Service Academy: A Learning Analytics for Batangas State University Alangilan Campus Extension Services

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Bachelor of Science in Information Technology
Major in Business Analytics

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APPROVAL SHEET

In partial fulfillment of the requirements for the course Bachelor of Science in Information Technology, this study entitled: **SERVICE ACADEMY: A LEARNING ANALYTICS FOR BATANGAS STATE UNIVERSITY - THE NATIONAL ENGINEERING UNIVERSITY – ALANGILAN CAMPUS EXTENSION SERVICE** submitted by **Gaite, Jhon Edward, Hortal, Gian Carlo, Quiroz, Charles Wayne** are hereby recommended for Proposal Defense.

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DEDICATION

This research paper is dedicated to the researcher's loving parents, who have served as an inspiration and motivation to them while conducting the study. They gave them strength, courage and the will of perseverance when they thought of giving up or feeling hopeless. This act of perseverance that they possess is all lighted up by the flames of their intent of responding to their parent’s endless love, support and encouragement, physically, mentally, financially, and emotionally.

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This humble piece of work is for you all and this wouldn’t be possible without all of you.

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Chapter 1

INTRODUCTION

This chapter presents the background, purpose, and description, objectives, scope, and limitations of the study, as well as the definition of different terminology used within the study.

1.1 Background of the Study

From interactive platforms to multimedia and digital communication, the emerging digital world has played a crucial role in pioneering and shaping the learning experience of students and educators. E-learning, one of the foundations of modern education, utilizes and leverage the power and connection of technology to facilitate learning, anytime and anywhere. As the demand for a flexible learning option continuously rise, E-learning has become the pioneer to the emerging primary mode of education delivery in various academic institutions. (Aali, et al., 2020).

One of the key-components of E-learning is the platform of Learning Management System (LMS), which acts as a backbone for online education. LMS platforms is utilized as a centralized hub for course management, content delivery, and instructor-student interaction. By offering multiple functionalities or features such as discussion threads, quizzes and multimedia content integration, LMS

platforms has built the foundation of enhancing the overall learning experience of students and educators (Maslov et al., 2021).

The platform has become more efficient and effective with its iterative and continuous development that developers of this type of system included additional features such as learning analytics, an emerging field in the sphere of education that complements E-learning by leveraging data collected to gain insights into multiple student behavior and performance. By using analytics on student interactions, educators can identify and create patterns, monitor progress and personalize learning experiences (Susnjak, T, 2023), giving them the tools to create data-driven decision making in optimizing course design, improve instructional strategies and enhance student outcomes and performance.

Among the institutions that are embracing the advancement of educational technologies is the Batangas State University – The National Engineering University (BatStateU – TNEU) who utilizes various resources to committing to an educational excellence and innovation. By recognizing the transformative potential of E-learning can bring to the educational sphere, BatStateU- TNEU has been on the forefront of integrating digital technology into its educational practices, to enhance the quality and accessibility of its offerings. Despite of this commitment, however, there are still parts of the university that haven't utilized these technologies.

The Extension Service Office stands as the forefront of the university when it comes to community outreach and development, playing a critical role in

extending the university's impact beyond the campus borders. Committed to serve communities with needs and fostering economic development, the Extension Service Office embodies BatStateU – TNEU's commitment to excellence in leading innovations and transforming lives. As part of the office's goal of enhancing the quality and accessibility of multiple educational training offerings, the office consistently seeks multiple approaches and methods to expand the reach and effectiveness of its delivery and service to the community.

However, despite their dedication, a significant challenge persists in the Extension Service Office's goal of effective delivering of trainings as they were yet to fully embrace e-learning technologies. Traditional methods of training delivery often lack scalability, accessibility, and personalization, that hinder the Extension Service's ability to fully achieve its goals and deliverables to the diverse needs of trainees and the communities. This study seeks to address these critical issues by proposing a modernized approach to training delivery; Theses challenges include;

Lack of a Centralized Platform: Unlike modernized tools, traditional training method heavily relies on disparate tools and resources, leading to a lack of cohesion and efficiency in managing the Extension Service Office's programs. Without a centralized platform for program management and content delivery, coordination among the coordinators and trainees become challenging, resulting in a fragmented learning experiences and disjointed program processes. Furthermore, a lack of centralized platform also hinders the ability of the offices to offer services and programs to outside university reach. By implementing a centralized platform,

equipped with tools capable for learning analytics, the office can gather insights into trainee engagement and performance, enabling the development of tailored program that cater to community needs and preferences.

Lack of Progress Tracking and Evaluation: Traditional training leverages the use of manual feedback process and manual progress tracking. Without a streamlined process, tracking of trainee progress and evaluating the effectiveness of the program becomes inconvenient, hindering the ability to create data-driven decisions and improvements

Inefficiencies in Training Processes and Delivery: Manual process for managing different programs and other administrative tasks results in efficiencies, errors and delay in program delivery. Administrative tasks such as enrollment, course scheduling, and progress tracking consume valuable time and resources, diverting attention away from core training objectives. Moreover, the lack of automated systems for data analysis and reporting inhibits the office's ability to monitor program effectiveness and make informed decisions.

These challenges collectively underscore the need for a modernized approach to training delivery within the Extension Services Office. By leveraging technology and adopting innovative methodologies, the office can overcome existing barriers and enhance the effectiveness and accessibility of its training programs.

1.2 Purpose and Description

The Service Academy project aims to revolutionize the training operations provided by the Extension Services Office at BatStateU - TNEU - Alangilan Campus. Despite the university's successful adoption of e-learning in academic programs, the Extension Services Office still relies on traditional training methods for its programs and initiatives, limiting its ability to effectively reach and serve communities beyond campus borders. Manual administrative processes and a lack of real-time tracking further impede the office's capacity to assess program effectiveness and tailor offerings to evolving needs.

The primary objective of the Service Academy project is to modernize and optimize training operations through the implementation of a comprehensive LMS (LMS) integrated with an integrated learning analytics technology. Service Academy will provide a fast, responsive, and user-friendly online platform for trainees, coordinators and administrators the tools needed to achieve the office’s goals and objectives. The integrated learning analytics technology will enable enhanced monitoring of trainee interactions and performance, allowing coordinators and the administrator to have the necessary data for data-driven improvements to course content, delivery methods, and overall effectiveness.

Access to the web-based system will be restricted to registered coordinators and authorized trainees, with administrators overseeing data management and reporting for program evaluation. By replacing manual processes with automated systems for enrollment, assessment, tracking, and certification, Service Academy is

expected to streamline administrative workflows, optimize program effectiveness, and improve accessibility to training resources.

The incorporation of learning analytics capabilities within Service Academy will provide administrators with valuable insights for data-driven decision-making. By analyzing trainee interactions and performance metrics, administrators can identify areas for improvement, personalize learning experiences, and continuously enhance the quality of training programs and services.

This project represents a transformative endeavor to bridge the gap between traditional methodologies and contemporary educational imperatives. By leveraging the power of both LMS technology and learning analytics, the project aims to drive positive societal change by empowering trainees with personalized learning experiences and tangible certifications upon course completion, ultimately contributing to the university's commitment to educational excellence and innovation.

1.3 Objectives of the Study

The main objectives of this study are to develop and implement a comprehensive LMS integrated with learning analytics capabilities to enhance the efficiency and effectiveness of training operations in the Extension Services Office at BatStateU - TNEU - Alangilan Campus.

Specifically, this study aims to:

1. Design and deploy a centralized LMS tailored to the needs of the Extension Services Office, facilitating seamless program management and content delivery.
2. Leverage the astuteness of learning analytics to identify patterns, analyze results and trends to create better data-driven decision making and improvements.
3. Streamline training processes and enhance operational efficiency through the automation of administrative tasks and data-driven decision-making.

    3.1. Automate enrollment procedures, course scheduling, and progress tracking within the LMS platform, reducing administrative burdens and minimizing delays.

1.4 Scope and Limitations

This study aims to address the challenges faced by the Extension Services Office at BatStateU - TNEU - Alangilan Campus in delivering training and services effectively. It proposes the implementation of a comprehensive LMS integrated with learning analytics capabilities. The research focuses on the development and execution of the "Service Academy" project, specifically designed to modernize training operations within the office. Its scope encompasses the design, development, implementation, and assessment of the Service Academy platform.

This includes aspects like course management, content delivery, learner engagement tracking, and certification issuance. Additionally, the research will analyze the impact of the project on enhancing the efficiency, accessibility, and efficacy of training delivery within the Extension Services Office.

However, it is crucial to acknowledge certain limitations of this study. Firstly, the research is confined to the Extension Services Office at BatStateU - TNEU - Alangilan Campus and does not extend to other university office or campuses. Secondly, while the implementation of the Service Academy project aims to address various challenges associated with traditional training methods, it may encounter technical, organizational, and resource-related obstacles. Despite these limitations, the study strives to provide valuable insights and recommendations for improving training delivery in similar educational settings, with a focus on long-term viability and adaptability.

1.5 Definition of Terms

This section aims to clarify and define terms utilized within the study, particularly those that may be unfamiliar or hold specific significance within the context of the project.

E-Learning: Defined as a technology-mediated learning approach that utilizes modern technology to facilitate academic activities

Learning Analytics: The process of collecting, analyzing, and interpreting data related to learner interactions and engagement with educational materials and platforms, with the aim of informing instructional strategies and improving learning outcomes.

Extension Services: A office in BatStateU - TNEU that facilitated programs and initiatives aimed at extending educational resources, services, and expertise beyond the confines of the traditional academic setting, often targeting underserved or marginalized communities.

Program: Program is defined as the type of training a trainee can go under. It is also what the Extension Office calls their services.

Extensionist: The person that works under the Extension Service Office. They are the people who handle the proposal of different programs under a specific agenda of the office. They can be the coordinator, the trainer or the head of a office.

BatStateU - TNEU: An abbreviation of Batangas State University - The National Engineering University

Chapter 2

REVIEW OF RELATED SYSTEMS/STUDY

This section provides an in-depth exploration of existing research and systems in the field of learning management platforms and related studies, offering insights to refine the Service Academy project for Batangas State University - Alangilan Campus's Extension Services Department.

2.1 Technical Background

Developing a Learning Management System with an authenticated E-certificate and Learning Analytics needs a series of multiple components that needs to work together seamlessly and effectively to ensure the system will meets its needed functionalities and requirements. Furthermore, the development of this system requires a series of testing, revision before its deployment for the public. In order for researchers to have a clear grasp of what to do, what to use, what to consider and how to integrate an API to a web-based system a review on technical background is needed. In this section, the researchers will identify the system's technical background. A technical background serves as a basis for comprehending and interpreting findings from research. It often involves established theories or models to help explain and predict phenomena in the area of study.

Software development is a multi-stage process where you build and run applications in repeated cycles. This approach allows for continuous measurement

and improvement, ensuring the software is constantly being analyzed and refined throughout its development. This multi-stage process is also called as System Development Life Cycle (SDLC) or System Life Cycle (SLC). The SDLC is a set of procedures an organization uses to create and implement software. There is not a single, integrated SDLC that exist. Instead, development teams use a number of frameworks and models in order to design, test, distribute, and manage software.

According to the System Engineering Handbook 5th Edition edited by Walden, (2023), the main purpose of System Engineering (SE) is to achieve successful system realization while balancing the often-conflicting objectives of various stakeholders. This is accomplished by dividing the development process into distinct, transformative stages. This staged development process is said to mirror the life cycle of living organisms, hence the term system life cycle to describe the set of stages a system goes through. In essence, engineered systems progress through a series of stages, forming a conceptual system life cycle.

This conceptual SDLC includes six general stages. This stage includes the planning stage, analysis stage, design stage, implementation stage, testing and integration stage and maintenance stage all of which is depicted by **Figure 2-1.**

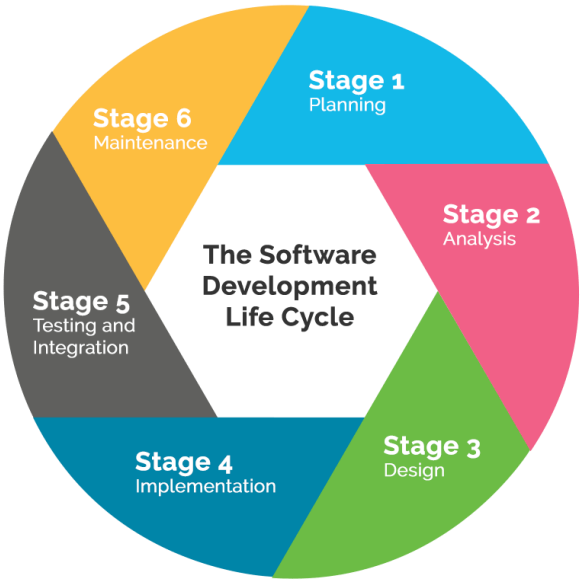

Figure 2-1. The System Development Life Cycle

Source:https://miro.medium.com/v2/resize:fit:800/1*XA7kJxmdZTTE-t34GlaiNQ.png

This methodology served as the primary guideline throughout the development process, guiding developers from planning to deployment stages. The SDLC ensures a systematic approach to examining and testing web-based systems, mitigating potential issues before deployment. Given that the research study involves developing a web-based application, the SDLC stands as the preferred methodology, facilitating effective development and deployment processes.

However, as stated that there is not a single integrated SDLC, various models of the SDLC exist, each with its own strength and weaknesses. Given the dynamic nature of the research study and the need for continuous feedback and adaptation, the Agile methodology was chosen as the primary SDLC approach.

The researchers chose the Agile methodology due to its adaptive and collaborative nature. Basically, agile methodologies are alternatives to traditional

methodologies which are usually used in systems development. It helps teams to break large projects into small chunks which could be managed better. It also focuses on keeping the code simple, testing regularly and delivering functional bits of the system as soon as they are ready. Hence, the goal is to build upon small chunks approved by the clients as the development progresses instead of delivering one large system at the end of the project (Sekgweleo, 2019).

In essence, the fundamental premise of the Agile framework lies in its prioritization of rapid adaptation and continuous improvement within the development process. This is achieved through a collaborative environment where developers work together, guided by a well-defined set of principles and objectives that provide the necessary flexibility for iterative development cycles.

Figure 2-2 depicts the iterative workflow of the Agile methodology.

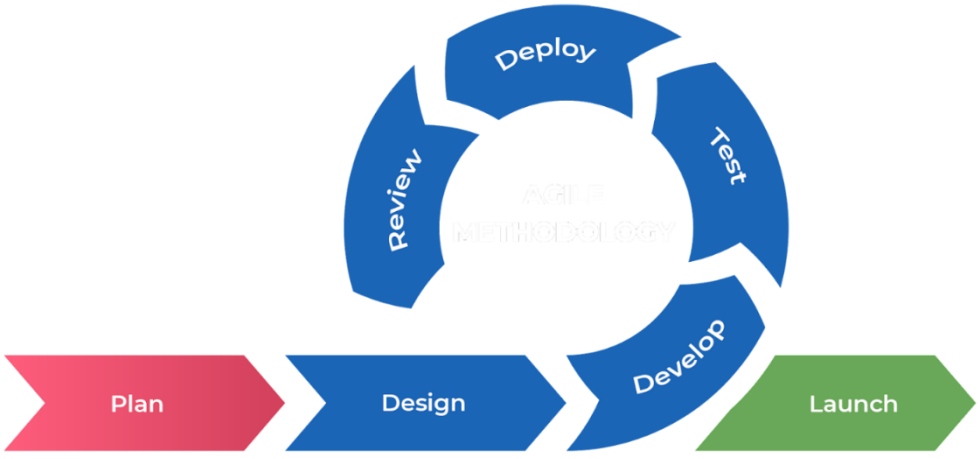

Figure 2-2. The Agile Methodology Framework

Source: https://www.credencys.com/wp-content/uploads/2023/02/Agile-Methodologyin-Software-Development.png

The research study specifically employs the Scrum framework within the Agile methodology. According to Zikopi, (2019), Scrum framework is constructed to adapt for customer's expectations and therefore supports the development of high-quality product. Furthermore, Zikopi explained different benefits and features of Scrum over conventional development frameworks. This includes, short iteration cycles, small team sizes, strong communication channels as well as early delivery which allows teams to receive near real-time feedback. Zikopi also explained how Scrum simulates a team's evolutionary, adaptive and self-correcting systems in such a way that enables rapid adaptation to change in the business and technical domain. Additional features of Scrum are team autonomy, end-to-end responsibility, transparency and cross-functionality including all the expertise required for every stage of the developing process.

Choosing the right technology stack is crucial for efficient development within the Agile Methodology, Scrum framework. The research study utilizes the following technologies:

.NET FRAMEWORK

The .NET framework is one of Microsoft's offerings, together with .NET (Core), of commonly used frameworks that are currently supporting .NET implementations for building server-side application. These products share a lot between them, with both being the mainstay in the industry and even working

similarly enough thus a developer experienced in one could switch with little to no drawback (Binyamin, 2023).

The .NET Framework provides a comprehensive set of libraries and tools for building various types of applications, including web applications, desktop applications, mobile applications, and more. The researchers will utilize the .NET Framework for its robust features, extensive library support, and strong integration with other Microsoft technologies. Furthermore, the .NET Framework provides better maintainability, separation of concerns, performance, and compatibility with modern front-end technologies. It also provides other programming language to use for a back-end like C# to create a more secure and robust functionalities especially when the research study will handle sensitive data and requiring complex computations.

HYPERTEXT MARKUP LANGUAGE (HTML)

The Hypertext Markup Language or commonly known as HTML is a standard markup language used to create the content of a web page. HTML has been the known official hypertext standard since the beginning of the Web. Pioneered by Tim Berners-Lee, HTML has been supporting the idea of connecting files into different computers throughout hyperlinks since its creation, establishing as the language that can intertwine different web pages. In the last years and thanks to the rising of HTML5, its associated technologies (CSS3, JavaScript, etc.) and features (video, canvas, etc.), HTML has experienced a great transformation that defies the

previous conception of hypertext as a standard valid for interconnecting documents throughout different computers (Tabarés, 2019),

Within the context and development of this research study, HTML plays a crucial role in structuring the content of the web-based application. Its extensive libraries of tags and attributes, together with the tools and infrastructure provided by .NET framework will give the researchers the necessary tools of creating various elements, formatting the text and establishing hyperlinks in building a dynamic web application and ensuring it's user-friendly and informative interface.

CASCADING STYLE SHEET (CSS)

If HTML is the structure or the language in-charge of handling the content, the Cascading Style Sheet or CSS for short is responsible in stylizing the elements within that content. According to Muketha et.al, (2019), CSS is a Web-based style sheet language that is used for the presentation of Web documents. It is an integral part of a Web-based application and its purpose is to separate content from presentation. Muketha et.al basically summarized CSS as a language that makes it possible to style Web pages on themes such as the use of colors, fonts, and layout.

From a technical standpoint, CSS will also play a crucial role in enhancing the visual appeal and user experience of the web-based application. By utilizing its library, researchers can work around the set of rules provided by CSS to define and create the visual representation of the HTML elements. Furthermore, CSS is a separate file from HTML, which will give the researchers an efficient and ease of

modifying the code with regards to the chosen methodology. Adding the fact that from the name itself Cascading, CSS styles each element by inheriting parent elements to a child element. This cascading manner of the CSS will give the researchers an efficient way of styling each web pages while maintaining consistency and modularity.

JAVASCRIPT (JS)

A web application consists different block of codes of different components that seamlessly work together to create it. This component is mentioned the mentioned HTML for the content and CSS for the design. In order to achieve a dynamic system that can be compatible to different devices as well as take user inputs, a backend must be use. The JavaScript or JS is a lightweight programming language used to make websites and applications dynamic and interactive. Following this, Li & Xie, (2023), explained that JS has become the most popular programming language for web front-end development. With such popularity, there is a great demand for thorough testing of client-side JavaScript web application.

With this in mind, the researchers will utilize JS to add interactivity and responsiveness to the web-based system. Its extensive library of functions and frameworks will allow researchers to create dynamic user interfaces, handle user interactions, and implement complex functionalities, ensuring a user-friendly and engaging experience. Furthermore, by choosing JS as the language to handle the

front-end of the web-application and C# or any programming language provided by the .NET framework as the back-end, researchers can create a seamless integration between the web application and learning analytic. This approach is also commonly known as full-stacked development.

BOOTSTRAP

Bootstrap is one of the most popular CSS frameworks for developing responsive and mobile-first websites. Bootstrap framework is created by Twitter in 2011 whose function encircles on creating and adjusting the resolution of websites that can be developed from a computer and then be displayed correctly in different resolutions on mobile devices (López-Gorozabel et al., (2021).

Researchers will leverage the use of Bootstrap's pre-build CSS classes and components and integrate it into the HTML code. This will allow the researchers to ensure the responsiveness of the web-based application. Furthermore, it's extensive library of pre-built components and classes allows researchers to quickly create a visually appealing and user-friendly interface that adapts seamlessly across different devices, from desktops to smartphones.

POSTGRESQL (POSTGRES)

PostgreSQL is an object-relational database management system (ORDBMS) based developed at the University of California at Berkeley Computer Science Department. POSTGRES has a long history that pioneered many concepts

that only became available in some commercial database systems much later. The beauty of POSTGRES is that it's an open-source RDBMS that offers a larger part of the SQL standard and modern features. According to Acuña et al, (2019), many companies are currently migrating to open-source software looking to ensure their economy. One of the tasks to achieve this goal is the migration to PostgreSQL database technology as it is the most advanced open-source DBMS in the world.

The researcher will utilize POSTGRES vast majority of SQL transactions, concurrent control, offering modern features such as complex queries, triggers, views, transactional integrity, and allowing to add data type extensions, functions, operators, and procedural languages. It also works well for both small projects and big company systems. Not only it's the common choice of developers, it is also fast, adaptable, and has a strong community behind it. Furthermore, the proposed system relies heavily on complex relationships, transactions and data integrity which POSTGRES can support.

LEARNING ANALYTICS

Learning analytics has been under study since early 2010. This study has continuously evolved exponentially in the areas of education, psychology as well as in computing and data science. Although the concept of learning analytics is still vaguely defined, various researchers have defined it into different conceptual variations. This variation includes Sergis and Sampson of school analytics or teacher and teaching analytics; Long and Siemens concept of academic analytics;

Noiura et. Al assessment analytics; Buckingham, Shum and Ferguson's social learning analytics, and; Blikstein and Worsley's multimodal learning analytics. (Ifenthaler, D, Yau, J.Y-K, 2020).

In line with the research study, the conceptual variation of Sergis and Sampson will be used as the basis for the learning analytics. Researchers will leverage different data that will be collected within the system. This data is also called predictor data, a data that is used to create predictive algorithms. One sample of this type of data is data collected via online behavior mainly logfiles and trace, forum interactions, engagement with learning artefacts and many more (Ifenthaler, D, Yau, J.Y-K, 2020). The utilization of this data can be achieved by using ML .Net, an open source and cross-platform machine learning framework built for .NET developers. Machine learning is a transformative force in various industries especially when it comes to creating predictive models for better outcomes and operational efficiency. ML.NET provides a versatile and user-friendly environment for building custom machine learning models within the .NET ecosystem. Its integration with popular .NET languages such as C# allows developers to seamlessly incorporate machine learning capabilities into their applications, whether they are desktop, web, or cloud-based. (Rajendran, R. M, 2022). Using this framework, researchers will focus on utilizing different data analytics method and model in order to create an algorithm to cater the stakeholder's needs. An analysis

and evaluation will also be created to test the precision and accuracy of the algorithm.

By delving into the intricacy of LMS development and the established SDLC methodologies, the researchers have laid the basic foundation for understanding the research study's approach in developing Service Academy. The chosen technologies including the .NET Framework, HTML, CSS, JavaScript, Bootstrap, and PostgreSQL will each play a crucial role in realizing the functionalities and features listed and envisioned for Service Academy. Furthermore, the fostering of the Agile methodology with the Scrum Sprint Framework will give the researchers the assurance of a dynamic and adaptable development process that prioritizes flexibility, continuous feedback and improvements. This technical groundwork will serve as the springboard for the future sections and sprints, where the researchers will delve deeper into the specific design, implementation, and evaluation processes undertaken throughout the research study.

To have a deeper understanding of any related studies or system can be achieved by examining the Literature Map and the following related studies and their synthesis. A literature map is a type of diagram that provides a visual representation of the major themes and subtopics within the existing related literatures. **Figure 2-1** gives the researchers organizing the vast body of the research a structured framework that makes navigating and identifying key of interest easily and efficiently.

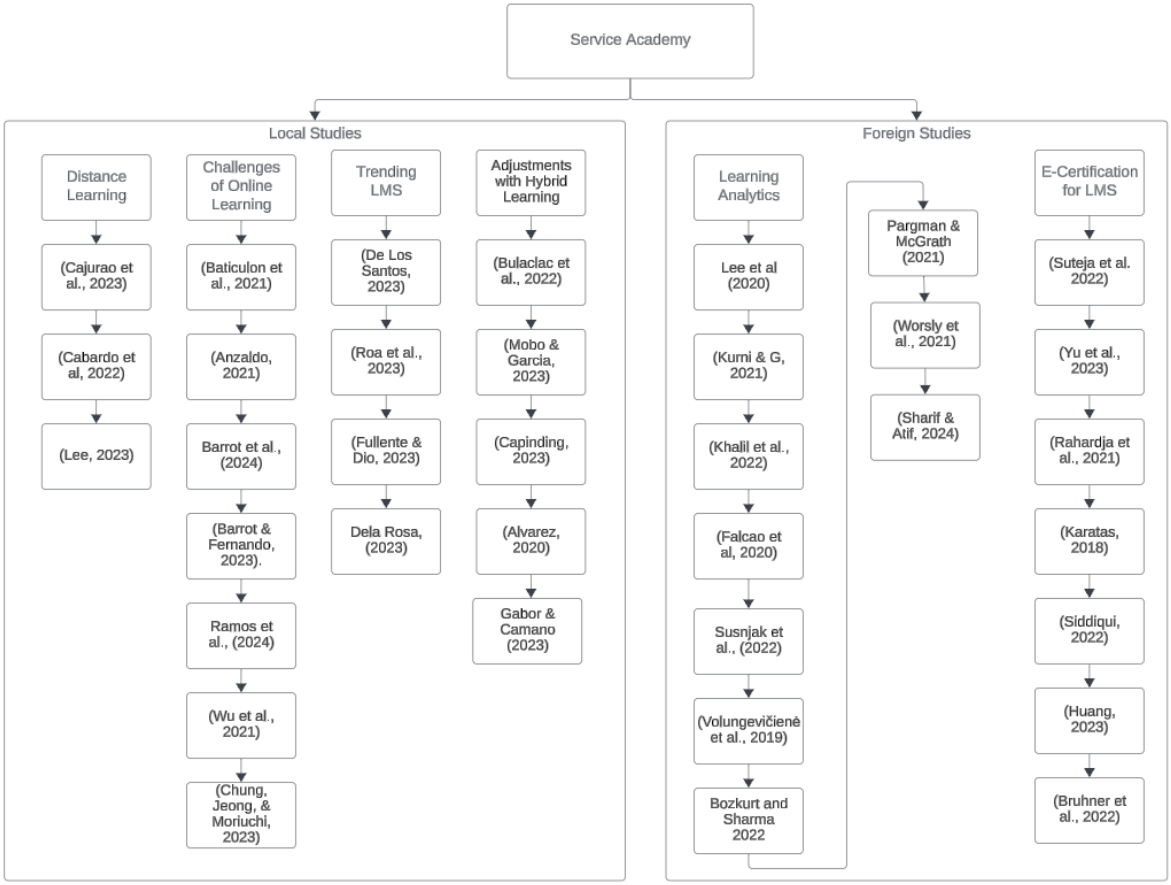

Figure 2-3. The Literature Review Map

2.2 Review of Related Studies/Systems

Presented in this section are the reviews of relevant literature and research that contributed to the development of the project's concepts. This part also includes the reviews and insights from systems and technologies that correspond to the objectives of the system.

Local Related Study

This section provides insights and reviews on the implementation of Distance Learning and Learning Management System in the educational landscape of the Philippines. This also includes the challenges, methods, and strategies that come with its adaptation.

Adoption of Distance Learning in the Philippines

Even before the emergence of the global health crisis in 2020, the educational landscape in the Philippines has been adopting distance learning practices to address various challenges in the traditional education system. Various institutions, most especially the large and private ones have been slowly integrating it to their academic teaching method for the past few years. However, the onset of the Covid-19 pandemic forced the education methods to undergo significant changes (Cajurao et al., 2023) and join this trend as a measure to ensure continuity of student's education.

In the initial phase of this transition, the educational institutions in the Philippines implemented distance learning in three ways: Modular Distance Learning (MDL), Online Learning, and TV/ Radio-based instructions (Cabardo et al, 2022) Among these modes of learning, the influence brought by the convenience and accessibility of online learning continued its reign even when the pandemic era marked its end.

That is evident with the growing utilization of Learning Management Systems (LMS) as a means to deliver course materials, facilitate interactions between students and teachers, and assessment of learning outcomes by educational institutions (Lee, 2023).

Synthesis:

One of the key drivers behind the idea of creating Service Academy stems from the experience of studying and learning during the pandemic. Similar to how the limitations made by the pandemic pushes a shift to the educational landscape, Service Academy also notices the inevitable need for changes within the Extension Services due to the limitation set by the advancement of time. The service academy also finds the convenience and efficiency of using online modality as a solution to bridge the gap set by the said limitations.

Though the goal is the same, Service Academy differs with the common adaptation of E-learning as it aims to develop an LMS platform for the purpose of accommodating various types of programs consisting of short trainings offered and initiated by the extension service department. The participants or trainees of the Service Academy are not limited to students, it could be participated by a variety of participants depending on the type and agenda of the training.

Challenges of Online Learning in the Philippines

Though the Philippines have been adopting E-learning and the use of Learning Management Systems quite well for the past years, it is still a fact that there are a lot of limitations which are inevitable due to its current state of being a country of low-middle-income. Unlike first world countries, the country has been behind in terms of technology related assets such as the availability of a fast internet connection, the lack of good quality electronic devices and the unavailability of ample study space at home. These challenges even call for the organization like the Association of Philippine Medical College to voice a request for the termination of the ongoing semester as medical students cite difficulties in keeping up with the requirements during the post pandemic era (Baticulon et al., 2021).

This dilemma is more apparent on the sectors like the Department of Education as they were forced to commit to the Modular Distance Learning (MDL) or the use of modules or the specifically called Self-learning Materials (SLM) made by teachers that contains activities and task based from the essential learning competencies to administer education on public academic institutions students that are mostly deprive with the privilege of internet connection and devices (Anzaldo, 2021).

These challenges extend to not just students but the educators themselves. It is mentioned in some parts of the study titled “What It Takes to Teach in a Fully Online Learning Environment: Provisional Views from a Developing Country” by

Barrot et al., (2024), that teachers face some difficulties with assimilating to the online and blended space for teaching. Specific hardships like stimulation of interaction to students, facilitation of student's focus retention and learning processes, lack of provision of real time feedback, and the adjustments to unfamiliar platforms and technology, hinders their flexibility and the effectiveness in delivering education. Considering also the difficulties and maintaining and acquiring of the required technological resources, specifically on resource lacking countries like the Philippines added to the weight of this challenges (Barrot & Fernando, 2023).

Synthesis

The challenges of the implementation of Online Learning in the Philippines is one of the considerations that is reviewed within the conceptualization phase of the Service Academy. The researchers and the stakeholders of these projects also acknowledge the implications of the limitations in resources as a factor that could hinder the implementation of the system and make fitting adjustments to the implementation plan for the system.

In resolution of this, considering the unavoidable circumstance of insufficiency of resources, the researchers adjusted the concept of the Service Academy's LMS platform to reduce the effects of this problem by adding the option of full self-paced online training and hybrid trainings. The LMS platform is also

developed as web-based system that is applicable for most digital devices. With this feature, the problem with the slow internet connection and the limitations on the device could be eased.

Filipinized Learning Management System (FLMS)

Despite the existing challenges of LMS and Online Learning in the Philippines, it doesn't stop Filipino researchers from finding ways in finding solutions and making advancements in technology. Considering the context of the increasing need for LMS platforms with considerations to the limitations in resources birthed the development of the Filipinized Learning Management System (FLMS).

As mentioned on its research documentation titled "Development of Filipinized Learning Management System", authored by Ramos et al., (2024), FLMS is a project implemented as a platform intended for the learning needs of Filipino nursing faculty and students. It is designed to address the problem of the scarce technology resources in the Philippines by providing an LMS platform that is freely accessible and with reduced used of internet connectivity.

The FLMS used a mixed-method approach that involves a series of focus group discussions, a popular technique that is defined as a small group discussion that is either video or audio taped, wherein a researchers or an educator presents a

topic of choice in a structure discussion framework where participants can respond to the topic (Wu et al., 2021), and the use of Technology-Acceptance Model (TAM), a popular information systems theoretical foundation which explains an individual's acceptance in technology base on its computer usage behavior (Chung, Jeong, & Moriuchi, 2023). Through the said method, FLMS design exhibits features that has lower system requirements and fewer system maintenance, features that are accessible offline, and a flexible means of communication, content presentation and collaboration, which are all appropriate for the target users.

Synthesis

Like the FLMS, Service Academy is also committed in providing an accessible platform that can be freely used by a variety of users. Similar to them also, Service Academy also utilizes TAM and the mix- method to ensure that the platform can tailor the needs of the possible trainees. Moreover, Service Academy also highlights features such as the availability and accessibility of some program contents anytime through self-pace training programs and the option for blended trainings that is focused on reducing the burden of the slow internet connectivity of the Philippines for the learning process of trainees.

What set Service Academy apart from FLMS is the incorporation of the Learning Analytics to its LMS Platform. With Learning Analytics, Service

Academy can attend more to the needs of the trainees not just in comfort but also in the aspect of effective education.

Trending LMS in the Philippines

Through the exploration of related studies, one of the common trends with the studies about LMS in the Philippines is the mention and use of MOODLE. It is an Open-source free online LMS platform written in PHP, distributed in GNU General Public License (De Los Santos, 2023). It has pioneered most of the current standard features of the LMS like calendars and grade books.

It is one of the most popular LMS platform in the Philippines that is adopted by a lot of educational institutions like The University of the Philippines Open University (UPOU) and the De La Salle University (DLSU) as a means to conduct E-Learning (Roa et al., 2023)]. In 2023, there is about 1519 site that are registered as MOODLE sites in the Philippines (Fullente & Dio, 2023).

Its popularity doesn't just stem from it being an open source and free as it yields a lot of successful implementations. Aside from the huge institutions like UPOU and DLSU, other private institutions find success in the use of MOODLE. An example of this is the results of the research conducted in Sorsogon, Philippines where they study the utilization of MOODLE LMS in teaching mathematics in the private schools by checking the mastery of mathematics teachers in the platform,

and the result shows a positive response as it shows that at least 50% - 60% of the 31 respondents have shown mastery in most of the features of MOODLE. This shows how intuitive the MOODLE LMS is.

Aside from MOODLE, there are a lot of other LMS that is used in the Philippines, one of that is Canvas, it is one of the latest learning managements in the market develop by Instructure, Inc. Though it is not as known as MOODLE, it is used and preferred by other institutions like the Bulacan State University (BulSU). In the research by Dela Rosa, (2023), on the implementation of Canvas in the College of Information and Communications Technology (CICT) department of BulSU in its Programming courses, the student's feedback shows that out of 169, 132 or approximately 78% of the participants have a favorable outlook on the use of Canvas. Other factors such as technicalities and presence also show favorable outcome which concluded the study suggesting Canvas LMS as an effective means of delivering their programming courses in asynchronous set up.

Synthesis

The development of Service Academy builds upon the trends of the LMS platforms in the Philippines. Similar to the established LMS platforms mentioned, Service Academy's goal is to create an intuitive platform with comprehensive features that could be navigated by all type of users without complications. Aside from that, some specific features of the Service Academy are influenced by the

pioneered features of those famous LMS platforms that serves as the foundation for the development and structure of its system as a whole.

What makes the Service Academy unique from those are its advance features like Learning Analytics and the generation of E-Certificates of which are not a common feature for most general platforms that specifically made for course facilitation only. With this feature, service academy would be able to assist not just students but also the administration of the programs.

Philippines Adjustments with Hybrid Learning

Aside from the pandemic, one of the most notable events that would be remember on the years of 2020-2022 in history is the forced shift in the educational landscape and the acceleration on the adoption of the concepts of Distance Learning which is just an emerging concept back then. In the Philippines, unlike the Department of Education that chose MDL due to the general limitation of resources, Commission on Higher Education (CHED) along with most of the Higher Education Institutions (HEIs) opted for the more advance approach which is through E-Learning and Blended Learning (Bulaclac et al., 2022)

Blended Learning also known as Hybrid Learning is a teaching method that integrates the traditional instruction-led classroom set up with technology through the use of Digital Media with the aim of employing flexibility in customizing the

learning experience of students. To administer that, platforms such as Zoom, Edmodo, Google Hangouts, Google Classroom, Facebook Messenger, Skype, MOODLE, Canvas, Blackboard Course Sites, and iSpring Learn are among the commonly utilized up until the present year where the pandemic ended.

There are two ways in which it is implemented in the Philippines, one is the HyFlex or the flexible learning set up where teachers are teaching in either synchronous or asynchronous method through Digital Media and video conferencing (Mobo & Garcia, 2023), and the other one is the limited face-to-face classes (Capinding, 2023) where students attend physical classes and online classes in varying schedules. Both of this method was helpful in ensuring the safety and continuity of education during the pandemic, however it is faced with a lot of challenges during its implementation.

At the time of the pandemic the concept of Blended Learning is fairly young and new (Alvarez, 2020) which made it prone to difficulty and challenges. In the conducted study by Alvarez (2020), where he assessed the challenges faced by their National Service Training Program (NSTP) in the implementing blended learning, the problem with the instructor's adjustment to the new way of delivery of education is highlighted. Aside from the fact that not all instructors can be expected to be technology inclined, some instructors viewed the use of technology as time consuming as they find preparing materials and discussion in hybrid approach more

rigorous as it takes more time compared to the face-to-face delivery. Other than that, there is also the limitation in the Information and Communication Technology.

Though it comes with challenges there are also some institutions that find success and efficiency in Hybrid Learning Approach. Just as highlighted in the study of Gabor & Camano (2023), there are aspects where the use of hybrid approach is effective. Among those is its benefits during the adjustments of student to face to face classes after the pandemic. As mentioned in the study there are some psychological after effects of pandemic which made students uncomfortable in their return in the face to face set up, and the infusion of hybrid helps them to gradually cope and adjust. Aside from that hybrid learning is also highlighted as an effective learning where there are aspects in which it could be taken as an advantage for the facilitation of student's learning.

Synthesis

The adoption and acceptance to hybrid approach in the Philippines gives emphasis on its usefulness as an alternative mode of knowledge delivery. Even though service academy's focus is on the development of a Learning Management integrated with learning analytics, the experiences of the Philippines in implementing hybrid approach provides a valuable insight in recognizing the benefits and also the challenges that comes with it.

Inspired by the prior approach of most institutions, Service Academy also employs hybrid learning on some of its program. However, instead of video conferencing like how standard hybrid learning is facilitated, Service Academy's hybrid approach will follow the limited face to face set up where trainees will have to attend trainings both physically and virtually on a specific schedule. The application of this method depends on the nature of the training that the trainee will register.

Foreign Related Study

This section provides insights and reviews on the implementation of Distance Learning and Learning Management System in the educational landscape outside the locality. This also includes the challenges, methods, and strategies that come with its adaptation.

Learning Analytics

With the growing reliance on internet over time, taking advantage of the data generated from it has become a trend in most fields in the professional industry, that includes the education industry. An emerging trend today in the field of education aside from LMS is the technology called Learning Analytics (LA). As defined by Lee et al (2020), LA encompasses the measurement, collection, analysis and reporting of a learner's data with the purpose of understanding and optimizing

learning experience. It is utilized to process data and gain insight to support data driven decision that can enhance education, boost student success and optimize resources.

Commonly, LA uses a variety of data sources such as Learning Management Systems (LMS) and Student Information Systems (SIS) for data collection (Kurni & G, 2021). Specifically, those data include engagement metrics data consisting of attendance and participation, student performance data including grades and test scores and the learning behavior patterns comprised of study habits and resource usage (Khalil et al., 2022). Those collected data will then be analyzed in the LA platform using algorithms like machine learning techniques to get insights.

One of the main requirements and considerations in using LA is the quality of data and security. Ensuring that the quality of data is high is needed to guarantee the accuracy and correctness of insights and analysis that would be generated. The same goes for the security of data, since it is dealing with sensitive information, it is of paramount importance to ensure that the data is safe from attacks and breaches.

On a specific note, LA is widely used in Higher Education Institutions (HEIs). They apply LA in their LMS platforms with the goal of making observations such as Data Visualization to simplify data and help stakeholders understand and make data driven decisions, Trace Data Analysis to analyze students' trace data and get an overview on their learning patterns and behavior, and lastly as a basis for

creating and conceptualizing policy for effective implementation in educational settings (Falcao et al, 2020). Aside from that, study by Susnjak et al., (2022), also highlights other benefits like the boost in student retention in classes as an effect of learning analytics being able to track students that are at-risk and the competitive edge that could be gained through maximizing the student's success by utilizing LA.

Aside from enhancing administrative decision-making processes, the utilization of LA can also assist the educator to make decisions on conceptualization of learning designs and curriculum (Volungevičienė et al., 2019). In a study by Volungevičienė et al., (2019), it is recognized how utilizing LA helps educators in making curriculum decisions, in the study it is viewed in two perspectives; in the first perspective educators use LA to understand student behavior and on the second perspective the educators used those finding to design their work. This observation is further supported by the study of Bozkurt and Sharma 2022, as improvements to curriculum through the analysis of student learning pattern is highlighted in the study to help students to avoid falling behind.

Though the usefulness of LA has been recognized, the use of LA has its own challenges and consideration. One of those that should be observed as shown in the study of Pargman & McGrath (2021) is the ethical considerations that comes with the use of LA, since it utilizes data, the concern of choosing or deciding which data is necessary for the collection, storing, and analyzation as well as the specific purpose of it is highlighted. On the technical side, the use of low-cost sensors and

computational techniques in development of LA often lead developers to difficulties in the accurate interpretation and integration of different data streams which is also a concern that should be observe during the development phase (Worsly et al., 2021). Additionally, there is also the consideration in Technical and Resource Limitations (Alzahrani et al., 2022). As a data analytics tool LA has specified requirements like technical infrastructures, human resources, and funding that requires careful assessments before adoption [40].

Considering those challenges is important to efficiently utilizing LA. As discussed by Guzmán-Valenzuela et al. (2021), the successful adoption of LA involves a good collaboration of the organization. In the designing of LA, there should be an educator involvement to ensure alignment with the teaching activities. There is also a need for a specific admin role and an expertise of data scientist this should ensure that the design align with the goal of the organization.

Though the current implementation is quite effective, LA still holds a lot more potential for advancement in the future. Those potential is apparent on the current trends of LA explored by Sghir & Adadi (2023). Mention in his exploration is the current use of Predictive Analytics, Adaptive Learning Systems, Real-Time Feedback and educational data mining in LA, which exhibits advance functionalities that makes a more tailored observation analysis. These advancements LA holds significance in the future of teaching and learning practices (Sharif & Atif, 2024).

Synthesis

Service Academy will revolve around this concept. By implanting learning analytics to collect and measure diverse data that are inputted within the system by its users, researchers will gather the necessary insight to generate reports and help in making data-driven decision. This can be achieved by using different tools such as machine learning to create a model that is suitable for improving and optimizing the Extension Office's services within its reach. However, researchers should also consider and carefully plan in addressing the challenges stated by different studies, especially with ethical considerations and requirements for the development process. To develop Service Academy with integrity and accuracy, researchers must carefully identify and use multiple tools during the development process to avoid difficulties in interpretation and integration. Furthermore, researchers should also consider how they can create a robust security and authorization to carefully protect and hide sensitive data that they will gather using the system to create and generate reports. By creating a good collaboration within the organization and stakeholders, researchers can achieve the integration of LA into the Service Academy System without multiple problems arising during its development process

E – Certification for LMS

In all institutions, completion in participation of activities has always been guaranteed with certificates (Suteja et al. 2022). The issuance of that always comes

with fees for printing, paper and distribution. Acknowledging the efficiency of paper-less certification are opting for the use of E-Certification. In most cases it is distributed in the format Portable Document Format (PDF) through the internet. Electronic Certifications or digital certifications is becoming a global trend these days those countries like Taiwan have invested in developing related tools for it (Yu et al., 2023).

Despite its convenience, the use of E-certification is plague with the concerns of authenticity and security. Due to those technologies for secure certification have emerge. One of the most popular is the block chain technology. Blockchain is described as an uncontrolled ledger of decentralized digital transactions (Rahardja et al., 2021). In blockchain, databases are only available for download without being deleted where each transaction will be summarized into a new block that continuously forms a chain, this sets the blockchain apart from ordinary databases [46]. It is utilized most in LMS platforms that offers E-certification like some LMS listed under MOODLE (Karatas, 2018).

Aside from blockchain, there other secure authentication that has been developed for E-certification, one of these is the use of Physical Unclonable Function to the Public Key Infrastructure (Siddiqui, 2022). It is a presented scheme for certificate authentication which is based on the fuzzy extractor and the analysis of various security reasoning, like the mutual authentication session key agreement, etc. Another concept is the Biometric Signature, which is described as a pattern of

electronic documents stored in a biometric system's database (Huang, 2023). It is usually handwritten in an electronic device and the authentication process involve speed and depth of writing. Those are just a few of the variety of authentication systems, there are more modifications and innovations to those methods, all with the same aim of creating a foundation of secure communication and issuance of certificate over the internet (Bruhner et al., 2022).

Synthesis:

The use of E-certification has been one major innovations in the majority of fields. The introduction of online learning through various platform has continuously use the distribution of usable E-certificate where participants who receive this certificate can use as a credential for applying to different professional fields. However, the big concern of using E-certificate is how authenticated and real is it. With the emergence of new technologies, e-certificates can now be modified, edited and recreated to look authentic making it harder to distinguish who is the real participant or not. In light with this, there are technologies that can counter act against this issue. Service Academy will utilize a combination of using a centralized database and authenticated digital signature. With this, not only it will be hard to be duplicated but also there are references of the e-certificate number so that clients who have interviewees claiming they went to this training can be identified if it's true or not. Furthermore, with an authenticated digital signature, trainees can

guarantee that the certificate they will receive can be use given that it is still within the range of validity.

2.3 Conceptual Framework

As the digital landscape evolves and grows, the realm of education grows with it. The emergence of E-learning has ushered a new era where institutions and universities embrace the capability of online education and the usage of the Learning Management System (LMS). The introduction and continuation of LMS has transformed a new era of education where vast amounts of data re generated from its diverse educational activities. In this dynamic environment, the complexity of different data relationship such as student behaviors, course materials and institutional objectives has demanded the needs of a refined approach to harnessing this data effectively and efficiently. The innovative application of learning analytics to a LMS has given educators a revolutionary way of deciphering complex data sets that can give valuable insights to create an effective environment for learners to interact and learn. This conceptual framework underscores the crucial role of Service Academy empowered by learning analytics in helping to reshape the Extension's office landscape, empowering the extensionist to make data-drive decision and improving their service to the needs of the community.

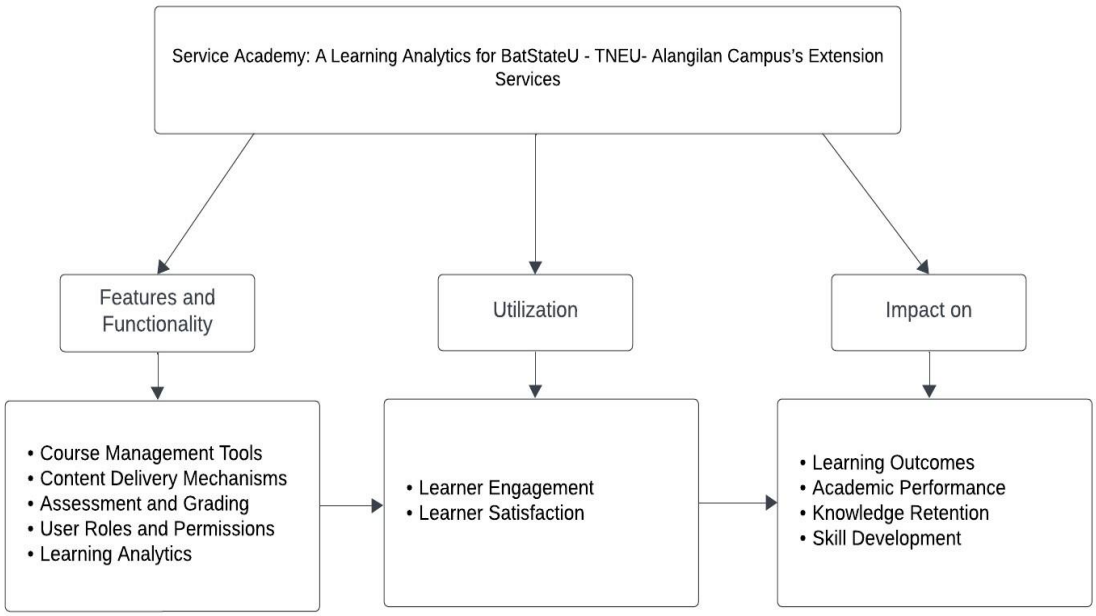

Figure 2-4. The Conceptual Framework

Chapter 3

DESIGN AND METHODOLOGY

The information flow and research methods utilized in the study are presented in this chapter. It covers the requirements for systems, testing, and evaluation procedures, data collection, and functional and non-functional needs of the development process.

3.1. Research Design

As stated in the technical background of chapter 2, the researchers will follow the Agile Development Process specifically the Scrum Sprint Framework to develop the Service Academy system. By using the agile methodology, researchers will have the benefit of flexibility and continuous improvement in developing the system unlike a rigid upfront plan. The Scrum Sprint framework within that methodology will give the researchers the tool of utilizing short development cycles called sprints (typically 1-4 weeks) which also fosters an adaptive approach. Within each sprint, the researchers will have the ability to explore features, adapt to changes and respond to the evolving requirements. This adaptability prowess will be achieved through a continuous testing and user client feedback and interaction. This feedback will be a crucial instrument in refining the design and the list of features and potentially give way to revisit designs for future sprints. By leveraging the Scrum Sprint Framework and the Agile methodology, the researchers can continuously improve Service Academy and its delivery of value,

Figure 3.1 depicts the iterative workflow of the Agile methodology, which the researchers will adopt for this project. This approach prioritizes flexibility and continuous improvement.

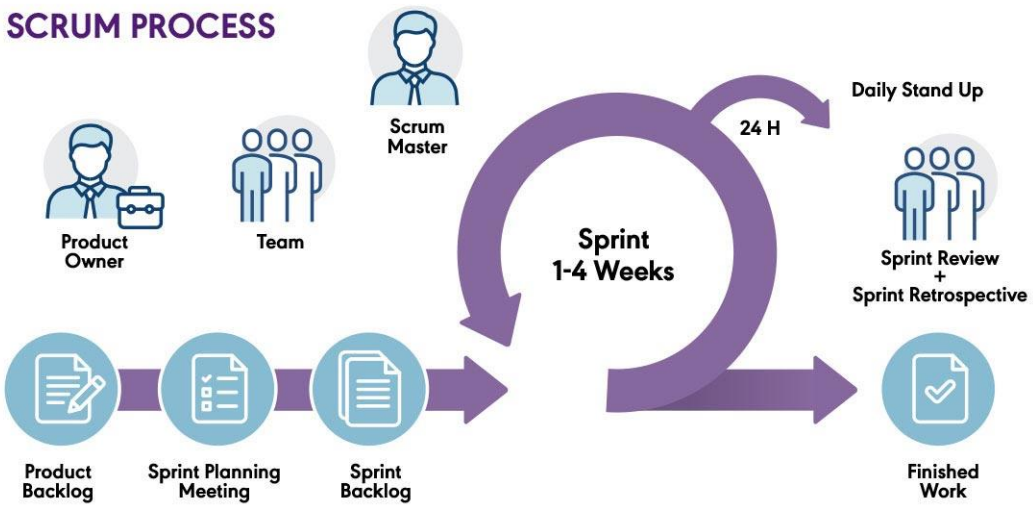

Figure 3-1. The Scrum Sprint Framework

Source: https://www.pm-partners.com.au/wp-content/uploads/2021/06/blog-scrum-process-opt.jpg

Each sprint will consist of three phases: Planning, Design and Development, and Review and Adaptation.

Planning Sprint

The first sprint will focus on Planning. During this phase, researchers will collaboratively plan the development of the Service Academy system, comprising on how and what to use for the creation of the frontend and backend aspects as well as identifying the functional and non-functional requirements of the proposed system. This involves identifying what and how the data will be use and what

database will be use to securely store it. This stage will also involve gathering information from relevant journals, articles, and studying similar systems to understand how the data and the system flows. Furthermore, researchers will create user stories and a list of features that will help in defining and creating a comprehensive list of modules for development. Researchers will also utilize different data tools and techniques to collect necessary primary and secondary data for a comprehensive data collection strategy.

This sprint will also include the planning of risk assessments for identifying potential challenges and issues that will appear before, during and after development, which will then help researchers develop mitigation strategies. Resource allocation will also be allocated effectively to meet project goals. A clear communication plan must also be established to ensure feedback, interaction, insight and progress report from the researcher and the stakeholder.

Design and Development Sprint

The design and development sprint will commence once the planning sprint is executed. Researchers will design and develop features based on the information gathered during the planning phase. This information includes, user stories, function and non-functional requirements, and the data collected. The researchers can then focus on designing and developing both the front-end and back-end aspects of the system while adhering to the given requirements and feedbacks of the stakeholders.

This can be achieved by utilizing Visual Studio as a development tool, incorporating various .NET Framework and .NET core tools and libraries. The researchers will also use different web-based languages such as HTML, CSS, JS to create the system and POSTGRES for the database. In this sprint, the researchers will also prioritize the creation of the user-interface (UI) and user-experience (UX) to ensure a user-friendly and accessible system. The researchers will also create a comprehensive documentation of the development sprint to ensure the maintainability of the system and its future updates. Robust security measures will also be developed to protect user-data, prevent unauthorized access and comply with relevant data privacy guidelines. Testing will be a series of on-going process throughout the development sprint to ensure the quality and identifying potential issues within the system, while optimizing the system to ensure its smooth and effective operation and responsiveness.

Researchers will also carefully select a suitable learning analytics based on the specific requirements of the chosen development tools to ensure seamless integration. Furthermore, a systematical design of the data flow, transformation and security protocol will be used to guarantee smooth and secure communication. This will allow the researchers to leverage the astuteness of learning analytics while maintaining a robust and maintainable system.

Review and Adaptation Sprint

After each execution of each sprint, the researchers will conduct a comprehensive review and adaptation of the completed work to the stakeholders to gather feedback and insights. This feedback and insights will be a crucial instrument in tuning and refining the different modules listed in features while also giving a potential of revisiting design for future sprints. Additionally, the researchers will conduct a scrum meeting to identify areas for improvement within the overall development process.

Additional meetings can also be conducted with the team to reflect on each success of the sprint, issues raise and areas that needs for improvement. Based on this meeting, the list of features may be adapted to be prioritize while addressing any issues it faced in the development process. Finally, documents such as user stories, list of features, design documents and other related documents will be updated, created to reflect latest changes.

By adopting the Agile Methodology and Scrum Sprint Framework, researchers can ensure the adaptability, responsiveness and continuous delivery of the development process in developing Service Academy. This iterative approach will provide researchers valuable feedbacks early and often, that can be leverage and utilize to ensure the system's deliverables meet the research study objectives

and stakeholder needs. Utilizing the sprint method will promote an efficient way of continuously improving the system and maintaining emphasis on feedback loops while reducing the risk of potential issues that can arise during and after the development and deployment of the system.

3.2. System Analysis and Design

For the development of this system, a thorough understanding of system analysis and design will be crucial to achieve precise and effective results. System analysis and design involves outlining the blueprint and execution strategy for building the system. This will be achieved by creating visual representations that illustrate the context, data flow, use cases, and the system boundaries of the developed web application.

Current System Analysis

BatStateU-TNEU-Alangilan Campus Extension Office currently handles all Program, Project and Activities (PPA) and other service agenda that helps the community outside the University. This type of extension service agenda includes, BatStateU Inclusive Social Innovation for Regional Growth (BISIG) Program, Livelihood and other Entrepreneurship related on Agri-Fisheries (LEAF), Environment and Natural Resources and Conservation, Protection and Rehabilitation Program, Smart Analytics and Engineering Innovation, Adopt-a Municipality/Barangay/School/Social Development Thru BIDANI Implementation

and many more. All these agendas are handled by the Extension Office by using a manual system. This manual system consists of process one of which includes managing and approval of programs. This system employs two distinct workflows depending on whether the program is initiated by a coordinator or the head itself.

For coordinator-initiated programs, the process starts with the coordinator's submitting a proposal form to the Extension Services Department. Once the University approves the proposal, the coordinator identifies eligible participants. Trainees then register for the program using an ISO form that are submitted in person or an online Google Form link (for online program). Trainee's that are in specific programs are required to attend depending on the given date range, where they are task to do activities and assessments. Trainees can then receive their certificate after careful evaluation.

On the other hand, head-initiated programs follow a different approach. In this case, the head identifies the need for specific seasonal programs and automatically approves them. The Head then locates suitable trainees for these programs. Registration procedures and tasks for these programs are identical to those used for coordinator-initiated programs.

While this manual system provides basic functionality, it has limitations that hinder the Extension Service's ability to fully achieve its goals and promote the Sustainable Development Goals for people outside the University and Batangas. To

gain a deeper understanding of these limitations and identify potential root causes, the researchers utilized the fishbone diagram presented in **Figure 3-2.** The fishbone

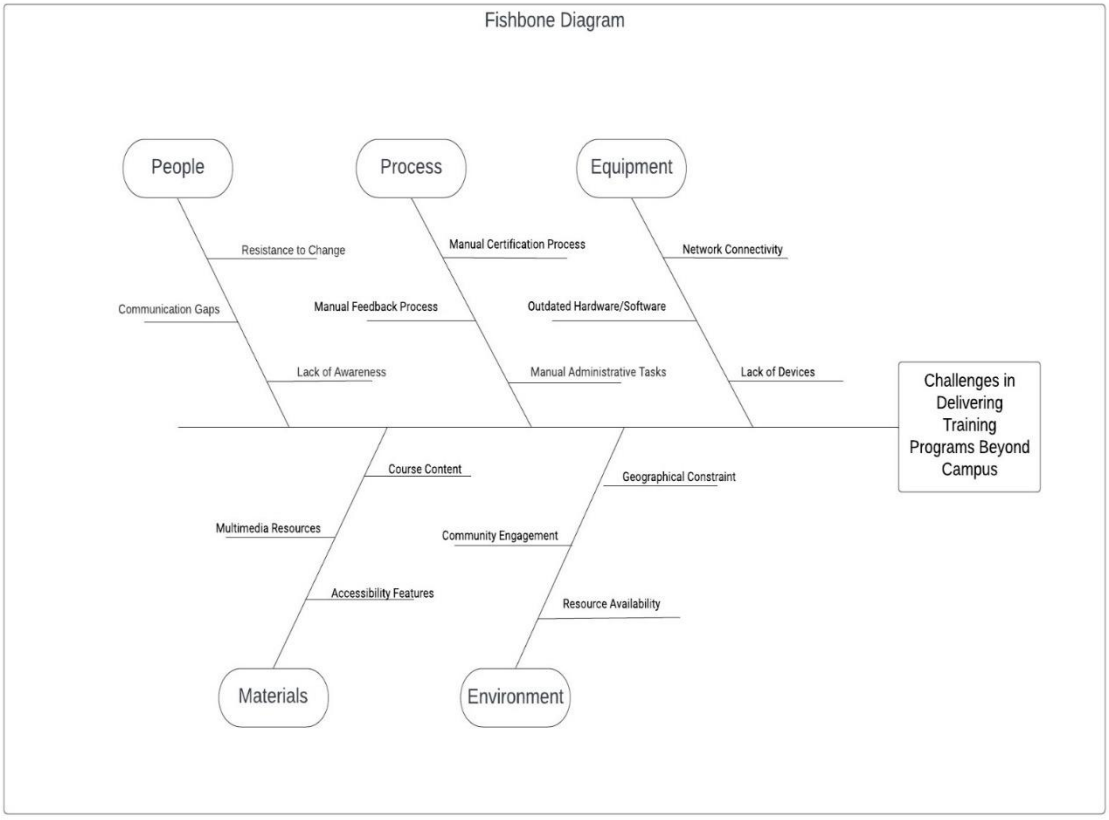

Figure 3-2. Fishbone Diagram Analysis of the Current System

diagram is used to identify potential causes of a problem in the system. The fishbone diagram assisted in breaking down complex problems into smaller, more manageable parts, as presented in **Figure 3.2**, making it simpler to identify underlying causes while implementing necessary corrective actions.

The main challenge of the current system being used by the Extension Service Department is reaching out different communities beyond the University

and Batangas Province. This limits the Extension Service of providing the service they can provide because not all communities outside the department's reach are being notified that the University is providing different types of programs which they probably need.

In addition to the challenge mentioned, the current system also encounters inefficiencies in managing program materials, processes and equipment. The manual process of proposing programs often leads to delays and inconsistencies since stakeholders may face problems in aligning their schedule to the given date range of the program as well as adhering to its objectives. Moreover, the lack of automation of gathering trainee inputs such as assessments, activities and feedback poses different challenges in terms of data collection, organization and analysis.

Without a streamlined process, tracking of trainee progress and evaluating the effectiveness of the program becomes inconvenient, hindering the ability to create data-driven decisions and improvements. These challenges highlight the need for a comprehensive system that addresses each point in the fishbone diagram to optimize experience for both administrator, coordinator and trainees.

Proposed System

To address the challenges and enhance the reach and effectiveness of the Extension Service, researchers proposed the development of Service Academy. Service Academy will be developed as a web-based platform that aims to streamline

the process of providing proram services to a diverse range of trainees even those outside of the immediate reach and vicinity of BatStateU- TNEU – Alangilan Campus.

Delving deeper into the system's functionalities, the researchers used various tools to create a comprehensive overview of how the system will work, what data it needs, who are the entities and what external factors can influence its functionalities. The researchers started by creating a use-case diagram. A use case diagram summarizes the details of a system's users (also known as actors) and their interactions with the system

Figure 3-3 presents the use-case diagram, which illustrates the functional interactions between the Service Academy system and its users.

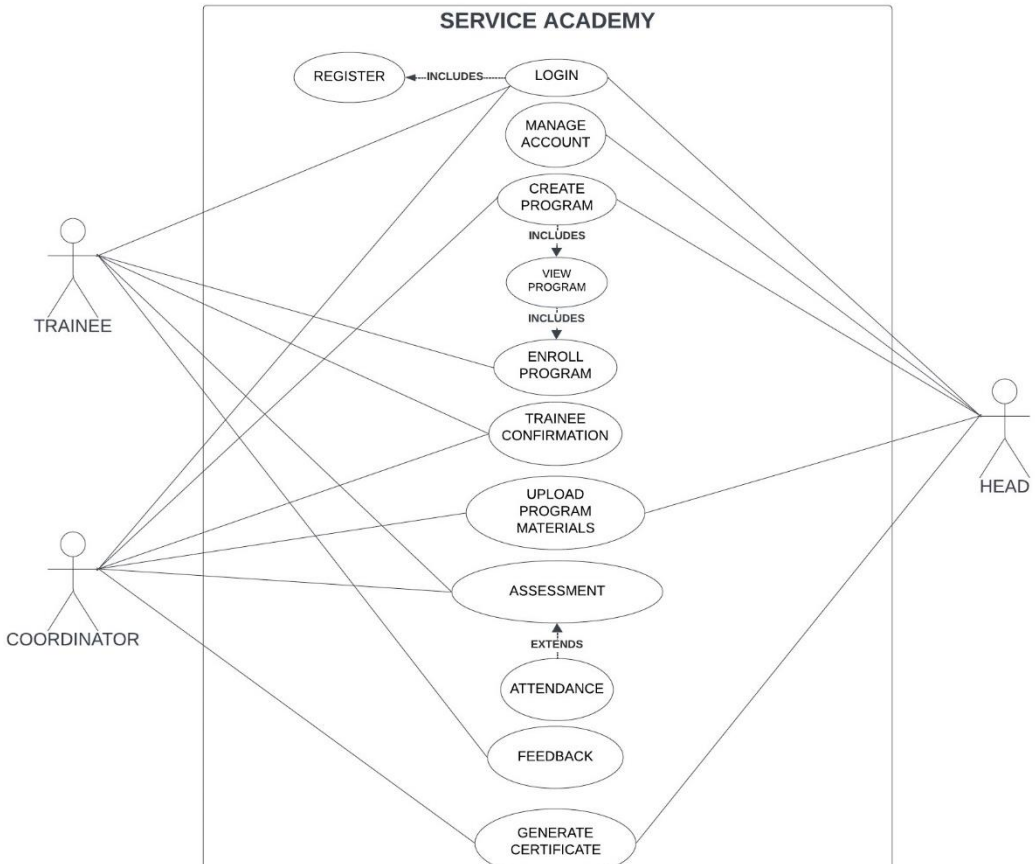

Figure 3-3. Use Case Diagram of Service Academy

The proposed system named Service Academy will cater to three main users; Trainee, Coordinator, and Head.

Trainees will be able to log in using their credentials, created during their registration. New trainees will be required to register before logging in for the first time. The trainees will then have the ability to browse both available and unavailable programs offered. Trainees will also have the ability to enroll in this program which they will fill up another form to be approved by the coordinator before having access to their personalized dashboard and copy of program materials. Within their dashboard, trainees will be able to browse their copy of program materials, take and upload activities and complete assessments required for the program. Upon completion trainees will be mandate to provide feedback while they will have to wait for the approval of the head to release their certificate.

Similarly, Coordinators will log in using their credentials or register if they are new users. Within their dashboard, coordinators will have the ability to propose a program, upload program materials, activities and assessments. They will also have the ability to approve who will be allowed to enroll in their handled programs. Coordinators will also have the ability to monitor trainee progress, update their marks.

The head of each department will oversee the entire Service Academy system and will be required to log in before accessing their dashboard. The head will have

the ability to manage the accounts of both trainees and coordinators. The head controls what programs should be added within the system by approving any program created or proposed by the coordinator or the head themselves. Approved programs will be transformed to programs within the list of programs offered by the system and the office. Additionally, the release of the trainee's certificate must be approved by the head within the system before being generated and distributed. This is to ensure trainees have completed the necessary requirements for the program

A deeper understanding of the Service Academy system can be achieved by examining its context diagram and system boundaries with their relationship to the use case diagram.

A context diagram is one of the most common used diagrams due to its ability to say things that would be hard for to explain in words, and they work for both technical and nontechnical audiences. **Figure 3.4** presents the **context diagram**, which illustrates the system's high-level interactions with external entities.

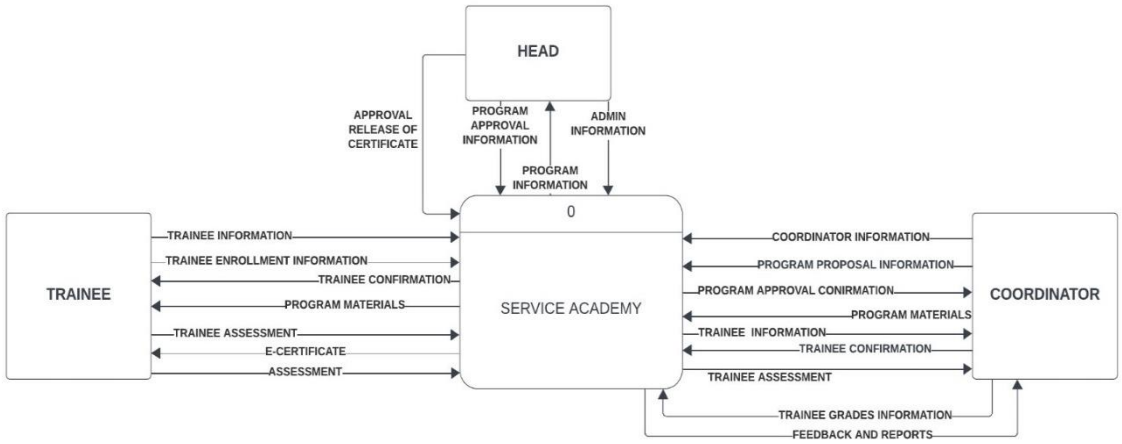

Figure 3-4. Depicting System Interactions and Internal Process- Context Diagram

The context diagram will serve as a cornerstone for comprehending the Service Academy system's scope and external interactions. It presents Service academy as a single system while clearly depicting the external entities that influences its operation. These external entities are trainee, coordinator and the administrator, each playing different roles in the program delivery process.

The visualization provided by the diagram will provide valuable insights into the system's purpose, interaction points with the outside environment, and the nature of the data it exchanges. By having a context diagram that can be analyze, researchers can gain valuable insights into the system's purpose, it's interaction points with the outside environment and the nature of its data exchange.

To further understand the context diagram, researchers must drill deeper within the given system and entity. **Figure 3.5** depicts a graphical visualization of delving deeper into the system's internal working.

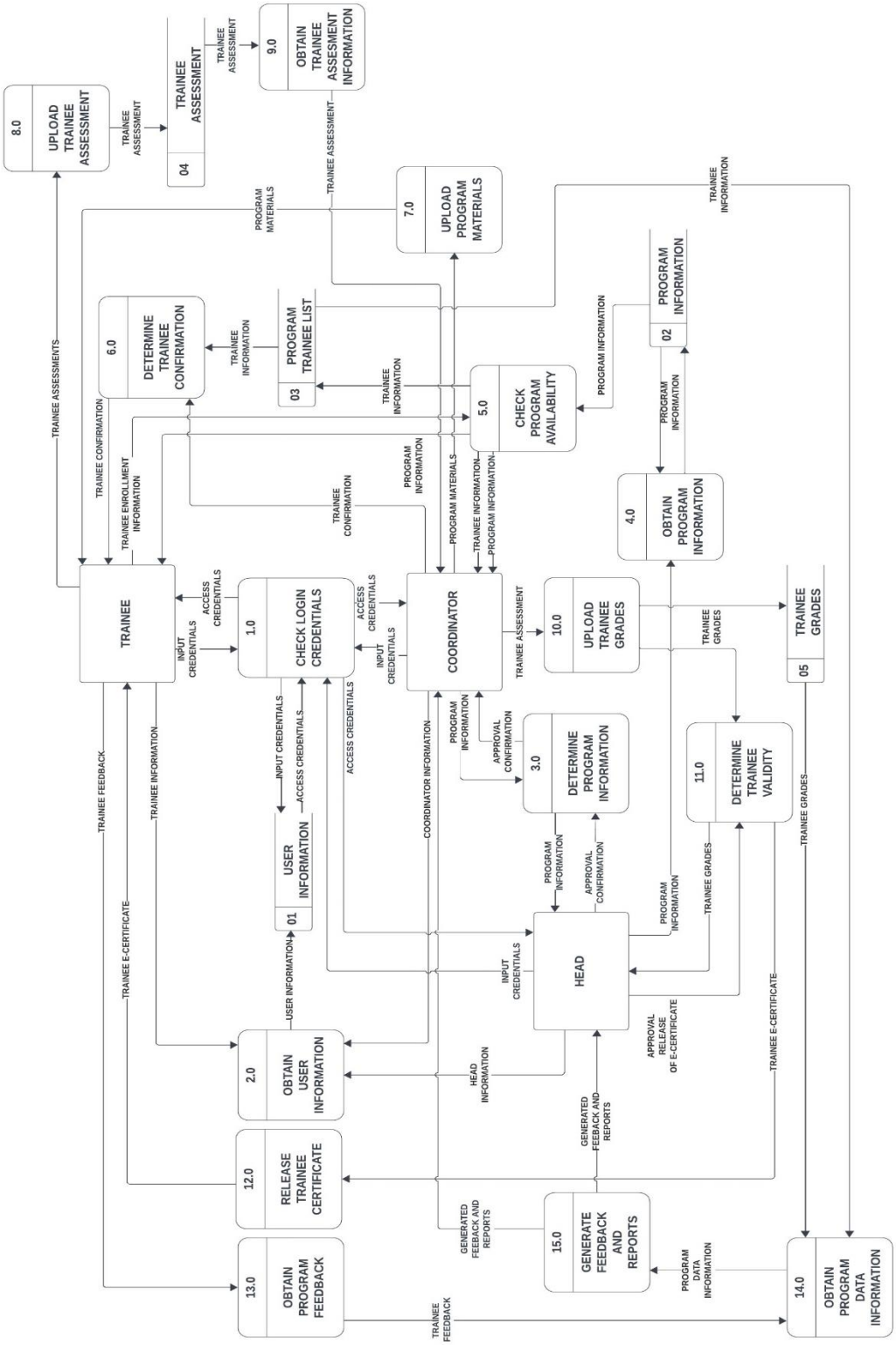

Figure 3-5. Depicting System Interactions and Internal Process- Level 1 Diagram

The level 1 diagram expands the details of the context diagram by decomposing the system into different primary sub-processes. It depicts how each process will work within the system while showing the flow of data on each internal processes and external entities. By analyzing the Level 1 Diagram of the Context Diagram, the researchers can have a granular understanding of the system's functionality and the data manipulation occurring within its boundaries.

Having established the system's internal interactions through the context diagram, it's crucial to define the system's boundaries. The system boundary is a conceptual line dividing the system you want to study from 'everything else'. It is useful to think of a system's environment as being made up of those things that are not part of the system but can either affect the system or be affected by it. **Figure 3.6** depicts the system boundary, illustrating the clear division between the Service Academy system and its external environment.

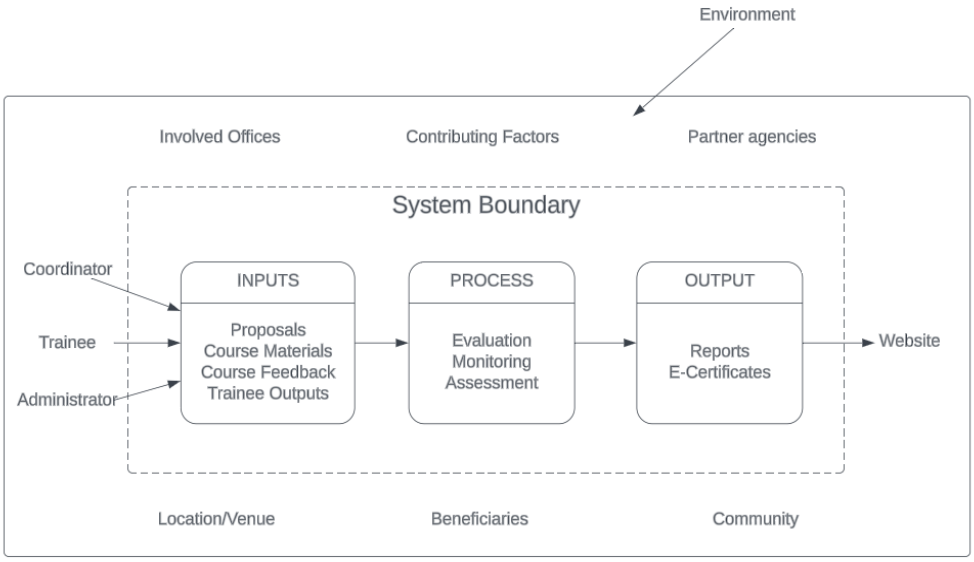

Figure 3-6. System Boundary of Service Academy

The system boundary depicts the scope and context of the system that will be developed. Within this boundary lies the system's internal components such as Inputs (Proposal, Course Materials, Course Feedback, Trainee Outputs), Process (Evaluation, Monitoring, Assessment), and Outputs (Reports and E-Certificate). This internal component explains the systems primary data and operational processes that encompasses the system's whole functionality and management.

Outside this boundary lies the system's external components that may influence or interact with the system. These external factors (Involved Offices, Contributing Factors, Partner agencies, Location/Venue, Beneficiaries, and Community) are situated outside of the system's boundaries but still has crucial roles in shaping the system's environment, requirements and outputs.

By utilizing various diagrams such as use case, context, level 1 and system boundaries showcased within this chapter, the researchers can gain a comprehensive understanding in developing Service Academy's system functionalities, user interaction and environment. This understanding will be a crucial instrument in creating a robust and effective system that addresses the limitations of the current system while also aligning to the proposed systems objectives and solutions.

3.3. System Requirements

Hardware Requirements

To comply with the need for fast-loading system and for data storage, hardware components are part of the considerations. The hardware requirements are divided into two; Minimum and Best Performance. The minimum requirements of the system currently border to the latest Windows 10 Version 22H2 OS. The Ram must be at least 8GB or higher and the processor must be at least 11th Gen Intel(R) Core i5-1135G7 @ 2.40GHz 2.42 GHz. A minimum of 256 GB of Solid-State Drive is needed for storage and a 50mbps internet connection is needed to access the built system. Because high-end applications are not needed for system development, there aren't too many hardware requirements. This requirement was necessary at the time the system was being developed since the storage and versions chosen are appropriate for a web-based management system, particularly when the system would be utilized on computer setups. For best performance or smooth progression in creating the system, the system needs at least an OS of the latest Windows 11 Version 23H2. The processor can be the same or it can be 12th Gen Intel Core i5-12500 that clocks on 3.0 GHz. The RAM can be 8GB or at least 16GB while the storage must be at least 512 of SSD or 1TB of Hard Drive if available. The internet speed must be at least 60-100mbps for both upload and download speed. **Table 3.1** details the hardware requirements for the Service Academy system.

Equipment	Minimum Type/Specification	Best Performance Type/Specification
Operating System	Windows 10 Version 22H2	Windows 11 Version 23H2
Processor	11th Gen Intel Core i5-1135G7	11th Gen Intel Core i5-1135G7 or 12th Gen Intel Core i5-12500
RAM	8GB RAM	8-16GB RAM
Storage	256 Solid-State Drive Storage	512 Solid-State Drive or 1TB Hard Drive
Network	50mbps	60-100mbps

Table 3-1. Hardware Requirements for Developing the System

There are also established requirements for the system's correct and efficient operation that is applicable to both computer and phone setup. **Table 3.2** details the hardware requirements for the Service Academy system to operate at its peak efficiency. The technology on their gadget can function just fine with a steady internet connection

Equipment	Computer Type/Specification	Phone Type/Specification
Operating System	Windows 10 Version 22H2 or Higher	Android 7.0 or Higher/ iOS 12Higher
Processor	Intel Core i5 or AMD Ryzen 5 series	Android: Qualcomm Snapdragon 600 series or higher/ iOS: Apple A10 Fusion chip or later
RAM	8 GB RAM or 16 GB (for multitasking)	3 GB RAM (Minimum) 4 GB RAM (Recommended)
Storage	256 Solid-State Drive Storage	64 GB of Storage for Android and iOS

Table 3-2. Hardware Requirements for Using the System

Software Requirements

Following the information and plans devised during the planning sprint phase, the researchers will require different software requirements in developing the web-based system Service Academy with Learning Analytics. Utilizing different software tools will enhance Service Academy's functionality and efficiency. The researchers will employ a web-technology programming languages such as Hypertext Markup Language (HTML), Cascading Style Sheet (CSS) for the front-end design while JavaScript (JS) and C# will be used for the back-end of the system utilizing .NET Framework ASP Web Form. Additionally, researchers will also use bootstrap to create a user-friendly and responsive system.

The researchers can achieve this by utilizing Visual Studio Community 2022 which supports development tasks such as task execution, debugging, and version control/ A streamlined approach will also be used that will allow the researchers to focus using essential tools for a rapid code-build- debug cycle. Furthermore, a relational database management system like PostgreSQL to be use for testing. Researchers will also use the API integration method of integrating Learning Analytic tools for the creation of insights and reports.

Functional Requirements

This section details the functional requirements of the Service Academy system. These requirements will define the system's general behavior and operation, ensuring developers can build a system that meets its intended objectives. **Table 3.3** displays the system's general functional requirements, which specify general behavior and operation.

Module	Description
General System Functions	
Login	Grants Trainee, Coordinator, and Administrator to login to the system using their registered credentials
Register	Permits the Trainee, Coordinator, and Administrator to register and create accounts
Data Information	The Trainee, Coordinator, and Administrator interacts with the system to manage various types of data
Display Profile	Allows Trainee, Coordinator, and Administrator to view user profiles stored in the system
Browse Dashboard	Permits the Trainee, Coordinator and Administrator to browse various information within the dashboard of the system
Logout	Allows the Trainee, Coordinator and Administrator to log out in the system

Table 3-3. System Functional Requirements - System General Functions

Table 3.4 details the functional requirements specific to the system administrator role. These requirements will define the head's capabilities and actions within the Service Academy system

Module	Description
Head System Functions	
Approve Program Proposal	Permits the Administrator to approve coordinator proposals and create a course option in the system
Browse Administrator Dashboard	Grants the administrator to view the generated analytics of various data
Browse Coordinator Profile	Permits the Administrator to view specific stored Coordinator information
Browse Trainee Profile	Grants the administrator to view specific stored Trainee information
Generate E-Certificate	Allows the Administrator to email and confirm the release of Trainee E-Certificate
Generate Reports	The Administrator interacts with the system to generate reports

Table 3-4. System Functional Requirements - Head System Functions

Table 3.5 details the functional requirements specific to the system coordinator role. These requirements will define the coordinator's capabilities and actions within the Service Academy system.

Module	Description
Coordinator System Functions	
Browse Coordinator Dashboard	Grants the administrator to view various stored information through their dashboard (e.g., course materials,)
Browse Trainee Profiles	Permits the administrator to view specific information, outputs of the trainee
Update Trainee Grades	Enables the Coordinator to update Trainee Grades
Upload Course Materials	Function to upload, update and delete course material information (e.g., activities, modules)
Propose Program	Permits the Coordinator to provide information of the given program

Table 3-5. System Functional Requirements - Coordinator System Functions

Table 3.6 details the functional requirements specific to the system trainee role. These requirements will define the trainee's capabilities and actions within the Service Academy system.

Module	Description
Trainee System Functions	
Browse Trainee Dashboard	Grants the Trainee to view various stored information through their dashboard (e.g., course materials,)
Course Feedback	Gives the Trainee the ability to give Feedback for a specific course
E-Certificate	Function that signals the user has passed and completed the course
Enroll in a Course	Function that permits Trainee's to enroll to a course that is open and displayed by the system
Trainee Profiles	Permits the trainee to view and update account profile
Upload Course Materials	Allows the user to update and upload course material information (e.g., assessments, activities)

Table 3-6. System Functional Requirements - Trainee System Functions

Non-Functional Requirements

This section details the quality attributes of the Service Academy system. These attributes define the characteristics beyond core functionality, such as performance, reliability, and security. Fulfilling these quality attributes ensures the system will meet its intended objectives while providing a positive user experience. **Table 3.7** details the non-functional requirements of Service Academy.

Attributes	Description
Compatibility	The system must be accessible and functions properly on wide ranges of devices and web browsers.
Functionality	The system shall satisfy all documented functional requirements for admins, coordinators and trainees
Maintainability	The system's codebase should be well-documented, modular, and easy to maintain
Scalability	The system should be designed to scale horizontally or vertically to accommodate future growth in users, data, and functionality.
Security	The system shall implement robust security measures to protect user data confidentiality, integrity, and availability
Usability	The system interface shall be intuitive, user-friendly, and employ an efficient layout.

Table 3-7. System Non-Functional Requirements

3.4. Data Collection

To gather data necessary for creating a learning and predictive analysis, researchers will employ numerous data collection methods. This collection will include various tools and techniques such as surveys, interviews, and specific mechanisms integrated or embedded within the system. The collection of primary data will focus on user interaction and profile data. User interaction data will include data like the number of hours a user spent on a program material, number of attempts on assessments and completion rates, all of which will be collected through the system itself. Profile data such as age,

gender, or jobs (if applicable) will be gathered through the system's registration form.

On the other hand, to capture course effectiveness and user feedback, feedback and survey data will be gathered through Service Academy's course feedback survey which will be a process after a Trainee completes the course. This can be accomplished by integrating an embedded survey form or using a third-party tool of survey like google forms.

Moreover, historical data trends and course demands are the secondary data that the researchers will use. This data includes information on previous programs conducted by the Extension Office, that of which can be obtained by the researchers through interviews or using data mining techniques

By leveraging these data collection tools and techniques, researchers will gather the necessary data to generate and gain valuable insights in generating reports that can help in data-driven decision making. These reports will help the researchers and the head to identify if a program is effective, what programs are in-demand and guide future program development.

3.5 Data Analysis

To leverage the data collected by the researcher and the system that will be developed a comprehensive approach will be adopted for both quantitative and qualitative data. Quantitative data like user interaction data, which includes data including the number of times spent on materials, number of attempts on quizzes and assessments, and completion rate, will be pre-processed and clean before going to a statistical analysis using mechanisms or third-party API. Descriptive statistics will be analyzed and created by leveraging summarized key metrics that will provide user engagement and the effectiveness of the course. A regression analysis can also be used to analyze any correlation of profile data and learning outcomes.

Meanwhile, researchers will use a qualitative and content analysis for qualitative data which will be obtained in the course feedback and survey within the system. By using a qualitative analysis with content analysis, researchers can identify recurring themes, patterns and user insights with regards to course effectiveness, and satisfaction.

These insights and information will help the researchers create evidence-based decision making, making the identification of course effectiveness, area for improvement, and opportunities for development to meet user needs and enhance user experience.

3.6. Ethical Considerations

In accordance to Republic Act No. 10173 also known as the Data Privacy Act of 2012, the researchers will adhere to the different guidelines regarding data handling, privacy and participant rights. The researchers will develop the system while ensuring ethical considerations such as protection of user privacy, maintain data integrity and upholding ethical standards.

For data handling, the researchers will use a large but maintainable data storage to ensure efficient way of managing and maintaining data and its security. Data integration will be properly planned to ensure no data silos or leaks can occur. Data security will be implemented by using various robust data security tools like encryptions and access controls to ensure data privacy.

For interviews, surveys and registration, the researchers will obtain participants informed consent before proceeding to any data collection of various data needs while also making sure that their information are anonymized and protected. Researchers will try to minimize the data that will be collected while also ensuring it will achieve the research objective. Furthermore, user's will be offered an option to control and opt-out data to honor their request for any data update or deletion while also maintaining transparency.

By following these ethical guidelines, researchers can build and ensure the trust given by the users will be honor while being responsible with the collection, storage, and analysis of data. This ethical approach will contribute to the success of the Service Academy system and its ability to deliver its objectives.

3.7. Validity and Reliability

System testing is crucial to the creation of new systems. This is to ensure that the system that is developed is evaluated and adheres to the following functional and non-functional requirements while also achieving the objectives of its development. However, to ensure its validity and reliability of the data and the system that will be developed, the researchers will employ various testing methods.

Following this, the researchers has chosen Unit-Testing as a testing method. Unit testing is a component of the test-driven development (TDD) which is a pragmatic methodology that carefully approach developing systems by means of continuous testing and revisions. Given the chosen methodology and framework of the study, researchers will utilize this method by isolating the different modules of the system with a written series of unit test and test cases to simulate and cover various situations. This will give the researchers the leverage of testing the system while adhering to the listed functional and non-functional requirements

This testing methodology will also tell the researchers as well as the stakeholders any potential flaws, errors and issues that can occur during the early stages of the system while allowing for timely correction and ultimately leading to a more robust and trustworthy system.

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