

**A CONTEXTUAL ANALYSIS OF EDUCATION MANAGEMENT INFORMATION  
SYSTEM (EMIS) IN TERTIARY EDUCATION SYSTEM: FORMS, ISSUES AND  
FACTORS FOR INTEGRATION.**

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## **Abstract**

Education Management Information System (EMIS), being the form of management information systems that is specific to the education system, is a distinct tool and comprehensive system for managing and making changes in the education system. In the context of a tertiary education system, such as the University, with decentralised structure of academic and administrative units, several EMIS are deployed at different units to manage their respective information system requirements. However, these EMIS needs to be seamlessly integrated to delivers on its core benefits of providing holistic, timely and reliable information for management decision. Achieving this seamless integration of several EMIS with heterogeneous platforms and programing languages requires a contextual understanding of the distinctive components and forms of EMIS that are deployed and the consideration for technical factors that affect its integration. This research study examined the literature on EMIS within the context of a tertiary education system to justify the observations that were made in the semi-structured interview that was conducted with five (5) EMIS professionals in five (5) purposively selected Universities in Nigeria. The objectives are to identify the various forms of EMIS in tertiary education system and to further establish the alignment of issues and factors for consideration to achieve seamless integration of several EMIS.

## 1: Introduction

Hua & Herstein (2003) argued that the management of the information, intended to make meaningful changes to education system, is the design essence of EMIS. The argument further stressed that EMIS is also to highlight the interdependencies that exist within and across the different elements of the education systems. It can also be seen that different EMIS are used to manage key and separate activities: enrolment, course selection, result processing, student and staff profile management among others. This observation is premised on the argument by Mohd Hasan & Abdulmonem (2009) that the deployment of various types of EMIS to address each of these academic activities has offered an efficient and effective means of managing the education system.

Kurt (2001) posited that EMIS is critical to the education system. They are seen as a tool and as a comprehensive education support system for bringing people, process and technology together, as shown Figure 1.1.1. This is to ensure the provision of timely, cost effective and user appropriate information at whatever level that it is needed. The argument further strengthened the fact that EMIS is an important factor in education system that should be given attention. It is, however, different from other forms of Information Systems such as the Statistical Information System (SIS) or Decision Support Information System (DSIS).

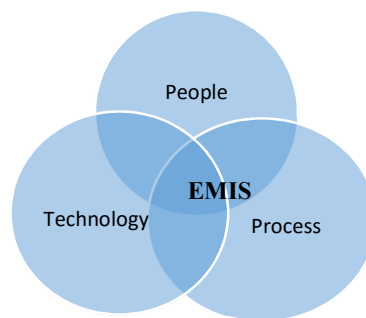


Figure 1.1: The Three Key Components of EMIS

Within the context of accurate and timely retrieval of information, such as enrolment figures that link students and costs in education institutions, Kurt (2001) argued that an integrated EMIS is very important to achieve this objective. This further establishes the need for integrated EMIS in education institutions.

The efficiency and effectiveness of EMIS to deliver on timely and reliable information within the education system can be evaluated on some fundamental criteria. These fundamental criteria are argued by Hua & Herstein (2003) as the ability of the EMIS to provide basis for:

- i. Definition, collection and processing of data for educational information and statistics.
- ii. Integration of data from multiple sources within the education system
- iii. Systematic storage and retrieval of data on request

It is therefore necessary and sufficient to describe an efficient and effective EMIS as one that is technologically designed to be integrated with several other EMIS. Each EMIS is to allow for the collection, storage, retrieval, processing and sharing of data across several other EMIS. The exchange of data is serialised to be platform independent; recognising the need to exchange data across several EMIS of different platforms and standards.

## **2: Background Study**

The tertiary or higher education system, as used inter-changeably in literature, encapsulates all forms of post-secondary education, including but not limited to the University. The University, being the ivory tower of learning with decentralised structure of faculties and departments, requires an integrated EMIS to manage the flow of information among the different Information Systems used at its different levels.

Ekundayo & Ajayi (2009) argued that an effective EMIS would need to address the two levels of a tertiary education system: the internal system that reflects the organisational structure and external level that connects the tertiary education with the government and development partners or external sources. This argument is supported by Ali (2013) with clarification on the three distinctive component parts of the tertiary EMIS at the internal level:

- i. **Higher Education Student Information System (HESIS):** this is concerned with student related information and with two subsystems: teacher-student information exchange system and student-management information exchange system.

- ii. **Internal Management Information System (IMIS):** concerned with information flow across faculties and departments – academic and managerial divisions.
- iii. **Open Source Information System (OSIS):** concerned with learning resources such as the e-Library Information Systems (e-LIS) for students, lecturers and researchers to connect to external research materials or the institution staff to connect to other external sources.
- iv.

The entire information flow within the tertiary EMIS is, therefore, an interaction between the information flow at the internal and external levels, as shown in the Figure 1.2. To maximise the benefits of these systems, there is the need for a strategic technical approach to integrate and coordinate the systems (Aserey & Alshawi, 2013) to make the EMIS available in a comprehensive, but succinct form for all stakeholders (Villanueva, 2003). The representation of interaction, with respect to information flow, between the internal and external levels of tertiary EMIS that is provided in Figure 1.2 is an adaptation from (Villanueva, 2003) for Nigeria context.

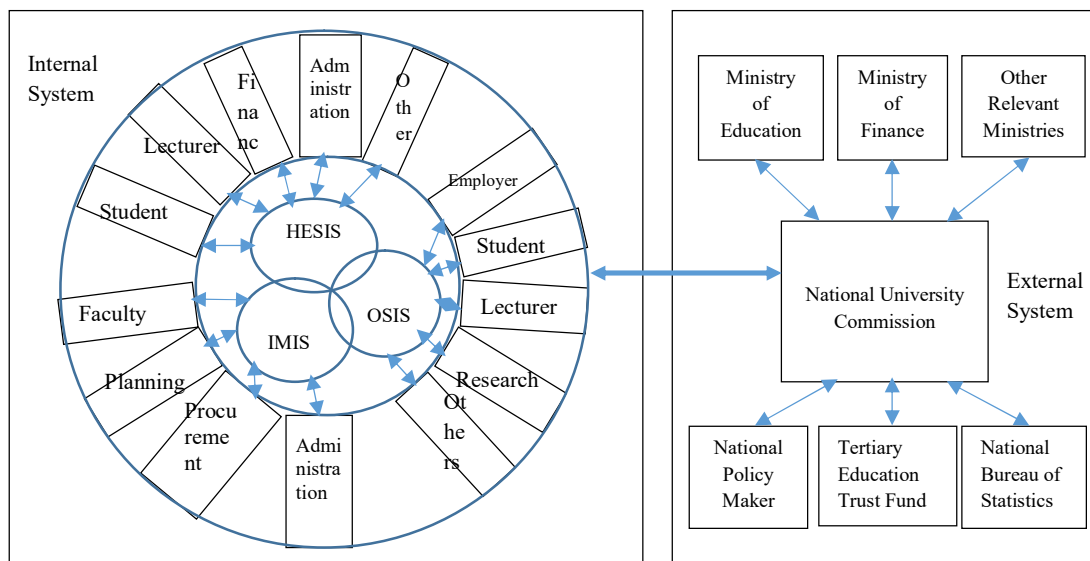


Figure 1.2: Information Flow across Levels in Tertiary EMIS adapted from (Villanueva, 2003)

The argument of Guo & Song (2010) is found adequate in describing the EMIS for tertiary education system as a complex system that involves the management of activities such as

teaching plans, students' profile information, course selection, academic performance, teaching evaluation, course allocation to lecturers and its registration by students among other vital activities.

However, Aserey & Alshawi (2013) considered a typical tertiary education system (King Abdulaziz University (KAU), Kingdom of Saudi Arabia) and described the different forms of EMIS for academic and administrative purposes to include: Student Services System (SSS), Academic and Staff Services Systems (ASSS), Administrative Service Systems (ASS), University Bid System (UBS) and Other Extra Services Systems (OESS). The author submitted that tertiary education institutions deploy a variety EMIS to support their academic and administrative activities, and that these systems require integration to exchange data across different platforms. The integrated data provides useful information to for planning and decision-making.

Meanwhile, Bisaso & Visscher (2005) argued on a survey to investigate the most common modules of EMIS in tertiary institution to include Financial Monitoring and Planning, Student Records and Student Assessment with least common modules being Library Management and Student Attendance; the common modules were noted to be mostly used by management for decision-making.

### **3: Research Methodology**

The research study takes an epistemological stance on post-positivism - a careful observation of the objective reality (Creswell, 2009). The research study is explanatory with deductive reasoning and adopts the narrative strategy by taking a qualitative approach (literature review, expert interview and observation) on data collection. The literature on EMIS was examined within the context of a tertiary education system to justify the observations that were made in the semi-structured interview that was conducted with five (5) EMIS professionals in five (5) purposively selected Universities in Nigeria. The purpose of selection is based on higher education institutions, within the reach of the researcher, that have deployed several EMIS requiring integration for optimum service delivery. The objectives are to identify the various forms of EMIS in tertiary education system and to further establish the alignment of issues and factors for consideration to achieve seamless integration of several EMIS.

The data analysis is done through a mix of content analysis, thematic analysis and recursive abstraction.

#### 4: Forms of EMIS in Tertiary Education Institutions

It is observed that different tertiary education institutions deploy different forms of EMIS for each academic challenge. While most of these EMIS are custom built for specific purposes, a few others are open source solutions. For clarity of argument and understanding, the major forms of EMIS used in tertiary education system are identified, categorised and described by the tasks (academic or administrative) that they are made to manage. These are represented in the below. Table

##### 1.1: Forms of EMIS in Tertiary Education Institutions

Tasks	Forms of EMIS	Characteristics
<b>Applications for Admission</b>	Online Application and Admissions Information System (OAAIS)	Custom
<b>Course Administration</b>	Course Selection and Registration Information System (CSRIS)	Custom
<b>Teaching and Learning</b>	Modular Object Oriented Development Learning Environment (MOODLE), Sakai Project, OpenEMIS	Open Source
	Blackboard Learning Management Systems	Proprietary
<b>Finance and Payments</b>	Online Payment and Financial Information System (OPAIS)	Custom
<b>Profile Management</b>	User Profile Information System (UPIS)	Custom
<b>Academic Units Management</b>	School Information System (SIS)	Custom
<b>Results and Grading</b>	Result Processing Information System (RPIS)	Open Source
<b>Library Management</b>	Koha Integrated Library Information System (LIS), Evergreen LIS, Open Automated Library System (OPAL)	Open Source

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It is therefore necessary and sufficient to describe an efficient and effective EMIS as one that is technologically designed to be integrated with several other EMIS. Each EMIS is to allow for the collection, storage, retrieval, processing and sharing of data across several other EMIS. The exchange of data is serialised to be platform independent; recognising the need to data exchange across several EMIS of different platforms and standards.

## **5: Contextual Issues in EMIS Integration**

The increasing technical demand for interconnection of different enterprise systems to seamlessly work together has informed the need for integration (François, 2009). Integration of various EMIS is, therefore, a technical approach of removing the barrier and allowing the interactions among several EMIS to enhance the overall efficiency and effectiveness of the education system. This view is corroborated by the argument of Panetto & Cecil (2013) that integration of enterprise systems, such as EMIS, allows applications to communicate in the most effective way. This is achievable by providing interface or platform for exchanging data.

For instance, an Application Programming Interface (API) or a Central Data Exchange Server (CDES) can be deployed as possible technological means of effectively achieving integration of different EMIS. The API, which is a bundle of programming codes with class objects and data, can be developed to serve as interface among different EMIS for exchanging data. Such interface accepts data request, process and respond with appropriate data in a standardised format using the Extensible Markup Language (XML) or Java Script Object Notation (JSON) technologies. The alternative of using the CDES is to develop mobile agents that moves



between a central EMIS server and the other EMIS applications. Data exchange across integrated EMIS is through the CDES and by the mobile agents.

In an environment, like the education system, where several EMIS applications are used to manage different information challenges at different levels, integration becomes a key technical approach to remove communication barriers and allow interconnection of such systems. To properly identify the most effective technical means of achieving integration and set a clearly defined objective for its realisation, there is the need to examine some issues for considerations: focus, purpose and level of integrations.

### **5.1: The Focus of Integration**

Maier, Hadrich & Peinl (2009) while citing Merten (2001) argued for some dimensions to integration when considering it in the context of information processing. These dimensions set the focus for EMIS integration and include:

- i. Considerations for the data objects: This relates to the structures of the data, functions, methods, programs and processes that are maintained by applications to be integrated.
- ii. The direction of integration: This can be horizontal (integration of processes within a service provision) or vertical (integration across service levels).
- iii. The scope and range of the integration: This involves the integration of functions and processes within or across specific area (internal or external environments) of singular or several EMIS.
- iv. The degree of automation of the integrated systems: This is a consideration for the level of intervention needed for the integrated systems to fulfil its functions.

It is only appropriate, therefore, to take a holistic consideration on the focus for the integration of several EMIS.

## **5.2: The Purpose of Integration**

Moreover, as the education system, like every other organised system, aligns with the technical approach of integrating EMIS, there is the need to examine the key achievable purpose of integration. In a critical assessment, the integration of various EMIS can be argued generally to be for three key technology purposes.

- i. **Scalability:** This refers to the need to integrate various enterprise systems to expand its scope of operations and functionalities. In this instance, the purpose of integration is to allow for the expansion and upgrade of the EMIS by adding new modules (Horizontal Scalability) or connecting a new functional EMIS (Vertical Scalability).
- ii. **Performance:** This refers to the need to enhance or optimise the functionality of an EMIS. The purpose of integration, in this instance, is to ensure that the EMIS can process information from various data sources more effectively and efficiently. It can, however, be argued that scalable EMIS may result in good performance but the reverse may not be the same.
- iii. **Interoperability:** This refers to the provisioning of technical standard for seamless data communication and exchange across heterogeneous EMIS platforms. The Integration of various EMIS, in this instance, is for the purpose of ensuring seamless data exchange and communication across various EMIS of different information and communication semantics.

## **5.3: The Level of Integration**

The goal of integrating various enterprise applications, relative to achieving interoperability, is for each application to gain access to shared data (Panetto & Cecil, 2013). This, therefore, requires an understanding of the movement of data and functional processes across the different levels of the EMIS application layers. Within the context of enterprise application integration, achieving the integration of various EMIS requires a clear understanding and decision on the level of the EMIS application layer at which integration can be performed. These levels of enterprise application integration, applicable to EMIS, are argued by Tariq & Abrar (2012) as thus:

- i. **User-Interface Level:** This primitive approach requires the use of a common user interface to represent the point of integration. In this instance, various EMIS are integrated through a common application window or menu platform to extract and exchange data. The key benefit of this approach is its simplicity in providing uniform channel for conveying synchronised information from several EMIS data sources. Meanwhile, the lack of standard and technology support has limited the possibility of achieving seamless data exchange at this level of EMIS integration
  
- ii. **Application Interface Level:** The integration of the various EMIS is achieved at the Application Programming Interface (API) level. In this instance, the API of each EMIS exposes the objects and data in an EMIS function as an application interface. The interfaces of an EMIS are used to access the process and data of another EMIS. Thus, integrating various EMIS to share data and logic. Service Oriented Architecture (SOA) and Enterprise Application Integration (EAI) are the two common technologies that are used for integration at the application interface level. While the EAI implementation adopts the middleware means of providing common infrastructure for data exchange, the SOA approach is based on services that are exposed and accessible to other technologies, using the XML and web services as data exchange technologies. The integration at application interface level has the advantage of shared services and standard technology support that makes it a re-usable and effective means for integration. However, its lack of support for shared data and complexity of administration are its major limitations.
  
- iii. **Method Level:** The integration of EMIS at this level involves the synchronisation of methods and processes from several functional modules of different EMIS. The approach at this level of integration requires the use and re-use of EMIS methods (representation or instance of an EMIS programming logic that can be called for execution) in another EMIS, without necessarily rewriting such piece of codes. This is possible with the availability of standard tool and technology for the programming paradigm at this level of integration. Thus, various EMIS can be integrated to exchange data and logic by calling and re-using their respective methods. The challenge at this level of integration is the absence of a shared data source and interface for seamless integration.

- iv. **Data Level:** This approach requires the process or technology of extracting, manipulating, storing and moving data across the respective databases of various EMIS. In this instance, data exchange across various EMIS is achieved in such a way that extracted data is manipulated only once where it occurred and stored with appropriate access rights for other EMIS to use. This creates a single and common data source for respective modules in various EMIS to share, thus effectively managing data redundancy and consistency. Meanwhile, the absence of standard and complexity of its implementation are major limitations to data level integration.

**Table 1.2: Comparing Levels of Integration**

Factors of Comparison	User-Interface Level	Application Interface Level	Method level	Data level
Shared Interface	Yes	No	No	No
Shared Data	No	No	No	Yes
Shared Services	No	Yes	No	No
Standards/Technology	No	Yes	Yes	No
Complexity	No	No	No	Yes

- v. While the integration of various EMIS to achieve interoperability of data can be achieved at the User-Interface, Application Interface, Method and Data levels, it can be argued that the application interface level is the most effective level of achieving seamless integration of various EMIS of different programming languages and platforms. This argument is premised on a cursory appraisal of information presented in

Table 1.2, where application interface level integration creates greater support for shared services with standard technologies for managing the complexity of achieving integration of enterprise applications of different platforms.

## **6: Factors Affecting EMIS Integration**

Schwabe, Rossi, Esmeraldo, & Lyardet (2001) argued that application development involves the use of design structures and different technologies like programming languages and databases; designed in a systematic way that allows for the re-use of the design structures and the application codes. The effective re-use of the application codes, however, can be argued to be on its data structure capability for data integration that allow several applications to seamlessly exchange data across different platforms. Thus, there is the need for technical considerations to manage the volume of data that is being exchanged across various EMIS platforms (Hua & Herstein, 2003).

These technical considerations represent key factors that affect the effectiveness and efficiency of EMIS integration. Castano, Palopoli, & Torlone (2000) argued in a submission that Enterprise Applications, such as EMIS, varies significantly base on the application objectives, functionalities, structures and architectures. However, Hua & Herstein (2003) suggested that an understanding of the unique identification codes, the structure of the contents of the data and the context from which data is derived are technical issues to consider when working on integrating EMIS.

Thus, the above arguments can be annexed to have substantially captured the key factors that affect the integration of several EMIS to achieve seamless data exchange. These factors can assist in the clarity of arguments relating to the purpose and objectives, access mode and update frequency, functionality and performance, data structure and schema, and architecture and format of data for integration.

### **6.1: Purpose and Objectives**

Kaya & Dogu (2013) observed that the success of an education system is dependent on the objectives of its Information System to provide support for sharing, storing, classifying and use of information. This objective is needed to be mapped with the purpose integration to achieve, for instance, interoperability of data across EMIS of different platforms. Thus, it is important to consider the purpose and objective of EMIS integration to decide, as a factor, on

the means and appropriate technology for integrating several EMIS to effectively and efficiently manage the education system.

### **6.2: Access Mode and Update Frequency**

The integration of several EMIS requires a consideration on the methods and technologies for accessing data and the frequency at which data is updated. This definitely affects how data is stored, queried, referenced, modified and exchanged with other databases in other EMIS.

For instance, data from an EMIS can be accessed remotely by other EMIS over the web using such methods or technologies as Application Programming Interfaces (APIs) and Remote Services to communicate. Another alternative is for the various EMIS to exchange data through direct file access using the technologies of the File Transfer Protocol (FTP) or HyperText Transfer Protocol (HTTP).

It is, however, important to note that the frequency at which data are updated has an effect on the technology for the data access mode. This, thus, becomes a factor for consideration in the integration of various EMIS for data exchange or interoperability.

### **6.3: Functionality and Performance**

The functionality of the EMIS is defined by the collective features of the various EMIS or its modules that are integrated, such that it covers a wider spectrum of the needs of the education system. Thus, achieving the key objective for integration requires the appropriate mix of features to enhance the EMIS functionality. This is also related to the performance of the EMIS, which is arguably the capability of the functional modules of various EMIS that are integrated to respond to data request by returning query results, timely. This also extends to the reliability of the data obtained that is obtained from such query.

Achieving performance driven EMIS with enhanced functionality requires careful consideration of the methods and technologies for integration to achieve the key objectives. Such methods and technologies bother on the data characteristics defined by its format, schema, structure and its serialisation.

#### **6.4: Data Structures and Formats**

The encoding of the data that is being exchanged among various integrated EMIS defines the data format, which can be serialised through standard technologies like XML or JSON, being the most common text-based serialisation format (Sumaray & Makki, 2012). It can therefore be argued that the choice of effective standard technology for serialisation of data across integrated EMIS is influenced by the format of data that is being shared. Related to this is the data structure, which defines the logical representation of the data in such a way that it can be easily stored and accessed by query.

In essence, the consideration for data structure and format of various EMIS to be integrated affects the mode of data storage and retrieval, the technology for data serialisation and the query for data manipulation.

## **6: Summary and Conclusion**

This study examined the discussion on the description of EMIS as an enterprise education support system for bringing people, process and technology together. In tertiary or higher education system, an integrated EMIS is required to manage the flow of information among the various EMIS that are used at its different levels: the internal level that reflects the tertiary education structure and external level that connects the tertiary education with the external sources – government or development partners. However, it is argued from the research findings that different tertiary education institutions in Nigeria deploy different forms of EMIS for each task or academic challenge: Applications for Admission, Course Administration, Teaching and Learning, Finance and Payments, Profile Management, Academic Units Management, Results and Grading, Library Management. While most of these EMIS are custom built for specific purposes, a few others are open source or proprietary solutions. The contextual factors for EMIS integration is examined to properly identify some of the considerations to be made while deciding on the integration of several EMIS to achieve defined objectives for its realisation. These considerations are examined along the argument on the focus, purpose and level of integration. The study then examined some of the factors that affect the EMIS integration to include the purpose and objectives of integration, access modes and update frequency of shared data, functionality and performance of the integrated EMIS, and the structure and format of the data being exchanged.



## References

- Ali, S. M. (2013). Strategic Requirements of Higher Education Management Information System. *Collnet Journal of Scientometrics and Information Management*, 145 - 155.
- Aserey, N., & Alshawi, S. (2013). A CONCEPTUAL MODEL OF ENTERPRISE APPLICATION INTEGRATION IN HIGHER EDUCATION INSTITUTIONS. *European, Mediterranean & Middle Eastern Conference on Information Systems*. Windsor, United Kingdom.
- Castano, S., Palopoli, L., & Torlone, R. (2000). A General Methodological Framework for the Development of Web-Based Information Systems. In *Conceptual Modelling for E-Business and the Web* (pp. 128 - 139). Springer-Verlag.
- Creswell, J. W. (2009). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. London: SAGE.
- Damin, R., Kadry, M., & Hamed, E. (2014). An investigation into the use of the Education Management Information System (EMIS) in Iraq: Case study. *International Conference on Engineering and Technology (ICET)* (pp. 1 - 6). Cairo: IEEE.
- Duan, R., & Zhang, M. (2007). Design f a Web-based Management Information System for Academic Degree & Graduate Education. *International Federation for Information Processing*, 252, 218-226.
- François, B. V. (2009). Enterprise Integration and Interoperability. In S. Y. Nof, *Springer Handbook of Automation* (pp. 1529-1538). Springer Berlin Heidelberg.
- Guo, F., & Song, H. (2010). On Designing the Security System of LAN-based Educational Management Information System. *2nd International Conference on e-Business and Information System Security (EBISS)* (pp. 1 - 4). IEEE.
- Hua, H., & Herstein, J. (2003). Education Management Information System (EMIS): Integrated Data and Information Systems and Their Implication in Educational Management. *Annual COnference of Comparative and International Education Society*. New Orleans, USA.

- Indrayani, E. (2013). Management of Academic Information System (AIS) at Higher Education in the City of Bandung. *13th International Educational Conference* (pp. 628 - 636). Sakarya: Elsevier.
- Kaya, A., & Dogu, Z. (2013). E-Okul Education Management Information System (e-Okul EMIS): Sanliurfa. *European Journal of Research on Education*, 36 - 41.
- Kurt D, M. (2001). Education Management Information System: What is It and Why Do We Not Have More of It. *International Journal of Technologies for the Advancement of Knowledge and Learning*, 8 - 12.
- Maier, R., Hädrich, T., & Peinl, R. (2009). Integration Services. In *Enterprise Knowledge Infrastructures* (pp. 1 - 90). Springer Berlin Heidelberg.
- Panetto, H., & Cecil, J. (2013). Information Systems for Enterprise Integration, Interoperability and Networking: Theory and Applications. *Enterprise Information Systems*, 7(1), 1-6.
- Sajjad, A. B., & Awais, A. (2010). Challenges in Education Management Information System in Developing Countries.
- Schwabe, D., Rossi, G., Esmeraldo, L., & Lyardet, F. (2001). Web Design Frameworks: An Approach to Improve Reuse in Web Applications. In *Web Engineering* (pp. 335 - 352). Berlin: Springer Berlin Heidelberg.
- Sumaray, A., & Makki, S. K. (2012). A Comparison of Data Serialization Formats for Optimal Efficiency on a Mobile Platform. *6th International Conference on Ubiquitous Information Management and Communication*. New York, USA: ACM .
- Tariq, R. S., & Abrar, H. A. (2012). Challenges and Future of Enterprise Application Integration. *International Journal of Computer Applications*, 42(7), 42 - 45.
- Villanueva, C. C. (2003). *Education Management Information System (EMIS) and the Formulation of Education for All (EFA) Plan of Action - 2002 - 2015*. UNESCO.