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Empowering Local Government Units with Open-Source Tools: Building A Dynamic Web-Based Information System

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RESEARCH ARTICLE INFORMATION	ABSTRACT
Received: May 03, 2023 **Reviewed:** May 23, 2024 **Accepted:** June 06, 2024 **Published:** June 29, 2024 	The Local Government Unit (LGU) of Cabagan, Isabela targets to enhance transparency and public service delivery. To achieve these goals, a dynamic web-based information system was developed with three primary objectives: promoting transparency, showcasing municipal accomplishments, and providing easy access to essential services and financial data. The web development process was employed to create the system, utilizing a client-server architecture for efficient data management and processing. Open-source tools such as PHP, HTML, JavaScript, Bootstrap, MySQL, and web browsers were used in the website's development. The site featured a user-friendly, responsive interface and included data uploaded from the municipal level via cPanel web hosting, with the domain registered at www.lgucabagan.gov.ph. The web hosting company ensured reliable data management and website maintenance. Furthermore, a user-end evaluation using a 5-point Likert scale rated the website's design and layout as very satisfactory. Users appreciated the logical structure, easy navigation, and accurate information presentation of the system. The forum page facilitated user feedback, enabling continuous improvement based on community input. The findings from this study demonstrate the potential of open-source technologies to improve local governance and public service delivery. The results highlight the importance of user-centered design in creating effective digital platforms for local government units. The successful implementation of this system in Cabagan underscores its potential for replication in

other municipalities, promoting transparency and enhancing public service delivery across the Philippines.

Keywords: *accountability, accessibility, local governance, open-source, transparency, user-centered design*

Introduction

The Philippine government has undertaken various technology-based initiatives to improve public services and foster transparency. Programs like the e-Government Master Plan 2.0, Open Data Philippines, and the Philippine Transparency Seal have significantly increased the availability of government data (Department of Information and Communications Technology [DICT], 2016). Additionally, the Free Wi-Fi for All program aims to boost internet connectivity and expand the digital infrastructure across the country (DICT, 2021). Nevertheless, despite these efforts, there remains a substantial need for further enhancement in the accessibility of services, financial information, and overall transparency to the public.

Moreover, effective local governance and transparency are widely recognized as drivers of economic growth and progress, benefiting businesses, law enforcement, and the local community. For instance, the implementation of the Open Data Philippines initiative has led to a 20% increase in public access to government data, fostering greater civic engagement and accountability (Open Data Philippines, 2020). Moreover, the Free Wi-Fi for All program has connected over 10,000 public sites nationwide, improving internet access for millions of Filipinos and supporting economic activities, particularly in rural areas (DICT, 2021). According to a recent study by the World Bank (2021), countries that have implemented comprehensive e-government strategies have seen a 15% increase in administrative efficiency and a 10% boost in public trust in government operations.

To strengthen the Philippine economy, grassroots reforms and development initiatives, starting with barangay ng Bayan, are essential. Establishing an information infrastructure that allows constituents to conveniently access local information and services is a crucial step. This initiative should align with the mandates of the Local Government Code, ensuring that *barangay ng Bayan* can compete effectively with more advantaged local government units (LGUs).

Additionally, a municipality's website plays a key role in educating citizens about the roles and responsibilities of local government administrators. It can facilitate the implementation of structural mechanisms like the *Katarungang Pambarangay ng Bayan* by providing direct access to information and officials, thereby enhancing the efficiency of the justice system and improving governance transparency. A dynamic website is not only an economic and administrative asset but also empowers citizens and encourages active participation in barangay activities, which is crucial for nation-building.

According to the Global S&T Competitiveness Report 2022, the Philippines ranks 56th in technological readiness, trailing neighboring Southeast Asian countries like Malaysia, Thailand, and Singapore (Global Innovation Index, 2022). This underscores the urgency of utilizing technology to increase awareness among *barangay ng Bayan* constituents about the importance of transparency and participation in local governance, thereby promoting economic growth and technological progress.

This study, conducted within the Local Government Unit (LGU) of Cabagan, Isabela, Region 02, aimed to develop and evaluate a dynamic web-based information system in the municipality. Its objectives included enhancing transparency by providing public access to municipal accomplishments, financial data, and local products (Government Efficiency and Transparency, 2017); promoting trust and accountability through showcasing municipal achievements (OECD Public Governance Reviews, 2019); and improving accessibility to essential services and financial data, thereby enhancing public service delivery (World Development Report, 2021).

To effectively manage administrative services and enhance development capacity in Cabagan, investing in information infrastructure such as a website is crucial. This platform will facilitate information exchange among local residents, tourists, researchers, students, and other visitors (Digital Philippines, 2018), thereby improving service delivery and fostering collaboration with the business sector (International Journal of Information Management, 2020). This, in turn, may attract investments across various sectors of society (Economic Development Quarterly, 2022).

While commercial web application software used to create websites can be costly and inaccessible to Cabagan, recent access to open-source tools provides limitless alternative ways of designing a website (Journal of Open Innovation: Technology, Market, and Complexity, 2020). Therefore, utilizing open-source tools or freeware was the main objective of this research (Digital Government: Research and Practice, 2023). Promoting information technology and internet use among constituents and administrators, the *barangay ng Bayan* website also serves as an avenue to advocate transparency and cultivate the unique culture of the Ibanags, which has been slowly waning in present times (International Journal of E-Government Research, 2016).

Thus, this study emphasized the importance of e-government websites in enhancing transparency, fostering citizen participation, and driving economic development in local government units like Cabagan (Public Administration Review, 2021). By addressing gaps in the current literature and proposing practical recommendations, this research aimed to significantly contribute to the advancement of governance practices in the Philippines (Philippine Journal of Public Administration, 2018).

Methods

The study employed a combination of descriptive and developmental research methodologies. The descriptive research component involved collecting data on website information and subsequently analyzing and describing the gathered data. Meanwhile, the developmental approach focused on the creation of a dynamic web-based information system.

Development Process

The development of the dynamic web-based information system for the Local Government Unit (LGU) of Cabagan, Isabela, followed a structured web development process consisting of five phases: planning, design, development, launch, and maintenance. Each phase involved specific activities to ensure the system met the needs of the LGU and its constituents.

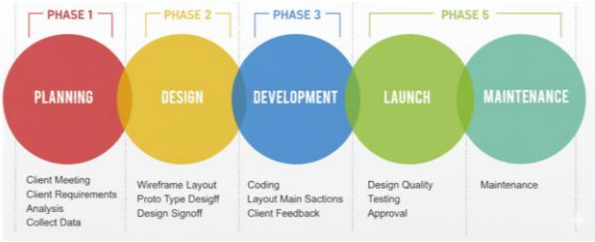

Figure 1. *Web Development Process*

Planning

The planning phase commenced with a series of preliminary activities aimed at comprehending the Local Government Unit's (LGU) needs and requirements. This process began with a thorough needs assessment, which involved meetings and interviews with LGU officials and staff to identify specific challenges and areas of concern. Existing documents and reports related to municipal services, financial data, and transparency initiatives were meticulously reviewed. Key stakeholders, including local business owners, community leaders, and residents were interviewed to gather valuable feedback on the desired features and services for the proposed website. Furthermore, a technical feasibility study was conducted to evaluate the LGU's technical capabilities and available resources for website development and maintenance. This study also assessed potential open-source tools and technologies that could be utilized for the project, ensuring an efficient and cost-effective solution.

Design

The design phase concentrated on developing a comprehensive blueprint for the dynamic website. Mockups showcasing the layout and structure were created, allowing for visualization of the site's design and functionality. This ensured a user-friendly interface and responsive design, safeguarding optimal accessibility across various devices. The primary objectives were to promote transparency by making information readily accessible, enhance accessibility through an intuitive interface, and deliver an exceptional user experience with a responsive and visually appealing design. Meticulous attention was given to crafting the site map, architectural design, and database schema, ensuring optimal performance and usability for the website.

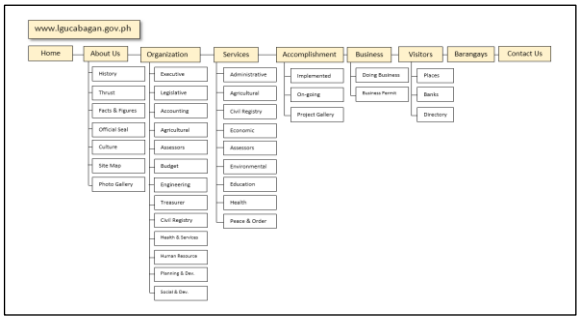

Figure 2. *Sitemap of the Web-Based Information System*

Figure 2 presents the sitemap, a hierarchical blueprint crucial for outlining the structure, content, and navigation of the LGU Cabagan dynamic website, ensuring a logical and user-friendly information architecture.

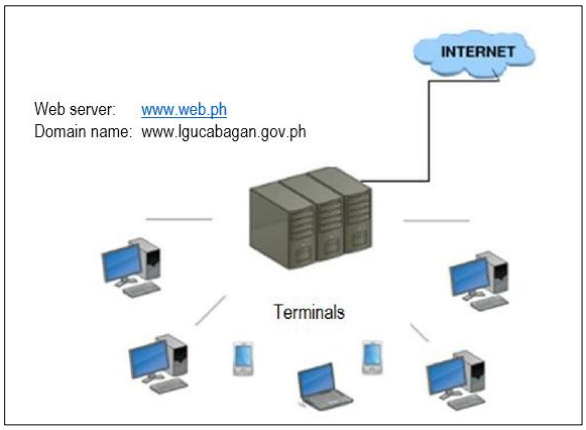

Figure 3. *Client-Server Architecture Design of the Web-Based Information System*

As illustrated in Figure 3, the architectural design of the website tool follows a client-server architecture, consisting of two main components: the web server and the terminal. The web server includes a file manager that manages the municipal website's information using the cPanel tool. Data from the municipality was extracted and uploaded via web hosting, utilizing an account in the cPanel tool on the web server at www.web.com.ph, and facilitating integration over the Internet. Administrative tasks were managed by a web application that uses Hypertext Preprocessor (PHP) and Hypertext Markup Language (HTML). The Web Services Description Language (WSDL) defined the rules for interfacing and interaction between the terminal, which requests services, and the server, which responds to these requests.

Additionally, the client-server architecture was chosen for developing the web-based information system in Cabagan, Isabela, Philippines, due to its efficiency in data management and processing, scalability, and maintainability. This architectural model divides the application into two primary components: the client side which is responsible for user interaction, and the server side which is responsible for managing data storage and processing. This division allows for efficient handling of data operations, ensuring secure storage and on-demand access. Additionally, the architecture supports scalability, enabling the system to handle increasing data volumes and user requests over time without performance degradation. It also enhances maintainability by isolating changes made to the client and server sides, minimizing the risk of errors during updates, and simplifying debugging processes.

The choice of client-server architecture closely aligns with the objectives of the web-based information system. It promotes transparency by securely managing and providing access to municipal accomplishments, services, and financial data. This supports the system's goal of showcasing municipal achievements and offering easy access to essential services and financial information through a user-friendly, responsive interface. Furthermore, the architecture supports the implementation of a forum page for user feedback, ensuring continuous improvement based on community input. Overall, the client-server architecture not only enhances data management efficiency but also supports the system's objectives of transparency, improving service delivery, and promoting effective governance in Cabagan.

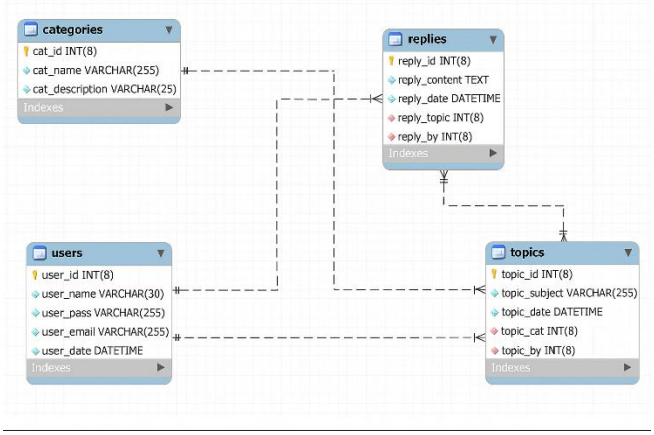

Figure 4. *Database Schema of the Web-Based Information System*

As depicted in Figure 4, the database schema of the municipal website outlines the organization of data and integration of different tables to construct the database. Two types of tables were involved in this process: the administrator and messages tables. The administrator table has full control over the messages table, enabling them to add or delete messages. The relationship between these tables can be one-to-one or one-to-many. Moreover, the administrator table can modify or delete existing accounts using the phpMyAdmin cPanel tool of the website.

Development

The Development phase involved the actual construction of the website. Open-source tools such as PHP, HTML, JavaScript, Bootstrap, Open Graphics, MySQL, and Open Browsers were utilized to build the website, implementing a client-server architecture for efficient data management and accessibility. Data were extracted from the municipal level and uploaded via cPanel web hosting, with the domain registered at www.lgucabagan.gov.ph. The web hosting company played a critical role in facilitating data management and website maintenance.

Launch

During the launch phase, the website was made live and accessible to the public. This deployment involved uploading the website data and configurations via cPanel web hosting and registering the domain www.lgucabagan.gov.ph, acquired from the Department of Science and Technology (DOST) Central Office. Functionality and usability testing were conducted to identify and address issues before the full launch. Selected users provided feedback on the design and functionality. Several challenges were encountered during this phase, including the continuous integration of data from various municipal departments and configuring the cPanel web hosting setup. These challenges were addressed through close collaboration with the municipal IT team and DOST support. Additionally, ensuring compatibility across different devices and browsers required adjustments to the website's codebase. Technical issues such as server downtime were promptly addressed by the web hosting provider, and regular

backups were implemented to prevent data loss. Issues with data integration were resolved by refining data extraction processes and ensuring compatibility with the cPanel system. Security measures were enhanced through testing and configuration adjustments to the cPanel settings.

To manage updates, a structured change management process was implemented. New features and enhancements underwent thorough testing in a staging environment before being deployed to the live system, minimizing disruption to services. Technical issues were promptly addressed by an IT support team from the LGU Cabagan, with assistance from the researcher, who would monitor system performance and prioritize technical support requests.

Moreover, a presentation was conducted for the Office of the Mayor to highlight the web-based information system, followed by training sessions for the Municipal Information Systems (MIS) Office which is responsible for updating the system's content. Additionally, barangay secretaries participated in the training to enhance their communication, access to information and service delivery, as well as for professional development. These efforts aimed to foster more effective local governance and community development in Cabagan municipality.

Figure 5. *Domain Name Registration of the Web-Based Information System*

Figure 5 illustrates the process of website domain name registration, which involves reserving a unique web address for the LGU, Cabagan website. This process establishes a formal online presence for the municipality, enhances accessibility and credibility, and supports the broader goals of transparency, public engagement, and efficient service delivery.

Maintenance

Following the website's launch, regular updates were necessary to keep the information current and relevant, including ongoing programs, projects, and services offered by the municipality. Alongside content management, technical maintenance was essential to ensure smooth and uninterrupted operation. These efforts allowed website administrators to effectively manage and maintain the site, ensuring its continued reliability and usefulness for the intended audience.

Data Collection and Evaluation

The data collection process utilized structured 5-point Likert scale questionnaires distributed to 100 respondents. This group included local constituents and LGU employees, providing insights from the perspective of end-users. Strategically, fourth-year BSIT students and members of the IT faculty were included to contribute their technical expertise and user experience perceptions. The questionnaires evaluated the

website design, layout, navigation, and content. Quantitative data underwent statistical analysis to derive mean scores for a comprehensive end-user evaluation.

Ethical Considerations

This research project was conducted with the authorization of the institutional head where the study was carried out. In addition, prior to data collection, all participants provided informed consent. It is important to note that all personal information gathered was treated with utmost confidentiality and solely used for the purpose of this research.

Results and Discussion

In this section, the study's findings are presented in accordance with its objectives, which focused on developing and evaluating a dynamic web-based information system. The system aimed to enhance transparency, highlight municipal accomplishments, and improve access to essential services and financial information, ultimately contributing to improved public service delivery.

Enhancing Transparency

The dynamic web-based information system successfully achieved its objective of enhancing transparency within the Local Government Unit (LGU) of Cabagan, Isabela. Through the website, constituents gained easy access to municipal accomplishments, financial data, and local products. The user-friendly design and responsive interface facilitated seamless navigation, allowing users to locate relevant information efficiently.

Showcasing Municipal Achievements

The website effectively showcased municipal achievements, promoting trust and accountability within the community. By highlighting accomplishments and initiatives undertaken by the LGU, the website contributed to building trust with constituents and demonstrating the government's commitment to accountability. The clear presentation of information on municipal achievements fostered a sense of pride and ownership among residents, encouraging active engagement with local governance processes.

Improving Accessibility to Essential Services and Financial Data

Accessibility to essential services and financial data was significantly improved through the dynamic web-based information system. Users could easily access information on available services, programs, and projects offered by the municipality, facilitating informed decision-making and engagement with government initiatives. Moreover, the website provided transparent access to financial data, promoting accountability and ensuring public scrutiny of municipal expenditures.

The Developed Web-Based Information System

Figure 6 displays the homepage of the dynamic web-based information system for LGU Cabagan. This comprehensive platform presents a range of essential information about the municipality, covering its organizational structure, available services, notable achievements, business opportunities, visitor resources, and contact details.

Figure 6. *The Main Page of the Website*

Notably, the main page prominently features transparency of data alongside other pertinent information crucial for the benefit of local constituents. The user-friendly interface ensures easy navigation, allowing users to quickly find and access the information they need. Additionally, the platform is designed to be accessible on various devices, ensuring that citizens can stay informed whether they are using a computer, tablet, or smartphone. The inclusion of updates and interactive features further enhances the user experience, making it a valuable tool for fostering community engagement and ensuring transparency in local governance.

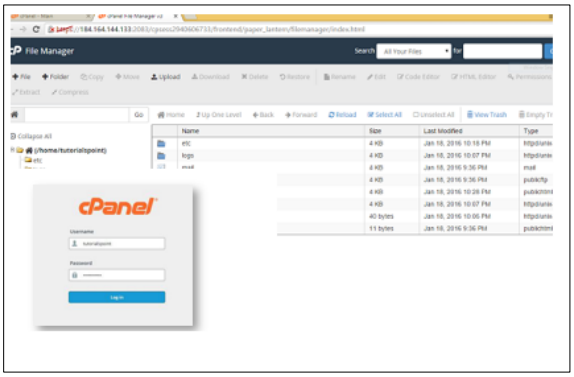

Figure 9. *Data Management on Web-Based Information System Using cPanel Tool*

Figure 9 illustrates the process of uploading relevant data, employing the cPanel tool's file manager feature. This functionality is accessed through the web server hosted by www.web.com.ph, a dedicated provider of server space for websites. An administrator account is assigned to manage data on the municipal website, enabling tasks like adding, updating, and removing information. Acting as the vital link between the website and web browsers, the web server employs internet communication protocols to efficiently relay information to clients accessing the site.

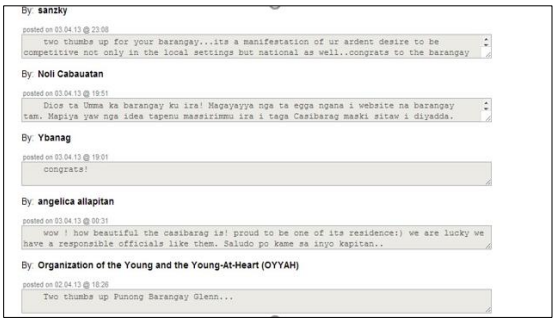

Figure 10. *Forum Page of the Web-Based Information System*

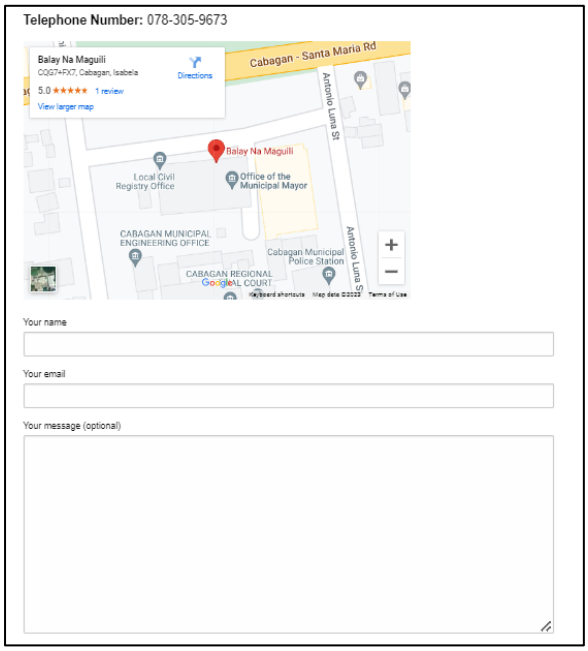

Figure 11. *The Contact Page of the Web-Based Information System*

As shown in Figure 10 and Figure 11, a web-based information system includes key features designed to enhance user interaction and feedback. A feedback forum allows community members to provide suggestions, report issues, and offer feedback on municipal services. This forum is integrated with the website's database, ensuring that user feedback is captured and organized for review by the MIS office.

A contact page is also available, providing users with direct access to municipal officials and departments. This feature enables citizens to ask questions, seek

information, and submit inquiries directly through the website. User feedback and inquiries are processed and managed by the MIS office, which ensures prompt responses and appropriate actions to improve service delivery and community engagement.

These features not only enhance transparency and accountability but also facilitate continuous improvement of municipal services based on community input and feedback.

On Open-Source Tools

The utilization of open-source tools for website development offers a compelling advantage in both functionality and cost-effectiveness. By utilizing a combination of PHP, JavaScript, Bootstrap, Open Design Graphics, HTML, Notepad++, and browsers like Comet Bird and Firefox, a website that is not only highly functional but also visually captivating can be created. This approach allows individuals and organizations to achieve professional results without the typical financial burden associated with commercial software, making it an appealing choice for the development of dynamic and visually appealing websites.

Evaluation of the Dynamic Web-based Information System

Table 1. Summary of the Statistical Values-Based on the End-User Evaluation

Description	Respondents								Overall Weighted Mean	Overall Description
	Local Constituents of the Municipality		BSIT 4th Year-Students		LGU Employee Cabagan		IT Faculty			
	Weighted Mean	Descrip-tion	Weighted Mean	Descrip-tion	Weighted Mean	Descrip-tion	Weighted Mean	Descrip-tion		
Design and Layout										
Q1. The design (overall appearance) of the web pages is pleasing to look at.	4.58	SA	4.50	SA	4.45	SA	4.60	SA	4.53	SA
Q2. The choice of colors enhances the layout of the pages.	4.60	SA	3.06	SA	4.47	SA	4.80	SA	4.23	SA
Q3. The layout of the pages (e.g., location of different section) works well.	4.53	SA	4.51	SA	4.55	SA	4.40	SA	4.50	SA
Q4. The images on the web pages complement the text information and are appropriate to the layout (e.g., placement, size, and theme of the images).	4.48	SA	4.50	SA	4.48	SA	4.20	SA	4.42	SA
Navigation										
Q5. The overall structure of the municipal website is logical.	4.60	SA	4.53	SA	4.47	SA	4.50	SA	4.53	SA
Q6. Using the municipal navigation links to locate information is easy and works well.	4.60	SA	4.44	SA	4.67	SA	4.50	SA	4.55	SA
Q7. The words used on the navigation links are sensible and helpful.	4.24	SA	4.38	SA	4.33	SA	4.50	SA	4.36	SA
Actual Content										
Q8. The content is well-written and formative.	4.56	SA	4.56	SA	3.60	A	4.40	SA	4.28	SA
Q9. The content is accurate.	4.55	SA	4.55	SA	3.63	A	4.40	SA	4.28	SA
Q10. The words in the content are appropriate (e.g., commonly used language that is well understood).	4.29	SA	4.29	SA	3.60	A	4.60	SA	**4.20**	**SA**

The statistical analysis and evaluation of the municipal web-based information system, based on end-user evaluations, indicate a high overall satisfaction across different respondent groups. The table summarizes weighted mean scores and descriptive evaluations from the local constituents of the Municipality, BSIT fourth-year students, LGU employees of Cabagan, and IT faculty members, focusing on three main aspects: design and layout, navigation, and actual content.

For design and layout, the overall appearance of the web-based information system received high scores, with a weighted mean ranging from 4.45 to 4.60, indicating a strong satisfaction. However, the choice of colors showed notable variation; while local constituents rated it at 4.60 (Strongly Agree), BSIT fourth-year students rated it at 3.06 (Agree), resulting in an overall weighted mean of 4.23 (Strongly Agree). The layout consistency was highly rated across all groups, with a weighted mean of 4.50, showing a unanimous agreement. Image appropriateness also received high ratings, with an overall weighted mean of 4.42 (Strongly Agree).

In terms of navigation, the logical structure of the website was well-appreciated, with a weighted mean of 4.53 (Strongly Agree). The ease of using navigation links showed a strong agreement, with an overall weighted mean of 4.55 (Strongly Agree). The helpfulness of navigation link wording received slightly lower ratings but still fell under strong agreement with an overall weighted mean of 4.36 (Strongly Agree).

For the actual content, the quality of the content showed slight variation. LGU employees of Cabagan rated it at 3.60 (Agree), but overall, it was rated at 4.28 (Strongly Agree). Content accuracy followed a similar pattern, with an overall weighted mean of 4.28 (Strongly Agree). The appropriateness of the words used received lower ratings from LGU Employees of Cabagan (3.60, Agree), but overall, it was rated at 4.20 (Strongly Agree).

The overall weighted means reflect a high level of satisfaction with the website's design, layout, navigation, and content, with most scores in the "Strongly Agree" range. The BSIT fourth-year students offered constructive feedback on color choices, and LGU employees of Cabagan provided useful insights on content-related aspects. By exploring these valuable suggestions, it can further enhance these areas, increasing overall satisfaction and making the website even more effective and user-friendly.

Hence, the results of this study could provide important insights and teachings for upcoming website development endeavors focused on increasing transparency, encouraging citizen engagement, and enhancing public service provision within local government contexts. Through the adoption of open-source technologies, the emphasis on user-centric design, and the cultivation of transparent and easily accessible digital platforms, decision-makers, and professionals can harness technology's potential to nurture beneficial societal transformations and propel governance methodologies forward in the digital era.

Conclusion and Future Works

This study demonstrated the effective use of open-source tools to develop a dynamic web-based information system for the Local Government Unit (LGU) of Cabagan, Isabela. The primary goal of enhancing transparency and improving public service delivery was achieved through the system's user-friendly and responsive design. The website successfully provided constituents with easy access to municipal accomplishments, financial data, and essential services, thereby promoting trust and accountability within the community.

The evaluation results indicated a high level of user satisfaction, with the website being rated as very satisfactory in terms of design, layout, and information accuracy. The dynamic web-based information system has proven to be an asset in fostering civic engagement and enhancing the efficiency of public service delivery. The use of open-source technologies not only reduced costs but also ensured the flexibility and scalability of the system, making it a viable solution for other municipalities in the Philippines.

While the current system has been successful, there are several areas for future improvement and research. First, incorporating content in local languages or dialects could make the website more accessible to a broader audience, especially for constituents who may not be proficient in English. Second, there should be continuous improvement of the security features of the website to protect sensitive data and ensure the privacy and safety of users' information. Lastly, other local government units should be encouraged to adopt similar systems and create a network of interconnected municipal websites to share best practices and resources.

By addressing these areas, the LGU of Cabagan can further enhance the functionality and impact of its web-based information system, ensuring its significant role as a tool for transparency, accountability, and efficient public service delivery. These efforts not only aim to better serve constituents but also contribute to the continual improvement of local governance programs.

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