Interoperability Framework for Tech4ED E-Services

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Abstract: E-government plays an important role in providing better public services to people. In the Philippines, the government initiated the Tech4ED (Technology for Education, Employment, Entrepreneurship, and Economic Development) Centers to bridge the digital divide, provide access to government e-services, educate and empower individuals in underserved communities and rural areas. Numerous nations are adopting a well-established strategy within the e-government domain known as the 'whole-of-government approach'. This approach emphasized collaborative and integrated e-government to deliver more effective and efficient services. However, a significant portion of government e-services within the Tech4ED platform still operate in isolated silos and agency-specific applications. Considering these challenges in government e-services, this study examined how can Tech4ED e-services be integrated using the whole-of-government approach (WGA). Qualitative research methods, including focus group discussions with Tech4ED center managers in Carmona City, Cavite, and Technical Education and Skills Development Authority (TESDA) subject-matter experts (SME), were employed to gather and analyze data. The findings of this study led to the development of an interoperability framework for Tech4ED e-services based on benchmarking with Australia and South Korea Interoperability Frameworks and service-oriented architecture (SOA) in line with the recommendations of the WGA. The framework was then validated through additional focus group discussions with Tech4ED center managers. This study contributes to the understanding of e-government interoperability particularly within the context of the Philippines and its government learning management systems (LMS) offering insights into how integrated e-services can enhance public service delivery.

Key Words: e-government; e-learning; learning management system; interoperability

1. INTRODUCTION

1.1 Overview

Nowadays, the use of e-government initiatives to provide public services to people through information and communications technologies (ICTs) has rapidly increased around the world. E-services, which is one of the branches of the e-government domain, are now being utilized to offer more effective and efficient government services via the internet to citizens. In the Philippines, the government launched the Tech4ED (Technology for Education, Employment, Entrepreneurship, and Economic Development) initiative to provide access to government e-services in rural areas and communities. Tech4ED Centers also provide users

access to the Tech4ED Platform (www.tech4ed.gov.ph), an e-learning system offering various courses for informal education, skills training, and language proficiency. This initiative aims to bridge the education gap within communities. E-learning systems play a significant role in enhancing the skills and employability of its users by granting them accessible and quality educational opportunities. According to Aman et al. (2022), there is a positive role of e-learning environment on the employability skills and job opportunities as per labor market demand.

However, implementing a well integrated e-services has currently become one of the top priorities of many countries in the area of e-government. Termed as a whole-of-government approach (WGA), the call by United Nations (2012) for interoperable e-services by allowing the systems deployed throughout government to communicate with one another aims to strengthen public services and increase the availability, accessibility, productivity and effectiveness of e-government to citizens. To achieve interoperability, standards and specifications for three interoperability levels must be identified (Novakouski & Lewis, 2012). The three interoperability levels are (1) organizational interoperability, (2) semantic interoperability and (3) technical interoperability. European Commision (2017) argued that organizational interoperability is the alignment of business processes, responsibilities, and expectations of government agencies to achieve commonly agreed and mutually beneficial goals. Semantic interoperability, on the other hand, ensures that the precise format and meaning of exchanged data and information is preserved and understood throughout exchanges between e-services and application systems. While technical interoperability covers the applications and technical infrastructures linking systems and services. According to UNDP (2007), interoperability will allow data from different government agencies e-services to be used together to make faster and better decisions and deliver better services.

Given that the e-learning modules that can be accessed from Tech4ED platform were developed by different government agencies such as Department of Information and Communications Technology (DICT), TESDA, Department of Education (DepEd), and Department of Agriculture (DA) and were implemented using different technologies and programming languages, it is evident that these government e-services are still non-integrated and remain agency-specific applications. Thus, this study looked at how can whole-of-government approach (WGA) and interoperability be implemented to Tech4ED platform to provide a better learning experience for the users.

This study utilized both inductive and deductive research approach, alongside qualitative research methodologies, to investigate the implementation of WGA to Tech4ED e-services to provide better learning experience to users. Interoperability Framework for Tech4ED E-services was developed and proposed at the end of the study.

1.2 Research Statement & Objective

Based on the background of the study above, this study sought to answer the general problem: "How can Tech4ED e-services be designed to make each system become interoperable with one another for better governance and public services?"

Furthermore, this research aimed to answer the following specific questions:

- What are the information and communication technology (ICT) tools and practices that need to be considered to support interoperability of Tech4ED e-services?
- What are the standards and specifications for front-end systems to achieve interoperable Tech4ED e-services?
- What are the standards and specifications for back-end systems to support interoperable Tech4ED e-services?

In line with the research statement and questions, the specific objectives of the study were:

- To examine the current situation of Tech4ED e-services, their functions and challenges.
- To perform benchmarking of interoperability framework from top 2 international e-government leaders
- To benchmark the front-end and back-end system requirements of Tech4ED e-services to the standard interoperability tools and current best practices.

1.3 Conceptual Framework

According to United Nations (2012), the whole-of-government approach (WGA) can be achieved by implementing interoperability to government applications and e-services. Moreover, UNDP (2007) pointed out that e-government interoperability can be attained through the adoption of standards and through architecture. Furthermore, implementing a service-oriented architecture (SOA) for government systems can help achieve e-

government interoperability (UNDP, 2007). A service-oriented architecture (SOA) is an enterprise-wide IT architecture that promotes loose coupling, reuse, and interoperability between systems. Hence, the researcher used different e-government interoperability frameworks and SOA model in the study to answer the research question. Specifically, Philippine eGovernment Interoperability Framework (DOST-ICTO, 2014), Government Interoperability Guide (UNDP, 2007) and SOA Reference Architecture (The Open Group, 2009).

The researcher identified the components and principles from PeGIF, Government Interoperability Guide and SOA Reference Architecture and mapped them to the three interoperability levels such as organizational interoperability, semantic interoperability and technical interoperability to know which component among them can answer the research statement. Based on the analysis of the mapping, the researcher argued that the following SOA lens layers can close the research gap and support the implementation of interoperability to Tech4ED e-services.

Organizational Interoperability

- Business Process Layer – creation of standards to process representations and data flow to enable interactions between services and business processes of the government agencies
- Quality of Service Layer – a lens to assess what standards to implement to ensure that SOA adheres to the requirements with respect to reliability, availability, manageability, and scalability
- Governance Layer – guide to define standards for SOA governance including security and data privacy

Semantic Interoperability

- Integration Layer – tools and approaches to mediate, transform, route and transport service requests from the service requester to the correct service provider
- Information Architecture Layer – standards to ensure that the exchanged information between different systems is represented and understood within the same context and meaning

Technical Interoperability

- Services Layer – identification of list of reusable services by related government agencies
- Operational Layer – technical standards related to operational processes, network and software development life cycle
- Presentation Layer – outlines how to present the data to the user through various means

2. METHODOLOGY

This study used a combination of inductive and deductive research approach to explore the interoperability of Tech4ED e-services. Deductive approach was employed by looking at the existing concepts and theories such as whole-of-government approach, e-government interoperability and service-oriented architecture (SOA) and validated them if they can be included in the formulated proposed interoperability framework. The inductive approach, on the other hand, was used to derive the interoperability approaches from primary data gathering. Moreover, this study utilized qualitative research methods in data collection, data analysis and validation.

For data collection, the researcher used the focus group discussion (FGD) and site visits to gather the primary data. Document analysis for secondary data. The study was conducted in three Tech4ED Centers of Carmona City, Province of Carmona namely Katsumi Onda Tech4ED Center, Brgy 11 Mabuhay, and BLM Tech4ED Center Rural Impact Sourcing (RIS). Said Tech4ED centers were chosen to be part of the research because they were the pioneer Tech4ED centers in the Philippines and have been operating for more than five years already. Site visits were done to observe the activities being done in the centers. Moreover, the researcher conducted FGD with five Tech4ED Center Managers from said three Tech4ED Centers, Brgy Milagrosa and Brgy. Cabilang Baybay.. They were selected to partake in the FGD due to their extensive knowledge of the Tech4ED center activities. FGD questions were formulated based on the discussed SOA lens. The discussion mainly revolved around the Tech4ED platform, its current challenges, and what are their thoughts about implementing interoperability to the platform. No Tech4ED platform users was involved in the FGD because the platform was down during the period of the study. Thoughts on the user experience were based on the inputs also from Tech4ED manager recollection on the problems and issue raised by the users when the platform was up and operating.

For data analysis, the information that were gathered from the data collection phase was analyzed through situational analysis, triangulation and benchmarking. The researcher employed situational

analysis to identify and analyze the current status and challenges of Tech4ED e-service. The researcher then went through the process of triangulation to develop the interoperability framework based on the results of the FGD and the SOA lens. Requirements and details of each layer of proposed framework were identified at this stage. Valuable insights for the formulation of the framework were also gathered from the benchmarking conducted by the researcher. For the benchmarking, this study looked into different experiences and best e-government practices of Australia and South Korea. The two nations were selected because they are in the same region of the Philippines based on their geographical location, and they belong to the top 10 e-government leaders based on the United Nations E-Government Survey 2022. After the initial interoperability framework was developed, it was presented to eTESDA subject-matter experts (SMEs) of Technical Education and Skills Development Authority (TESDA) to get their insights about the developed framework. Three eTESDA SMEs (Chief TESD Specialist, Senior TESD Specialist, and TESD Specialist II) participated in the FGD and provided their feedback on the proposed interoperability framework.

For the validation, the proposed interoperability framework was validated with the same Carmona Tech4ED Center Managers through another FGD.

3. RESULTS AND DISCUSSION

Based on the data collection and analysis of the results of FGD with Tech4ED Center Managers and TESDA SMEs, here are the identified problems within the Tech4ED platform and other considerations examined through the SOA lens. For the organizational interoperability dimension, lack of standard business processes for authentication and integration between various government LMS and Tech4ED platform was identified. Multiple logins are still required when accessing different government agency e-learning contents. The reliability and availability of the platform were also highlighted during FGD. The platform was down during the study. Moreover, data privacy and security were also discussed and recommended that should always be available features of the platform. For semantic interoperability, the lack in data exchange mechanism or integration tool between Tech4ED platform and other government LMS was raised in the FGD. According to Tech4ED Center Managers and TESDA SMEs, single sign-on (SSO) can be implemented to avoid the keeping of multiple log-in credentials for different LMS. User authentication, user profile, course progress, certification and badges should be stored and managed also in a central database. They should be passed on and exchanged between Tech4ED platform and other government LMS via API technology for consistency of data, interoperability and enhanced user experience. For technical interoperability, ensuring seamless operations of the platform with very minimal downtime was emphasized during the FGD. Also, it was pointed out that there should be mobile version of the platform and it should be "responsive" in such a way that the screen of Tech4ED portal automatically adjust based on the device it is being viewed on.

In formulating the interoperability framework, the researcher considered the discussed problems and examined each layer of the SOA lens to determine how the issues could be effectively resolved. The developed interoperability framework was then validated through another FGD with the same Tech4ED Managers consulted for the primary data.

Below is the proposed Interoperability Framework for Tech4ED E-Services.

Streamline Process Workflows (Business Process Layer)

To enable and achieve data exchange between Tech4ED platform and external government LMS, DICT, Tech4ED stakeholders, and other government agencies with LMS such as TESDA, Department of Education (DepEd), Department of Agriculture (DA), and Department of Trade and Industry (DTI) should have agreement on business process standards on the authorization & authentication and data exchange mechanism.

Ensure High Performance and Reliability (Quality of Service Layer)

The Tech4ED platform should be equipped with the capability for auto-scaling, load balancing and high availability strategies to ensure optimal performance and reliability. The application should be able to handle varying workloads and maintain performance every time there is a peak in number of concurrent users.

Establish Governance and Management Standards (Governance Layer)

Design and implement strategies to ensure data privacy and security within Tech4ED platform and its interfaces. In line with Republic Act No. 10173, also known as the Data Privacy Act 2012 (DPA),

consent from the Tech4ED users should be obtained every time they use the platform. Security measures should also be implemented to keep the integrity, confidentiality and privacy of learner/user data. Apply role-based access control (RBAC) to ensure authorized personnel only have access to sensitive information.

Identify and Organize Common Data (Information Architecture Layer)

After the consensus on the organizational level between Tech4ED stakeholders and other government agencies with LMS such as DICT, TESDA, DepEd, DA and DTI on the common data types to be exchanged, structure and fields for the authentication, learner or user profile, progress and performance and certifications/badges data. The database table structure design and normalization should also be carefully considered to reduce redundancy and duplicate information.

Orchestrate Seamless Exchange of Data (Integration Layer)

Design and implement REST API to enable the data exchange of the common data between Tech4ED portal and other government LMS. Define all the use cases for data exchange between the Tech4ED portal and external LMS, such as user authentication, course progress and performance tracking, and certification and badge information. These pieces of information can be stored and managed in a central database that would serve as the database of lifelong education history of the individuals.

Define and Develop Modular Services (Services Layer)

Design and develop reusable system modules for the Tech4ED platform that can be used by other related government e-services as much as possible to reduce redundancy and minimize the need for recreating similar functionalities across different government e-services. For this study, the single sign-on (SSO) is the identified common functionality that can be developed for the Tech4ED platform and be re-used by other government LMS. Develop standardized LMS for government agencies also, if feasible, to make sharing and exchanging of identified common data easier.

Develop Effective User Experience (Presentation Layer)

Create and implement mobile device versions of the Tech4ED platform to enhance accessibility and availability to users aside from the desktop version. Apply basic screen standards, design principles and specifications on images, fonts, colors and icons for uniformity. This is also to encourage seamless navigation and functionality. The design should be also "responsive" in such a way that the screen of Tech4ED portal automatically adjust based on the device it is being viewed on.

Optimize Operational Processes (Operational Layer)

Identify and implement operational standards and processes to ensure robust IT infrastructure of Tech4ED platform on its daily operations. Ensure that related databases, software, network, and application servers operate seamlessly. Regularly monitor and assess the performance of the said IT infrastructure to address any anomaly or potential vulnerabilities. Implement also daily monitoring and logging tools to track the health of Tech4ED platform and its interfaces. This would help in troubleshooting whenever there is production issue and optimize the operational processes moving forward.

4. CONCLUSIONS

This research study was conducted with primary objective to determine how can Tech4ED e-services be designed to make each system become interoperable with one another for better user and learning experience. After conducting thorough research and analysis, it becomes evident that interoperability plays a significant role in providing better public services through government e-services. The seamless exchange of common information between the Tech4ED platform and different government LMS can improve operational efficiency and enhance user experience. The adoption of whole-of-government approach (WGA) alongside the implementation of service-oriented architecture (SOA) emerges as well-established strategy crucial for achieving the much-needed interoperability of government e-services. The findings of the study underscore the significance of adopting the said strategies and approaches for attaining integrated government systems. Specifically, the study unveiled the best practices and standards for front-end components to enable interoperability. It is mostly recommended to develop mobile versions of the system. For back-end systems, by developing re-usable services, standardizing business process flows, creation of integration tools such as APIs, identification of common data assets while ensuring optimum operations of IT infrastructure, high performing, secured and reliable applications, the

interoperability of Tech4ED platform can be achieved.

Based on the findings and limitations of this study, here are the following areas identified as recommendations for future research.

- Develop data model of common data to be shared across Tech4ED portal and other government LMS.
- Propose a framework for managing lifelong education records of citizens.
- Develop an interoperability framework for other related e-services of government agencies.

5. ACKNOWLEDGMENTS

The author extends gratitude to the following individuals for generously sharing their knowledge on Tech4ED and e-learning which greatly contribute to the completion of this study. Mr Angelo Macha of Carmona Tech4ED Center, Mr. Gringo M. Maquinay of Katsumi Tech4ED Center, John Cedric T. Villapando of BLM Tech4ED Center Rural Impact Sourcing (RIS), Mr. Emmanuel L. Manuel of Brgy Mabuhay Tech4ED Center, Mr. Arnold G. Legacion of Brgy. Cabilang Baybay Tech4ED Center, Ms. Nichole Anne D. Faraon of Brgy. Milagrosa, Ms Redilyn Agub of TESDA, Ms. Bianca H. Luya of TESDA and Mr. Jerwin Rodriguez of TESDA.

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