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EDUCATION INFORMATION SYSTEM DECENTRALIZATION: THE INTRODUCTION OF DIGITAL LEARNER RECORDS IN THE GAMBIA

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Abstract: The Gambia EMIS has mainly consisted of a manual, paper based reporting system maintained from the national level. The recent policy changes, which emphasize social inclusion in quality learning, call for an “EMIS shift”, which includes the development of a digital national Teacher Register, Learner Records, and the decentralization of key EMIS functions to regions and schools. Empirically, this paper concerns the steps taken towards a decentralized EMIS in the Gambia as we follow the initial implementation of the individual learner admission and registration system in 200 schools. We synthesize previous IS centralization and decentralization literature into an analytical framework, which we apply to make sense of the case findings and provide recommendations for future EMIS decentralization initiatives.

Keywords: centralization, decentralization, social inclusion, education management

1. Introduction

World development agendas, like the Millenium Development Goals (MDGs) and the Education for All framework (EFA), introduced in 2000 and 1990 respectively, focused on solving global issues of poverty, sanitation, education, health and wellbeing by ensuring access to public services for all. Countries, including developing ones, developed systems to help monitor indicators of access to these services, mainly on a collective level. In 2015, at the end of the MDG period, its final progress report indicated achievements, but also highlighted disparities across age, gender, socio economic and geographic groupings. A key takeaway from the MDG period was the need to tackle the inequalities and uneven progress by targeting interventions and resources in a fair and equitable manner. This set the theme for the ensuing Sustainable Development Goals 2030 Agenda (SDGs).

With the slogan “Leave no one behind” as a core principle, the SDGs promise to reach out to every individual to arrest these inequalities. This creates a phenomena wherein the information needs of countries shifts from the collective to the individual to be able to provide public services in an equitable manner. The Gambia is a developing country in sub-Saharan Africa that has aligned its national education policy with SDG4 (SDG for Education) which emphasizes the need to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all”. In particular, SDG Target 4.5 stresses the need to “ensure equal access to all levels of education and vocational

training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations”. The implications are that data needs to be disaggregated by gender, location, wealth quintile and other factors, such as disabilities and income levels (Unicef, 2020). Consequently, the national Education Management Information System (EMIS) needs to handle data on individuals disaggregated by a wide range of socio-economic factors (Alvesson & Viñuela, 2014) to target individual learners in terms of interventions, track their progress for early warning mechanisms and identifying and capturing the out-of-school learners.

The Gambia’s Ministry of Basic and Secondary Education is shifting its EMIS to collect individual level data. This includes a *granularization* of EMIS data and tools, *digitalization* of EMIS process, and *decentralization* of Key EMIS functions to schools. As the increased volume of information processing is enabled by the digitalization of EMIS routines, the ensuring workload could easily overwhelm the system if key EMIS functions aren’t decentralized. This paper zooms in on this and discusses four decentralization dimensions to understand the implications of the EMIS shift.

Empirically, this paper concerns the steps taken towards a decentralized EMIS in the Gambia. First, in section two, we review relevant literature on decentralization and centralization of management information systems. Our literature review synthesizes *four* dimensions along which decentralization and centralization needs to be balanced. In section 3, we describe our methods, which is followed by accounts from our empirical case (section 4). In the discussion part of our paper, section 5, we consider how the implementation of an EMIS, aimed at supporting evidence-based decision-making for inclusive and quality education, brings into play different EMIS decentralization dimensions. Finally, we offer some concluding remarks on the implications of the study.

2. IS Centralization and Decentralization

The centralization versus decentralization of information systems is an important but complex debate with a long history and few simple answers (Ein-Dor & Segev, 1978; Hugoson, 2009; Rockart & Leventer, 1976). Most conceptualizations rely on some notion of distance; distance between unit locations; distance between different levels of organizational hierarchy or operations within an organization; the physical or organizational distance between where decisions are made and where they are enacted (King, 1984). There is no clear boundary between centralized and decentralized information systems, but rather a core-periphery continuum (Heeks, 1999; Rockart & Leventer, 1976). The basic questions regarding centralization and decentralization revolve around tailoring organizational arrangements to meet the constraints of organization size, the nature of the IT involved in organizational operations, and the needs of different organizational actors (King, 1984).

Chang (2006) defined IS decentralization from the perspective of decision making as “the act or process of assigning the decision-making authority to lower levels of an organizational hierarchy”. The lower the average level at which decisions are made, the greater is the decentralization (Chang, 2006). King (1984) divides decentralization into three separate areas: physical location, function, and control. Control concerns the locus

of decision-making in the organization. Physical location concerns where operations and responsibilities are located in physical space, whereas function refers to the placement of a responsibility within the organizational structure (King, 1984).

Dimension of decentralization of MIS

Norton (1972) argues that the term "centralization" is meaningless with reference to an information system as a whole. Instead, it must be "approached in terms of the specific functions which make up the operations and management of an organization's information system" (Rockart & Leventer, 1976). Accordingly, Norton clusters information systems related activities into three categories: Systems Operations, Systems Development, and Systems Management.

Norton (1972) further points out that centralization of system operations include the applications that need information crossing hierarchical boundaries. Against centralization, the complexity of operating systems, high risk of failure, high communication costs, and competition for priority of service in centralized systems are argued (Rockart & Leventer, 1976). Norton subdivides systems development into its analysis, design and programming phases. According to Norton, there is "fair consensus" that the analysis phase should be decentralized. For the design and programming phases, with the level of expertise and specialization involved in mind, centralization is peddled (Rockart & Leventer, 1976). Concerning system management, there is no clear consensus in literature except for development of standards where the argument is in clear favor of centralization (Rockart & Leventer, 1976). Depending on changes in technology, economic situation, available capacity and political interests (King, 1984), the different aspects of an MIS can be either centralized or decentralized at a given point in time.

(Ein-Dor & Segev, 1978) identified five elements, the position of which should be considered on the centralization-decentralization axis according :

- 1) Organizational structure: As Pick (2015) argued, the choice of centralization vs decentralization may be influenced by the overall structural design of the organization housing the information technology. In the case of systems development for example, decentralized organizations have been found to have problems of inconsistency in data due to problems of syncing updates and reports.
- 2) MIS development and implementation: the degree to which MIS plans and projects are formulated and executed centrally.
- 3) MIS unit: This element has two sub elements; a) the degree to which MIS resources are controlled centrally. This included specialized personnel resources. b) The degree to which the decentralized MIS units are centrally controlled. The MIS units might have discretion with their decision-making or they could be an extension, implementing decisions of the central MIS unit at headquarters.
- 4) IT resource: The degree to which IT infrastructure and computer equipment is geographically concentrated. In a decentralized system, the bulk of the infrastructure

could be located at the headquarters with smaller computers and devices at the lower levels.

5) Data and Data Management in the organization. Redundancy is minimized by use of a centralized database. Decentralized databases could result in lack of data element standardization that is a major problem when it comes to synchronizing, processing and analyzing data.

(Heeks, 1999) identified 8 'areas of responsibilities' in dealing with public sector organization information systems. These areas are; information systems planning, organizational structures and staffing, data management, computing and data management architecture, information systems development, information technology acquisition, training, and technical support. He goes on to argue that centralization or decentralization of any of these responsibilities have both merits and challenges. Centralization generally promotes sharing of resources across the organization, avoids duplication and wastage, supports learning and control, and lowers acquisition costs through bulk purchases. However, centralization increases information system dependencies and vulnerabilities and weakens responsiveness as information needs to flow all the way between the central unit and the periphery to inform action. There is also limited ability to accommodate heterogeneous local information system needs.

In contrast, decentralization is praised for its closer distance between the users and the IS developers, easing IS designs around the local users' needs and enabling rapid development cycles. However, decentralization could create a barrier to sharing of data and other resources, including human resources, due to the different information systems that are incompatible. It also limits central planning and control which results in duplication of efforts and data redundancy reducing the efficiency of the information system.

Instead of identifying where each of these areas of responsibility would fall on the centralization-decentralization axis, Heeks recommended a different approach: a core-periphery one. In this, he reconciles the centralization and decentralization approaches into one where both the central and local actors would be involved in all areas of responsibility.

Heeks' in addition to Ein-Dor & Segev's paper, among the papers we reviewed, provided the most practical decomposition of information systems functions and responsibilities that can be mapped to practical issues in the organization. Heeks' paper is further endeared to us by the fact that it's from a similar public sector context. As a result, we synthesize the two papers into a framework that is both practical and focuses on the key components to shed light on the decentralization process from our case.

Our synthesis of the IS centralization-decentralization literature, with an emphasis on the public sector, results in a framework with 4 key dimensions to consider:

1. Organizational structures and staffing, including the structure of the MIS unit
2. Information systems planning, development and Implementation
3. Computer architecture, hardware resources (management and acquisition)
4. Data management

3. Methods

The Gambia is a relatively small developing country in a good position to experiment with individual learner records on a national scale. Learnings from The Gambia may inform similar initiatives in other parts of the world. The EMIS decentralization initiative is country driven and as such no buy-in was necessary, open access - no struggles in gaining or maintaining access - to resources, people, documents, offices etc. One of the authors has good access as a member of the national EMIS team and is involved in the design and implementation of the action research project as well.

The purpose of this research is centered around understanding the steps taken by the ministry towards the decentralization of the Gambia EMIS to the school level. We employed a case study methodology within the interpretive research paradigm as we follow the ministry's decentralization process and how it has been interpreted by the various stakeholders along the decentralization chain. The research covers the start of the project in January 2019 to its current state with the two authors very much involved from the beginning. The first author is more hands-on as a member of the local team that conceived the project and also one of the leaders of the implementation team. The second author follows the project from a distance, which allows for a birds eye view on project activity and findings. The authors balance out each other's positional shortcomings granting the research project both analytical rigor and local relevance.

3.1 Case Background

In the Gambia, a political progression towards decentralization is based on the 1997 Constitution, the Local Government Act (2002) and the Local Government Finance and Audit Act (2004). These legislations set out to fundamentally restructure the public sector through extensive fiscal and functional decentralization. Local government areas (2 Municipalities and 5 Councils), structures and officers, were granted authority to provide basic services in education, health, agriculture, road maintenance, sanitation and animal husbandry (Alam, 2009). The Education Sector has attempted to decentralize its functions, such as control of schools, through Regional Education Directorates located in each municipality and council. The two municipalities, both in urban areas, were able to open new schools. However, due to lack of expertise and constrained finances, the control of schools was transferred back to the central government shortly thereafter. The councils, mostly in rural areas, found themselves unable to even open new schools. The education sector, like other sectors, still remains under central government control.

The ministry of education in the Gambia has recognized the importance of EMIS to support decentralization and make strides towards the policy goal of inclusive quality education for all. This is why the EMIS is being decentralized to the school level in tandem with a shift from aggregate to individual level data about learners.

In early 2019, the ministry of education in the Gambia invited Health Information Systems Programmes Center from the University of Oslo, Norway (HISP UiO) and its regional arm, HISP West and Central Africa(HISP-WCA), to a workshop at the MoBSE offices in to discuss the current state of EMIS in Gambia, ongoing EMIS

strengthening efforts by the ministry and to identify the implementation scope of the EMIS-HISP UiO support project. Among the key outcomes of the workshop was an agreement to experiment with eRegisters for students and teachers in schools.

The Ministry of Basic and Secondary Education in the Gambia has customized and implemented the Free and Open Source DHIS2 software application as the new platform for the Education Management Information System (EMIS) in the Gambia. The Health Information Systems Programme (HISP) research group, located at the Department of Informatics, University of Oslo, is coordinating the development of the DHIS2 software and is providing support to implementation teams in various countries. HISP West and Central Africa as a regional organization and a partner of HISP/Department of Informatics, University of Oslo is responsible for coordinating and carrying Information System implementation, assessment, planning, capacity building and research activities in the West and Central Africa region within the HISP network. HISP-WCA trained the core EMIS staff of the ministry on the DHIS2, and supported the ministry during the configuration of the platform for tracking students and teachers to be implemented at the school level.

The education management system has three main levels, the central ministry of education, the regional education directorates, and the schools. There is a fourth level, in between the regional education directorates and the schools, called “Clusters” which are composed of clusters of schools for easier management and supervision, by cluster monitors (school inspectors). The cluster monitors are attached to the regional education directorates as there are no permanent structures that represent the cluster level. Due to resource constraints, only public Lower Basic Schools, Upper Basic School and Senior Secondary Schools are targeted in the initial EMIS decentralization initiative.

3.2 Data collection and data analysis.

Data collection started in January 2019 when the planning and development of tools began to around June 2021 when pilot implementation in two regions was concluded. Along the way, a pre-pilot test was held where teachers were trained and then observed while they used the system to register students. During the pilot, head teacher meetings were held to inform about the planned shift and notes were taken of their comments and reactions. Interviews were held with senior officials of the ministry - head of EMIS unit, EMIS advisor to the ministry and a former permanent secretary of the ministry - to identify their motivations and expectations with the EMIS shift. Discussion sessions were also held with regional officers to understand what their needs and concerns are and how this shift could affect their roles.

Document studies were also conducted covering the national education policy and strategic plan, national development plan and local government acts. These documents provided context and some background into the project giving us better understanding of the motivations and vision of the ‘EMIS shift’

We began to make sense of the data early into the data collection process. We applied qualitative data analysis to identify key themes that were coded and grouped. The

grouping helped distinguish the main dimensions along which we could analyze the data using the synthesized framework and Heeks core-periphery concept.

4. EMIS Decentralization in the Gambia

Currently, the central EMIS unit is overwhelmed with more schools opening each year and continuously expanding national and international data requirements. The ongoing shift to individual learner data poses significant data processing demands that cannot be handled by the central unit alone. The central EMIS unit would ideally spend its time and resources on making sense of the data and designing programs and interventions to improve the quality of education and mitigate barriers to social inclusion. EMIS decentralization has the potential to strengthen local ownership and enhance the utilization of data for decision-making at regional, cluster and school level.

4.1 Implementation of the “EMIS shift”

HISP UiO, through its regional arm, HISP-WCA, has supported the central EMIS unit in designing a solution to collect individual level student data at school level. Amongst the key processes in school administration are the admission and registration of children into the school, recording of student attendance, monitoring of performance, tracking of disciplinary records of students etc. The solution designed by the EMIS team incorporated all of the above key processes, but the ensuing pilot only focused on the admission and registration of students, as this is the entry point to student management processes in the schools.

The initial phase involved 200 schools of all primary and secondary education levels in two regions consisting of both urban and rural communities. Findings from the first phase were expected to inform a subsequent national implementation as the two chosen regions contained all the demographics in the country. Each of the 200 schools was supplied with a Chromebook to be used during enrollment of students. Chromebooks were chosen to leverage the offline capabilities of the DHIS2 android tracker app, as many of the schools have very limited access to the internet. This allows the schools to enroll students as they show up and periodically synchronize data with the server when there is internet access.

During the implementation, regional officers were invited to discuss the planning of the teacher training and help in the configuration of the Chromebooks. They supported the central EMIS team on conducting the training and served as regional support staff to schools. A head teacher meeting was organized to present the idea of the shift to individual data. Each head teacher was then tasked to delegate three (3) representatives from the schools, on account of the risks involved in ‘putting all our eggs in one basket’, to be trained on enrolling students using the chromebooks and synchronizing data. It was also suggested that schools use the trainees to train other teachers in their schools to further mitigate against capacity issues due to teacher transfer, promotion etc. Most of the trainees identified were teachers because they are mostly responsible for the

admission and registration of students as many of the schools don't have auxiliary staff to take up these responsibilities.

Through the use of managerial Dashboards on the DHIS2 platforms, both the central ministry and the regional offices now have real time access to enrolment data and analysis based on various demographics of the students. However, there is a plan to conduct an extended training of the regional officers on the use of DHIS2 as a reporting and analysis tool to support their monitoring and oversight functions. The schools can access the dashboards too, either through the web or through the DHIS2 dashboard android app, installed alongside the tracker app in the chromebooks. The schools, however, need internet connectivity to access the DHIS2 Dashboards. Internet connectivity is one of the main constraints facing the implementation.

4.2 Institutional reception

The initiative, as expected, was well received at the central and regional levels, although the regional officers pleaded for more involvement in shaping the project and for increased capacity building to use and manage the system to meet their information needs.

At the school level, the reaction was mixed. Some schools appreciated the initiative as they saw the need for progress and the role of IT in it. Some envisioned that the solution would help bring about their routine activities in the schools. Others were able to relate to the need for individual data and motivations for the “shift”, while others recognized the digital innovations ongoing in other sectors and were glad education was not being left behind. Nevertheless, a few schools were concerned with the implications for their existing data systems: would they need to throw them out in favor of this new initiative? This also resulted in concerns for interoperability between systems at the school level.

However, almost an equal number of school representatives doubted the feasibility of the initiative citing the history of the central units designing seemingly well thought out plans only to fail during implementation. Some bemoaned the unavailability of critical resources in some schools including internet access, electricity and staff. A few made reference to more pressing matters – dilapidated structures, learning materials, teacher motivation, performance issues (~ learning crisis) - that needed more urgent attention. From an operational point of view, concerns were raised regarding the authority of the ministry to collect individual data on learners and the legal grounds for it. A few schools, all private, blatantly refused to participate in the exercises, citing international laws on data privacy, confidentiality and security. Some argued that digital registration of students using the devices are not part of the teachers' Terms of Reference and that they are not qualified to handle the data analysis and reporting needs of the schools. Instead, they suggested qualified personnel to be trained and posted to each school.

Drawing on the synthesized framework, we outline the ongoing EMIS decentralization in the Gambia and the apparent trade-offs between centralization and decentralization.

System development includes analysis, design and development of information systems pertaining to the EMIS shift. Due to the level of expertise required and shortage of distributed capacity to develop components of the information system, this component is largely centralized. However, the development process is nonetheless informed by a participatory approach involving a combination of HISP WCA (mentioned in background above) for technical support and training, MoBSE technical and organizational stewardship, and representation of different stakeholders and user groups from the regional, cluster and school levels.

System management includes the administrative aspects of planning, developing, operating and controlling of the system. For the sake of uniformity of reporting, standardization of tools and procurement of electronic equipment, this component is largely centralized. There are specific procurement rules public institutions in the Gambia must follow when purchasing equipment. Decentralization of this process tantamount to unnecessary repetition of the same procurement process that might result in delays and procurement of sub-standard, incompatible or heterogenous equipment that will be hard to maintain.

System operations comprises the infrastructure, including the hardware, operations and human personnel. This component is largely decentralized because of huge processing tasks demanded by the shift in the data system. Computers will be provided at all public schools with the new information system available locally to handle the daily information processing needs. Network infrastructures will be provided to enable the transfer of information between the schools, regional directorates and the central EMIS unit at the ministry of education headquarters. Support staff will also be trained and made available either at the schools or at the regional directorates to support data processing activities and the maintenance of the information system.

5. Analysis

5.1 Framework Analysis

The synthesized framework when applied to our empirical case emphasized four dimensions.

5.1.1 Organizational structures and staffing, including the structure of the MIS unit

This dimension concerns how the organization partitions the responsibilities of development efforts and data management along its hierarchy between the central and local staff. In the case we studied, the central ministry trained staff at the school level to handle local data processing needs while handling their routine tasks in school in what Heeks (1999) dubs “hybrid staff”. In supporting the school level users on maintenance and making best use of the information systems, regional staffs were identified as focal points for the schools but the central ministry is yet to fully train them on supporting

schools and managing the data systems to relieve the stress on the schools of challenges related to remote support and decentralize that responsibility away from the central staff.

5.1.2 Information systems planning, development and implementation

The IS development dimension concerns the involvement and level of participation of end users and local units in the planning, development and implementation of the information system. It also includes the planning and coordination of training packages and the support rendered to the end users which always follows the development and implementation of any information system. During the planning stages, research work was conducted at the school level studying the data needs and the flow of information. Stakeholders were interviewed, which contributed to the design of the information system. The design and development of the information system was mostly handled centrally. However, a participatory evaluation of the system was carried out in a couple of schools generating invaluable feedback for the developers. The implementation and training was conducted with the full participation of the regional staff with the ongoing support also their responsibility.

5.1.3 Computer architecture, hardware resources (management and acquisition)

The computer architecture in practice is a client/server model as is most common in core-periphery approaches (Heeks, 1999). The server is hosted on the internet and accessible to the end users via the web or mobile applications. The purchase of hardware is handled centrally as is their replacement but feedback and suggestions from user experiences is invaluable for the central team to fulfill its coordinating and supportive role.

5.1.4 Data management

Data management dimension consists of defining the division between the central and end users on the creation, alteration, usage and control of data items within the information system. Data management was mostly handled centrally with the more 'generic' data relevant across all the levels and the more 'specific' data most relevant to the schools. The schools, however, are very homogenous across the country with close similarities in terms of structure, operation and information needs. Introducing specific data needs for each would increase the complexity of the system many fold. This makes the study cited above more important as specific data items common to the schools were introduced (many socio-economic indicators of the student) which has more relevance to the school than the central level.

6. Discussion

Centralized management is deeply rooted in the colonial history of the Gambia. Most sectors, including education, practiced centralized management until the local government act (2002) was passed. The implications of decentralization in such “a historically embedded system” (Sahay et al., 2010, p. 31) is highly dependent on the commitment and will of the top authorities, which, in the case of the Gambia, is very strong.

The central EMIS unit has long used the EMIS for generating statistics and reports for central management. The new individual learner information system offers much more than mere generation of statistics. The system is intended to facilitate administrative processes in the school like student admission and registration, assessment, disciplinary records and class allocations/timetabling. In addition, it is a monitoring tool to aid the regional education directorates in their planning and oversight functions over the schools.

With the introduction of ICT in all public schools, it is highly unlikely that a resource-constrained country will afford to place ICT technicians and information processing clerks in all schools, at least not in the short term. The bulk of the data processing responsibilities, including attendance and assessment, will be placed on the teachers who, others might argue, are already overburdened. The fact that data processing is technically not part of their “TOR” makes this issue complicated. The implications of this contradiction could be devastating for the project as a whole as data processing is an integral part of any information system.

7. Conclusion

The four decentralization dimensions, which we identified and developed into a framework and applied analytically in this case study, are all significant in the process of implementing an individual learner information system vis-a-vis an existing aggregate education management information system. Awareness around IS decentralization and its tradeoffs and interdependencies across different dimensions is critical as public sectors in developing economies move towards collecting more and more granular and individualized education data. The determination and will of education sector authorities to decentralize EMIS functions, to ensure progress towards social inclusion and equitable quality learning, are essential to this end, but is not sufficient on its own.

In the education sector, the push for data is informed by aspirations to make learning socially inclusive and equitable. This will need to go hand-in-hand with decentralization of key EMIS functions. Yet, decentralization of data handling tasks needs to be weighed against the availability of qualified staff at the school level. In theory, decentralization means distribution of power. However, it can also simply mean that overburdened teachers get even more data to collect, without time for reflection and self improvement. Here, we have identified and described four key dimensions along which EMIS can be

centralized or decentralized along a continuum: organizational structures and staffing, information systems planning, development and implementation, computer architecture and hardware resources, and data management. We believe decentralization along these dimensions need to be weighted carefully to ensure sustainable local empowerment without overburdening of local staff. Furthermore, decentralization needs to involve all organizational levels, including middle management levels, such as education sector regions, so that they can actively support the new decentralized responsibilities of the level below.

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