "for-profit" education providers with poorly facilitated schools. In this work, an approach is presented for data aggregation for various regulatory agencies and administrators, to resolve the problem of lack of, or inaccurate data for educational planning. An architectural framework is also provided for the development of an online information system, which institutions can sign up to as users. This system is expected to assist regulatory agencies acquire necessary data for planning purposes.**

Index Terms— Educational planning, data aggregation, information system, education system, quality assurance.

I. INTRODUCTION

Over the past decades, IT and computer technologies have advanced tremendously giving rise to networks and internet technologies. Computer applications have become extensively integrated into virtually all aspects of human endeavours.

Nigeria, with an estimated population of over 170 million is regarded as the sixth most populous nation in the world, after China, India, USA, Indonesia and Brazil. An estimated figure of over 55% of this population is made up of children and youth of school age.

Planning and developing adequate educational facilities and resources to cater for this ever-increasing population pose serious challenges to government and education providers.

In Nigeria, it is true that individuals, communities, organisations and governments have committed monumental human and material resources into making

education deliver its unquantifiable dividends to society. However, the outcome, sadly, has not been a clear success story. Dilapidated and obsolete structures and equipment, unstable academic calendars, underfunding, unemployable graduates are the grim reminders of a troubled education system [5].

A number of factors account for the inability of government and education providers to plan for quality education. Ololube, [13] outlines some of the problems of Educational planning in Nigeria:

- *Inaccurate data:* One of the most difficult challenges that educational planners face is the issue of inaccurate statistical data. The quality of technical planning is in most cases inhibited by statistical deficiencies and inaccurate data. The Nigerian educational system has failed to effectively plan because of lack of accurate data, which is because of the use of mediocres to prepare data for use in the planning and forecasting process.

- *Technological Problem:* Another serious problem in the planning of education is the lack of attention paid to emerging technological innovations and planning mechanisms.

- *Political Arrangement:* Planning processes started by one administration are brutally interrupted by the next and differences between federal, and state government education policies are quite challenging.

- *Inadequate Planning:* There is a popular saying that "if we fail to plan, we have planned to fail". Lack of effective planning poses a significant obstacle to the advancement of education across the country. The success of any educational system hinges on proper planning for human and material resources which has evolved to guide the allocation and utilization of educational resources in the school system.

Inadequate and ill-equipped classrooms, laboratories, libraries and other facilities, inadequate staff in the right mix, quality and quantity and en-employable graduates, most of whom parade certificates in the upper class categories with the relevant knowledge and skills to match the certificates they parade are grim reminders of a decaying education system.

This decay in the Nigerian education sector is largely attributable to a number of problems. However in this work, the focus is on inadequate planning which is consequence upon inaccurate or lack of statistical data which forms the basis for planning, besides political and other technological issues. The need to evolve IT-based approaches to resolving statistical data issues in Nigerian education system becomes desirable and requires urgent attention.

In this work, we have presented IT based approach to data aggregation, which is considered appropriate for educational planning in Nigeria or any other developing nation in

similar situation. This work is not an attempt to evaluate or compare different information systems dealing with educational planning.

II. BACKGROUND TO THE STUDY

A. Issues in Nigerian Education System

While Dewey, [2] defined education as "the reconstruction or re-organisation of experience", Adegbesan, [1] describes it as the bedrock of every society and a tool for nation building and asserts that people and nations are what they are because of the nature and types of education they have been exposed to. He opined that quality education is the right of every citizen, not a privilege that the rulers may grant or withhold. This view has been given greater urgency by demands of modern industrialized and technological age. Education today must have the effect of making it possible for a country to have a steady supply of highly creative citizens who help to keep improving the living conditions of the general citizenry, and to solve the existential problems that are thrown from time to time. Such problems are now being further complicated by the theory and reality of the so-called "global village".

It is well known, that the problem government has is in reconciling access with quality in the provision of education; but it is abnormal to describe education as anything that lacks quality [1]. Needless to over-emphasis the consequences of the decay in the Nigerian education system. Perhaps the most worrisome consequence is the poor academic output of the graduates from Nigeria institutions. The certificates they parade may be in First Class or Distinction and Upper classifications, but they lack appropriate skills to support the paper qualifications.

In quest for better standards, especially since the 1980's, there has been high mobility of students, academic staff and professionals [6]. In parallel, new delivering modes and cross boarder providers have appeared, such as campuses abroad, electronic delivery of higher education and "for-profit" providers. These new forms of cross-border higher education offer increased opportunities for improving the skills and competencies of individual students and the quality of national higher education system [17].

Coupled with globalization issues in education, Quality Assurance has drawn concerns from governments, industry and other stakeholders in international education. Every institution strives to have a fair share of the global market and gain competitive advantage. But this is only realizable if its graduates can compete favourably with their counterparts elsewhere.

It is noted that quality education is both the responsibility of the government and those charged with the responsibility to manage schools. The dwindling standard of education in Nigeria has been attributed to lack of adequate commitment by those who are charged with the responsibility to impart knowledge through qualitative teaching, as well as the attitude of government towards proper funding of education as required by the United Nations standard [12].

The Roles of Educational Managers in Assuring Quality in Nigeria Education System

Irrespective of the character traits of the manager, basic roles [9] of educational mangers are outlined as follows:
- **Planning:** This requires the ability of the manager to look ahead and be able to formulate and select appropriate objectives and procedures to be followed within the school system.
- **Organising:** This is the ability of the manager to create structural work. This focuses attention on the structure and process of allocating tasks to achieve common objectives.
- **Staffing:** This requires the ability to search for the right people and to place them on the right job both in quality and quantity which would reflect their experience and capability for the school objectives to be achieved.
- **Motivating:** Managers should know to keep good morale of their workers in order to obtain maximum efficiency and effectiveness from them.
- **Evaluating:** This is the ability of the school managers to assess and know the outcome of the school's aims and objectives. They ensure that set down goals and objectives are achieved through quality control system which includes:
  - An effective quality control system
  - Periodic audit of the operations of the system
  - Periodic review of the school system to ensure it meets changing requirements.

Strategies for establishing Quality Assurance in Education include monitoring, evaluation, supervision, inspection, quality control, access and equity [1].

Whatever strategies, are employed in pursuing quality assurance agenda, internal evaluation processes should be deployed to improve quality as well as for purposes of accountability.

Looking at the strategies outlined above, a rather rhetoric question echoes in one's mind. Are the regulatory agencies at all levels of education actually performing these roles creditably? It is presumed that the rather diverse and uncoordinated mix of institutions (government/private) in the Nigerian education sector pose huge challenge to regulatory agencies.

Unarguably, there are agencies charged with the responsibility for policy formulation and implementation, resource allocation and control, management and supervision, assessment and evaluation, quality control and feedback in the Nigerian education sector.

Unfortunately, poor standard of education and the high turnout of unskilled and un-employable graduates attest to the obvious fact that these agencies have not achieved their desired goals.

Lack of proper planning has given rise to a number of undesirable variables, which are at work in the Nigerian education system;

i. **Inconsistent Government Policies**

The fundamental education system in Nigeria includes:
6years of primary education
3years of Junior Secondary education
3years of Senior Secondary education
4years of University (or tertiary) education

On paper, this structure exists. In practice the implementation leaves much to be desired. Supervision and control are in disarray as the policies have become fluid

over time.

ii. *Poor Funding*

Funding represents one of the critical variables that must be addressed if the ideal education in general is to translate into tangible and measurable impact on the quality of life of citizens and by extension the nation [5].

iii. *Inadequate Staffing*

It would just be an understatement to say that Nigerian tertiary institutions are understaffed. Where staff exists, they are not in the appropriate subject mix, quality, gender balance and desired ratio. More often than not, appointments are made with political considerations, quota system, tribal and religious sentiments. Table I shows the status of academic staff in Nigeria tertiary institutions.

Table I: Faculty Staff in Tertiary Institution.

	School System	Academic Staff	No. Required	Shortfall
1	College of Education	11,256	26,114	14858 (56.9%)
2	National Teachers Institutes	6,526	7,000	474 (6.8%)
3	Polytechnics/Mono-technics	12,938	30,016	17,078 (56.9%)
4	Universities	30,452	50,000	19,548 (39.1%)
5	Noun	5,220	15,000	9,780 (65.2%)

Source: Shu'ara (2010)

Shu'ara puts the ratio of Academic staff:Non-Academic staff in universities at 1:2.6 and concluded as follows:

- o There are academic staff shortages across board particularly in the critical areas of science and technology.
- o Over 60% of the academic staff in the Nigeria University system are in the category of lecturer 1 and below
- o These shortages are compounded by inter and intra sectorial brain drain.

iv. *Politicised Access*

Access to education is based on political policies rather than competition. The establishment of the Joint Admission and Matriculation Board (JAMB) to regulate admission standard in Tertiary schools in Nigeria introduced and implemented schemes like catchment areas, cut off marks, federal character, state of origin (Instead of state of birth). These have had serious consequences on the education system. Less qualified candidates find their way into higher institutions because of where they come from at the expense of better candidates. Many prospective students, desperate to gain admission into higher institutions bribe their way through. When they are unable to maintain academic excellence, they resort to various forms of vices like cultism, prostitution, robbery and "blocking" as a means of continued stay on campus.

v. *Organised Corrupt Practices/Malpractices*

There are three dimensions to this virus ravaging the education system and destroying it to its foundation:

- o The role of parents
- o The role of students
- o The role of education managers/teachers

The Role of Parents

Regrettably, and beginning from elementary schools, many parents resort to buying admissions for their wards rather than encouraging them to prepare for qualifying examinations.

In the secondary school system, we hear of "cooperation fees" during WAEC or NECO examinations. In the tertiary institutions, grades have equivalent cash values. Parents provide funds to their wards for these. We are witnesses to it that at the end of semester examinations, parents and guardians move from one lecturer to another to solicit upgrade of scores for their wards, instead of encouraging their wards to study hard to earn excellence.

The Role of Students

Students are willing and active mobilizers for and collaborators with forces of darkness which want to destroy education.

Rather than working hard to achieve academic excellence, students prefer to "block" (with money, material and sex). Some of the students act as agents to evil forces of darkness robed in teachers' clothes. There is disproportionate increase in social more than academic activities on campus with net consequences of the birth of a generation of people whose intellectual, theoretical and practical ability is at sharp variance with the content of the paper certificate they carry around [5].

The Role of Education Managers/Teachers

The underlying factor for lack of enthusiasm on the part of educators to creditably deliver quality educational services is hinged on corruption and greed- motivated approaches and strategies. Many educators have mortgaged their conscience for money. They no longer think of the future and career of the learners. They collect bribes from parents and students, so as to aid enhanced performance. By the conduct of teachers and educational administrators who engage in ungodly transactions with students, we leave a long-lasting impression on students that success comes by fraudulent means, not by hard work nor dedication and commitment. Learners are denied the opportunity to acquire skills and knowledge, which are fundamental elements for employability and self-reliance.

vi. *Faulty Quality Assurance Strategies*

In a functional education system, there are two main strategies to enforce standards:

- o Internal quality control
- o External quality monitoring

Education administrators and school managers have yielded to pressures from grossly depraved society and are now in conformity with the standards and dictates of societal value system. This compromise, coupled with greed, has resulted in absence of the will and courage to carry out quality monitoring and control functions creditably. Strategies for resource allocation and management, control, supervision, assessment and evaluation, quality monitoring and feedback have been compromised.

This unstructured mix of policies and implementation

strategies has had devastating effect on quality education over the years

B. Information Technology Solution

The discussion of the ability of correct deployment and use of IT tools presented here derives from our knowledge of the existing practice in Nigeria, work experience, interest, observation, previous research works and extensive study of literature from available sources such as research journals, books, periodicals, technical materials, and seminars, various policies of regulatory bodies, government publications and reference books.

Lack of, or inadequate planning is an indication of lack of purpose. The very first step towards quality education is to set realistic long and short term goals. Then evolve technically and financially feasible plans and strategies for achieving these goals.

One of the problems of educational planning in Nigeria, among others, is inaccurate data. The quality of technical planning is, in most cases, inhibited by statistical deficiencies and inaccurate data [13].

The above problem can only be resolved with correct application of computer systems for school administration. In this work, a computer-based Academic Information Management System that captures students' enrolment and produces enrolment statistics that can serve multiple purposes is presented.

III. MODELLING APPROACH

Following design science approach [3], [8] and systems engineering hierarchy approach [14], we relied on the knowledge of the existing practice in Nigeria education sector, derived from work experience, interest and observations, to formulate innovative concepts and research idea that showed potential to improve actual human and organizational capabilities in educational planning Nigeria.

A. The System concept

There are four levels of administration in the Nigerian education system
i. The schools
  ii. Local Government Education Authority
  iii. State Government Education Ministry
  iv. Federal Government Education Ministry

These administrative authorities may be operating through various agencies responsible for policies implementation.

The global view of the data aggregation schema is illustrated in figure 1.

The schools form the operational source systems. The input data from the schools transactions come from different operational source systems. The data can be integrated at a data staging area, similar to that of data warehouse.

Schools are grouped in categories, such as Pre-Kindergarten/Kindergarten, Primary, Secondary, Tertiary institutions respectively. Each institution is associated with a Local Government, Each Local Government is associated with a State, and each State is associated with Federal Government for information sharing.

The school's information system generates the following;
- School profile report
- Students enrolment statistics
- Staffing profile/statistics
- Funding report
- Physical facilities report

These, form the base data for the system, which are shared across all administrative levels in the education system.
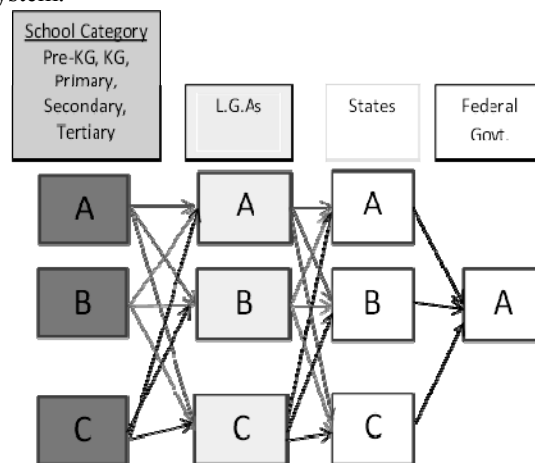

Fig 1 Global view of the data aggregation schema.

The Academic Information System's concept for the four levels of administration in Nigerian education is illustrated in figure 2.
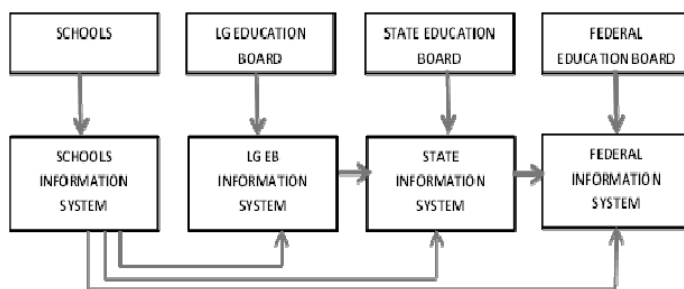

Fig 2 Academic information system data communication concept.

Data in the system arise from different independent operational units as illustrated in figure 3. The data from the operational subsystems are integrated at the data staging area of the repository. Standards and best practices are established for data integration [16], [4].
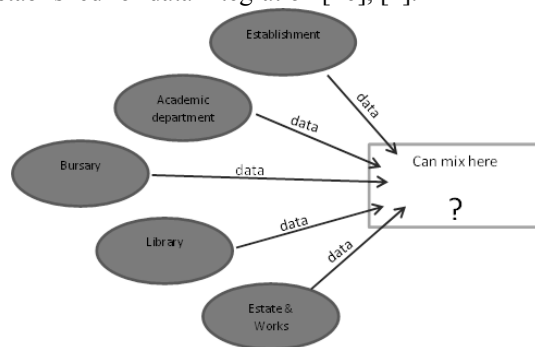

Fig 3 The operational source systems integration Concept.

The students' enrollment statistics, (Table II), forms the basis for staffing, funding and provision of physical facilities.

Table II: Students Enrolment Statistics

SCHOOL: … … … … … … … ENROLMENT STATISTICS FOR 2014/2015									
COURSE OF STUDY	CLASS 1			CLASS 2			CLASS 3		TOTAL
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MAL	FEM	AL TOT
TOTALS									

Schools in Nigeria are located in both rural and urban settlement. Schools in rural areas where there are no facilities can have much simpler information systems, or manual systems that can be used to prepare the input data. With the recent development and spread of telecommunication networks, it is possible for rural schools to create user profile in the Local Government Education Authorities, State Education Ministries or Agencies and Federal Government Education Ministry or Agencies' online platform to update the school's record. With advances in solar energy technologies, Government can assist the rural schools to set up at least one administrative computer unit for the purpose of data communication.

Figure 4 illustrates the extended data aggregation model with optional fuzzy classification layer to enable the system accept input in plain linguistic terms when desirable. This allows the use of both crisp and fuzzy queries to run on the system.

By extension, supervisory agencies, (LGA, State or Federal Government) can implement computer-based information systems to capture enrolment figures and other desired data from every school, thereby having an aggregate statistics report for their entire geographical domain.

Figures 5, 6 and 7 show the data aggregation flow diagrams for the various levels of information systems.

With available internet appliances, it is feasible for every school from Pre-KG to Tertiary institutions to have a username and password to the supervisory agencies' educational portal.

It therefore means that the government can know how many pupils in primary one in 2015, by sex, age, location etc.; it becomes feasible to have correct estimates of how many pupils we are expecting (+ or -) in primary six by 2021.

Government can start planning for all the required facilities for that population ahead of 2021. This scenario follows for all categories of institutions and for local, states and federal government respectively.
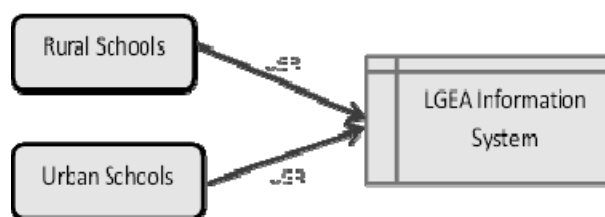

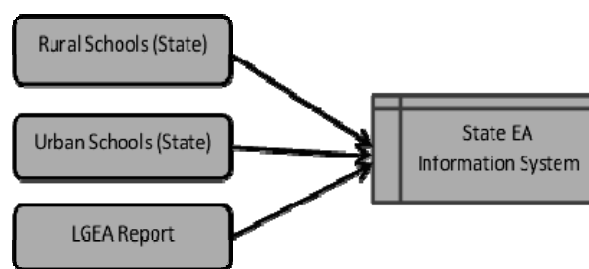Fig 5 Local Government Education Information System.

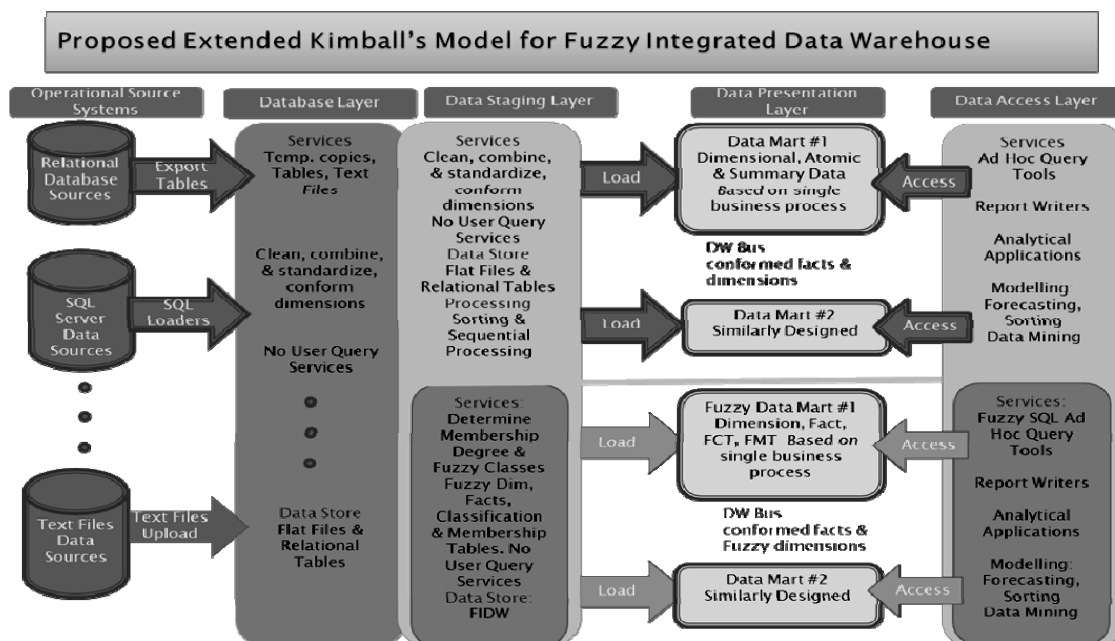Fig 6 State Education Information System.

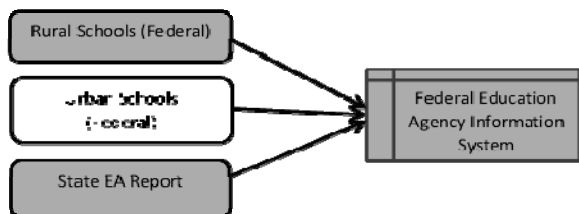Fig 4 Extended model of an integrated data warehouse with fuzzy layer

Fig 7: Federal Education Information System.

Government can put necessary legislation in place to ensure that any proprietor whose school (at whatever level) is not captured in the system is prosecuted and the school shut down. This will be another source for credible estimates of population statistics for the nation.

This integrated information system has accurate enrolment statistics as input data. The system tracks teacher: student ratios and the appropriate mix by gender, quality, number, cadre and subject mix. The government may not be able to resolve staff deficiencies for the on-going academic session or next. But obviously what is required in 3-5 years' time becomes glaring, and adequate preparations in terms of recruitment and training programmes can be embarked upon in view of the upcoming sessions.

B. Conclusion

In this work we have highlighted some of the major problems responsible for the falling standard of education in Nigeria. We have attributed this to lack of proper planning which takes root from incorrect or complete unavailability of statistical data for planning. We have presented an information system schema that can be used to achieve technically feasible data aggregation. Most institutions and supervisory agencies already have implemented "ad-hoc incompatible" information systems that may be functional in their own rights. We have presented an approach that can be used to aggregate data from these systems where they exist, so as to have an information system that can be used to aggregate enrolment statistics, staffing requirements statistics, funding and facilities requirements statistics for academic planning purposes. With this decision support system, it becomes possible for school administrators to know the status of each academic programme each term, semester or session.

This self-assessment platform will be of tremendous value to school managers for planning, resource allocation and management, budgeting and budget implementation. Managers would be able to know the strong indices to sustain while planning to strengthen the weak ones. With the chronological versioning of data in this system, it becomes possible to visualize what the programme status looks like at any point in time within the period under consideration.

For this platform to have healing effect on the system, government regulatory agencies need to deploy the integrated academic information system online and every institution signed up for use. With this, all information on institutions, their programmes and resources as well as enrolment become visible to the government and the supervisory agencies. The content of the accreditation instrument and other desired information can be provided and updated on the portal by user institutions at the beginning of new session, mid-session and end of session. This will reduce the voluminous paper feedback system which is slow and error prone. To ensure integrity of data and information provided by institutions, government should ensure that funding and resource allocation, provision of facilities and staffing are based on available data such as updated enrolment statistics on the portal.

While further work is on-going to produce online application that will serve the needs of the LGEA, State and Federal government supervisory agencies, we also encourage other developers to use the specifications in this report to develop online application with enhanced efficiency and reliability for the Nigerian education sector.

C. Further Studies.

Further work is being done on the implementation of this model as well as the introduction of fuzzy concepts to improve the decision support capability of the model.

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