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# E-APPS: a digital platform for application processing and records management in private educational institutions with data visualization

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**ABSTRACT**

Online application and processing systems are digital platforms that allow applications to be submitted, reviewed, and processed electronically. These systems enhance efficiency by streamlining workflows, reducing paperwork, and enabling faster and more accurate decision-making for both applicants and administrators. This paper presents the development, implementation, and evaluation of E-APPS: an electronic application processing system for private schools and educational institutions, and records management (E-APPS). Specifically, it determined the process and forms involved in private school applications for approval, developed an E-APPS for private schools and records management using the extreme programming model, assessed the software quality of the E-APPS, and evaluated its technical performance. Based on the result, the existing application process includes submission, validation of documents, inspection, endorsement to the regional Office, approval, and issuance of permits. The E-APPS was developed and evaluated to ensure it meets quality requirements. The developed system was also tested and proven to work reliably even when many users use it simultaneously. It can accommodate hundreds of users without delays or system errors.



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## 1. INTRODUCTION

The use of information and communications technology (ICT) has grown significantly over the past few years, and it has had a significant impact on various elements of society and economic activity by making usual procedures easier and more efficient. Globally, the transition from traditional to digital processes in educational systems has greatly improved accessibility and efficiency [1].

Paving the way in the implementation of electronic government (or e-government), this pertains to government functions and procedures that use ICTs to improve efficiency, citizen participation, and transparency. e-government refers to the use of ICT tools to automate and integrate into internal government processes to enhance information and service delivery [2]. By digitizing government processes, e-government transforms traditional, paper-based, and fragmented procedures into integrated, user-centered digital services accessible anytime, anywhere. This shift not only reduces operational costs and processing time but also improves the quality and reliability of public service delivery [3]. Moreover, e-government

plays a critical role in fostering citizen trust and participation by ensuring transparency, accessibility, and responsiveness of services. Studies have shown that effective e-government implementation can improve public satisfaction and strengthen governance outcomes, particularly in developing countries where administrative inefficiencies are more prevalent [4]. Also, electronic government system policies are particularly significant in enabling the deployment of e-government [5]. E-government plays a vital role in modern governance by transforming traditional public service delivery into a faster, more transparent, and more efficient system. E-government systems continuously provide better services to people, businesses, organizations, and societies [6]. Organizations must keep up with the global evolution of information and communication technology (ICT), such as the implementation of e-application systems, to be competitive.

Governments around the world have adopted similar principles and technologies in response of e-business revolutions, building websites to disseminate information and deliver public services more efficiently. In the Philippines, many government agencies implemented applications that support e-governance (eGov Plan 2022). Thus, implementing this for the Department of Education Regional Office 1 is vital and in compliance with the Republic Act 11032, also known as the Ease of Doing Business Act, to increase efficiency by reducing processing time and eliminating red tape.

The Department of Education, led by a Chairman, was founded by the Education Decree of 1863. In the twentieth century, amid shifting charters and governments, the Education Department undertook several reorganization measures to better define its mandate. The current Department of Education was founded by the Republic Act 9155, also known as the Governance of Basic Education Act of 2001, which outlined the agency's mandate. The Department of Education (DepEd) formulates, implements, coordinates, and manages policies, plans, projects, and programs in basic education. It oversees all public and private elementary and secondary schools, as well as alternative learning systems. It ensures the formation and maintenance of an adequate, comprehensive, and integrated system of basic education that is relevant to national development goals. The quality assurance division (QAD) provides the regional office and schools division offices with guidance on decision-making and policy directions that are compliant with the standards of quality in basic education, promoting accountability and transparency towards continuous improvement. One of the key result areas (KRAs) of the quality assurance division is to regulate and provide developmental services to schools. It is the directive of the Department of Education, Regional Office I (DepEd RO1), through the QAD, to process applications, ensure standards are met, and meet the minimum requirements of private schools. Developmental services to these private institutions in adherence to DepEd Order No.88, s.2010, or the "2010 Revised Manual of Regulations for Private Schools in Basic Education" include processing of their applications for tuition fee increase, no tuition fee increase, proposed/new fee, government permit, and government recognition; and school calendar.

However, the COVID-19 Pandemic has inevitably posed a challenge to the delivery of regulatory and developmental services of the DepEd RO1 and Schools Division Offices (SDOs) to private schools, along with health risks. The drawback of the government's restrictions regarding movement and physical transactions is the difficulty private schools have in submitting their applications to SDOs. Likewise, the processing, monitoring, evaluation, and validation of schools' applications are limited for the same reasons.

Further, the effect of work alternative arrangement (AWA) based on DepEd Order No. 11,s. 2020, or otherwise known as "Revised Guidelines on Alternative Work Arrangements in the Department of Education During the Period of State of National Emergency due to the COVID-19 Pandemic", limits the number of personnel physically reporting to work. In this scenario, it would be difficult, particularly for the SDO personnel in charge of private schools, to attend to the needs and processes of private school applications within their division. Likewise, the QAD personnel in AWA would have difficulty attending to or processing the applications of private schools, as endorsed by the SDOs assigned to them, since these are submitted to the Office. Further, the Office also encountered recurring problems in the processing of documents, such as incomplete/missing documents, late submission, and the like, which eventually led to the issuance of deficiency letters that resulted in the delay of the processing of documents. Thus, in light of these situations, a system in DepEd Region 1 is necessary that will provide effective and efficient service delivery to private schools.

As part of the its efforts to provide prompt services to government transactions as regards private schools' application and to streamline procedures of Regional Office services in adherence to Republic Act 11032 or the "The Ease of Doing Business and Efficient Delivery of Government Services, Amending for the Purpose of Republic Act No. 9485, Otherwise Known as the Anti-Red Tape Act of 2007, and For Other Purposes", in response to the strategic direction of the region on the modernization of education management and governance, the Department of the Education Regional Office 1, in coordination with the Information Communication and Technology Unit, and in partnership with Don Mariano Marcos Memorial State University-Mid La Union Campus will develop the E-APPS: an electronic application processing for private school and records management (E-APPS) which shall serve as the official platform form for the different applications of private schools of the Department of Education, Region 1, Philippines. Private schools will

use the e-Application System for the various government applications required by the Department of Education, and these will be part of the documents and records for each school's application. The system was designed to ensure the timely and efficient delivery of regulatory and developmental services to private schools. Specifically, a) facilitate the processing of private schools' applications; b) provide effective, efficient, and systematic records management; c) provide real-time and updated information to track the application and processing of documents; and d) provide information for monitoring and evaluation. Electronic records management systems, or ERMSs, help organize the vast amounts of data needed for planning and informed decision-making [7]. This study provides an innovative implementation of e-governance for the various applications of private schools in the region. Moreover, the system integrates data visualization to improve operational efficiency, enhance decision-making, and ensure transparency. With data visualization, the user can effectively comprehend the data and adjust various factors to observe how they affect visual representations [8] and to reveal essential insights in an interactive, practical way [9]. The E-APPS dashboard can display real-time statistics such as total applications, processed, and in progress of the entire region, per province, or per school division. It also enables timely intervention to improve workflow efficiency from application submission to approval.

The importance of e-government systems is clearly reflected in the development of the new online application and processing technology for private schools in the Philippines, as it applies the same principles of efficiency, transparency, accessibility, and user-centered service delivery, demonstrating how e-government concepts can effectively support digital transformation and improved service quality in the education sector. Moreover, the traditional or manual application processes in many private schools are often time-consuming, paper-based, and prone to errors, relying heavily on face-to-face transactions and physical document submission. These practices are often inefficient, time-consuming, and prone to human error, resulting in delayed processing, data inconsistency, and increased administrative workload [10], [11]. These limitations became more evident during the COVID-19 pandemic, when mobility restrictions, school closures, and health protocols disrupted in-person application and processing by private schools. While recent studies emphasize the importance of digital transformation and e-government principles in education, there remains limited empirical research on end-to-end online application and processing technologies tailored to the operational context of private schools [12]. Moreover, research highlights that digital government systems significantly improve institutional resilience by ensuring service continuity during crises [13]. This situation highlights the urgency of digitizing application processes to ensure continuity of services, improve efficiency, and build resilience against future disruptions, and the urgency of adopting e-government principles across sectors, including the private education sector.

## 2. METHOD

### 2.1. Data gathered

This study employed a purposive sampling technique, selecting private schools and key personnel directly involved in the application processing of private schools. In applied and exploratory research where outcomes depend on informed perspectives rather than broad representativeness, purposive sampling is appropriate and widely used [14], [15]. There were two sets of respondents for objective 3. The first set of respondents were representatives from DepEd RO1 quality assurance division, along with the ICT in-charge and application submission in-charge from private schools in La Union, Pangasinan, Ilocos Sur, and Ilocos Norte, who took part in the functional suitability and usability metrics analysis. These respondents also checked the functions and usability of the system. Likewise, five (5) IT experts helped determine the performance of the system in all of its software quality characteristics. These roles were chosen because they are directly responsible for application workflows and system decisions. Creswell and poth highlight that purposive sampling is suitable when the goal is to understand distinct operational practices or contextual challenges from knowledgeable respondents [16].

### 2.2. Materials and procedures

Developmental research design was utilized in this study. According to Ibrahim, developmental research is an organized study that involves designing, developing, and evaluating instructional programs, products, and processes that meet the criteria of effectiveness and consistency [17]. The researchers gathered the current processes involved in the private school application and determined the functional and technical requirements. Based on these variables, the system was developed using the extreme programming model and assessed using ISO 25010 and JMeter performance test. The researchers used a computer with a minimum requirements: 8 GB RAM or higher, CPU 2.00GHz or higher, video card 4GB or higher, with software installed for the development of the system are PHP, Apache, MySQL through the WAMP server, where PHP was used for back-end, and HTML5, CSS3, and JavaScript for front-end. For objective 1,

a consultative workshop or focused group discussion was conducted to describe the processing, monitoring, evaluation, and validation of schools' applications for private schools and to identify the E-APPS' functional and non-functional requirements.

The extreme programming (XP) software development model was utilized as shown in Figure 1 for objective 2. XP is an agile methodology that has emerged with a strong emphasis on engineering quality, fast iteration, and recurring input from clients [18] and ensures customer satisfaction [19]. The goal of agile software development is to produce high-quality software [20]. Moreover, XP is a lightweight software development framework that allows the development of high-quality software while also streamlining the activities of the development team. It consists of four major phases, such as the planning phase, where the researchers will create user stories based on the experiences and procedures of the personnel involved in the application of private schools. After which, iteration plans will be created so that groups of user stories will be developed as part of the iteration; design phase includes the creation of prototypes for the system through mock-ups, likewise, use-case diagram, activity diagram and class diagram will be the deliverables of this phase; coding phase is where the development of the system will be done, here the researchers will create the system using the laravel framework for faster development and implementation; testing phase is where the users of the system will test the system and provide feedbacks to the researcher so that it can add it to the next iterations.

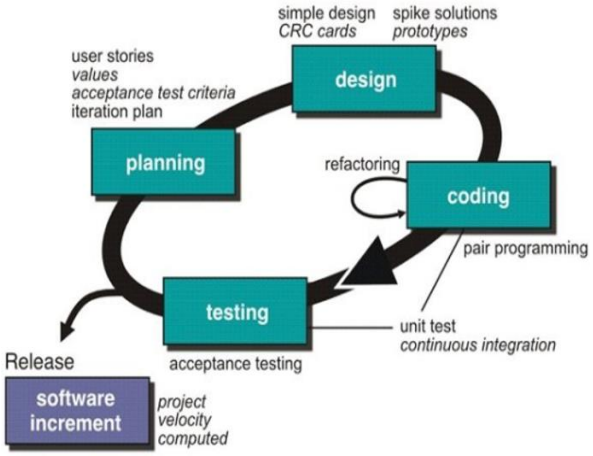


Figure 1. Extreme programming model [21]

For objective 3, after implementing the system as part of the software increment releases, the researchers will utilize ISO 25010 to determine the software quality of the system in terms of functional suitability, reliability, usability, security, compatibility, maintainability, and portability. This will be done through evaluations on different metrics for each indicator. The purpose of a performance test is to simulate a large number of users to verify the system's bearing capacity. This includes stress, load, configuration, peak, and other tests [22].

For objective 4, the researchers utilized JMeter. Performance testing is conducted to ascertain the system or application's scalability, responsiveness, reliability, throughput, and interoperability under a specific workload [23]. Suryaningrat also utilized Apache JMeter as a performance testing tool because of its features and advantages [24]. JMeter is an application that can test different protocols or technologies for load, regression, and performance-oriented business (functional) testing. JMeter is utilized to determine how many user HTTP requests it can handle [25].

### 2.3. Data analysis

In analyzing the data gathered, frequency count and percentages were used for the metrics functional suitability, reliability, security, compatibility, maintainability, usability, and portability. From this, the percentage of passing the test criteria will be computed. Based on industry standards, a 75% rating will be interpreted as PASSED; otherwise, 75% below means FAILED. The researchers utilized JMeter for the performance test of the EAPPS. Suppose around 350 users, which is fifty percent of the registered users, visit the EAPPS daily. Approximately 30 minutes were spent by a single user on the system. The peak hours mean the time when the system is experiencing high traffic is from 10:00 A.M to 2:00 P.M., i.e., 5 hours.

$$Concurrent\ users = no.users/no.of\ hours\ used * \left(\frac{total\ minutes}{avg\ minute\ usage\ of\ user}\right) \quad (1)$$

As a result, the approximate number of concurrent users on the website is 30. Table 1 shows the test plan parameters for the developed EAPPS.

Table 1. Test plan parameters

| Test plan | Concurrent users | RAM-up period per second | Loop counts | Samples (HTTP request) |
|---|---|---|---|---|
| 1 | 30 | 1 | 5 | 150 |
| 2 | 46 | 1 | 5 | 230 |
| 3 | 59 | 1 | 5 | 295 |

## 3. RESULTS AND DISCUSSION

### 3.1. Process of private school applications

The private schools submit their application by filling out the forms and then sending them to the SDO through courier. The officer in charge of each SDO validates the requirements. If there are missing or lacking documents in the application, the SDO will return the application documents to the school through courier. Otherwise, the SDO will schedule a visit to the school for inspection. After the inspection, the SDO will endorse the application to the regional office (RO). The RO also validates the application, schedules, and conducts inspections prior to approval. They also return the application if there are missing or lacking documents; otherwise, the application will be approved. The approved application will be sent to the private school. The sending, receiving, or returning of documents from one Office to another or to the school is carried out by a courier, which takes seven (7) to fifteen (15) days and depends on the location.

### 3.2. The developed E-APPS

The use of E-APPS was in support of the strategic goal of the Department of Education – "Modernizing Education Management and Governance". Through this information system, DepEd region 1 was able to automate core systems and processes that would improve the service delivery of the department's programs. The department contributes to the improvement of education governance guided by the principle of governance transparency and accountability.

The EAPPS consists of four types of users: admin, EPS division, EPS region, and school. For the private school users, a representative from the private school needs to register by completing the registration form in the EAPPS. The administrator of the system will validate the registration, and then a notification will be sent once activated. The private school user can submit the application by meeting the requirements of the desired application. The user can track the status of the application. If the application is returned, the private school user needs to comply by uploading the requested documents based on the remarks. Messages can also be checked once the private school logs in. The EPS division users verify, return, or endorse the submitted application. He/she can update the status to validated or with deficiency. Remarks will be indicated on the applications with deficiencies and will be returned to the private school user. If the application satisfies the requirements, it will be endorsed to the EPS region. The returned application will be evaluated again by the EPS division until the requirements are met. The applications endorsed by the EPS division will also be forwarded and verified by the EPS region. The EPS region validates the application. Select a finding based on the validation, either validated or with deficiency. If there is a deficiency, a remark needs to be indicated. The application may be recommended for approval and signature of the CES, ARD, and RD. If the EPS region noted some requirements to have deficiencies, the application may be returned to the applicant school. The EPS region can also view the SO applications from different schools that were endorsed by the division assigned to them. The admin page consists of a navigation bar that includes dashboard, configuration, maintenance, permits and recognition, activate school users, and message. The E-APPS was developed using extreme programming, which consists of four phases- planning, designing, coding, and testing.

Figure 2 shows the USE case diagram of E-APPS that describes what the system does and identifies the interactions between the system and the users or actors. The actors consist of the admin, EPS region, EPS division, and private school. All actors are required to log in to access the system. The private school can create, submit, and track applications. The EPS division can review, update, verify, or endorse applications submitted by the private school, and it can also generate reports. Figure 3 shows the E-APPS login page. All actors are required to log in to access the system. The actors consist of the admin, EPS region, EPS division, and private school. The EPS regional level can access and utilize all features available to the EPS division except for assigning special orders. The system administrator can also utilize features available to the EPS division and the EPS region aside from the user management feature.

The system was developed using Apache, SQLyog, Web Browser, and Windows PHP (WAMP) server. For the features and functionality of the system, the researchers utilized cascading style Sheet (CSS), JavaScript, personal home page (PHP), hypertext markup language (HTML), and MySQL for the database of the system. Laravel framework was also used for faster development and implementation.

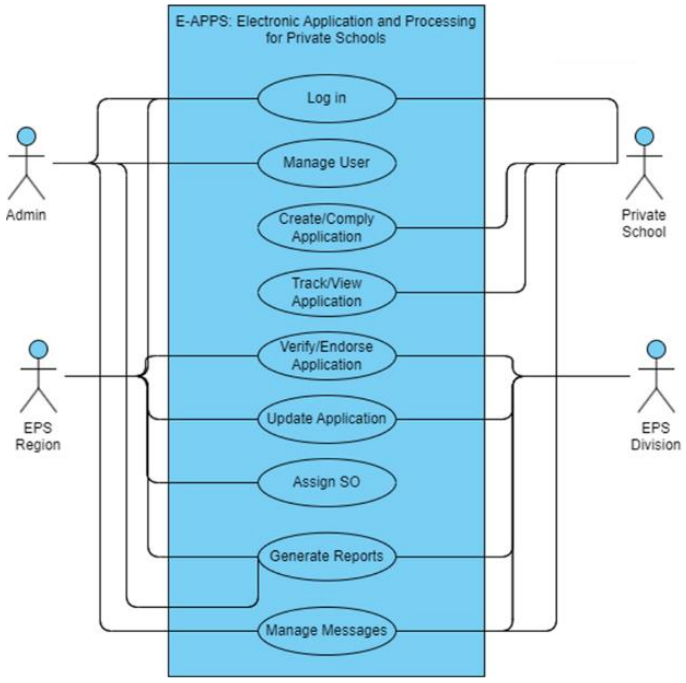


Figure 2. Use case diagram of the E-APPS

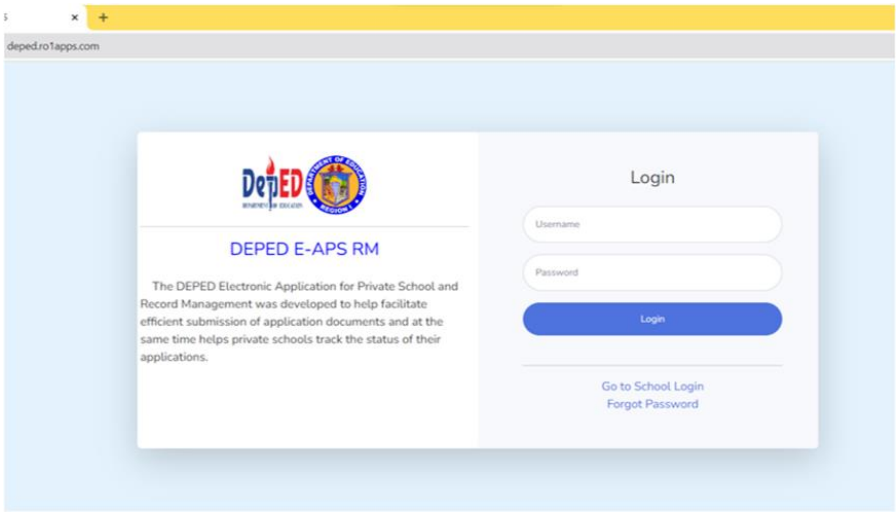


Figure 3. E-APPS login page

Figure 4 shows the dashboard for private school users, which consists of a menu to create new applications, permits, and recognition, as well as read messages. The page also shows the timeline for schools to view and track the application status.

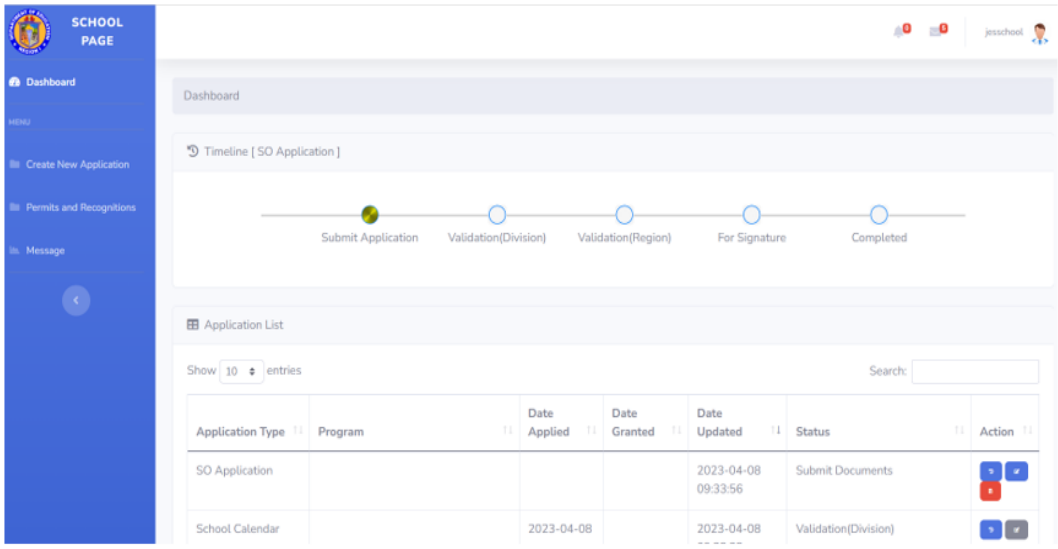


Figure 4. E-APPS school – dashboard

The applications that can be submitted using the E-APPS are government recognition, renewal of government permit, government permit, tuition fee increase, no tuition fee increase, proposed fee, government permit SHS application, SO application, school calendar application, and change SHS. These application types are under the create new application, as shown in Figure 5. The online application forms used were based on the existing forms used in DepEd.

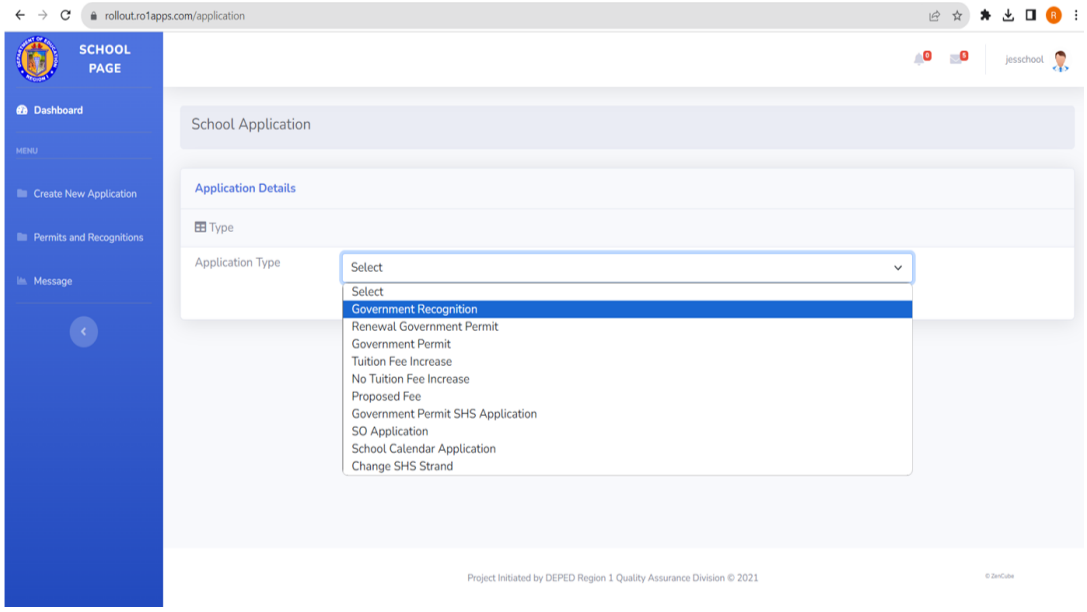


Figure 5. E-APPS school - create new application

A certain application that was verified by the division office or regional office with deficiencies will have “Returned” status. The school can comply with the remarks or comments or with the deficiency by uploading the needed documents as shown in Figure 6. The status of the application will be changed to “Validation” once the user resubmits the application.

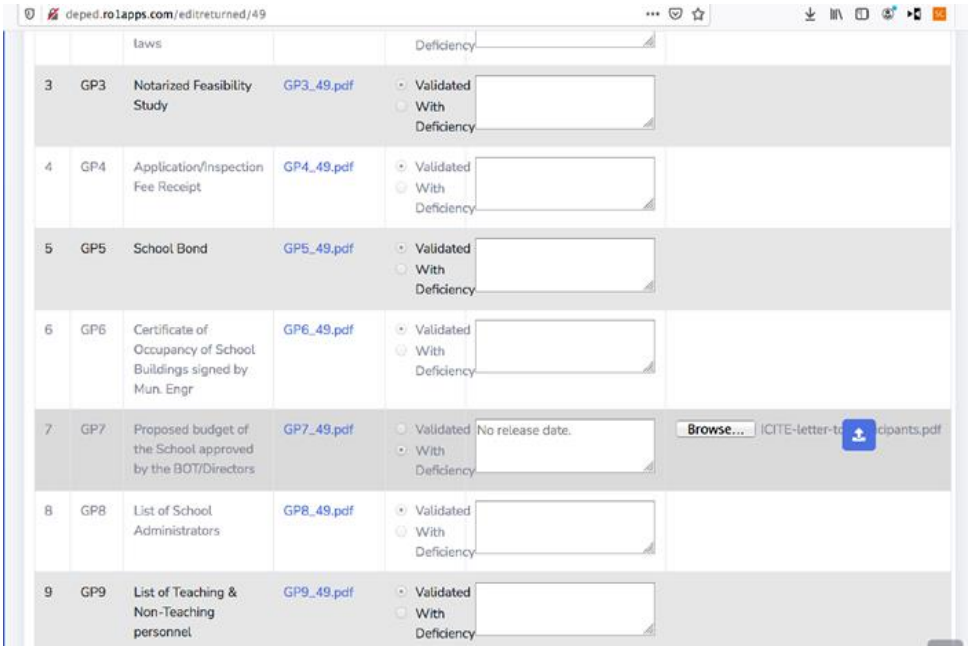


Figure 6. E-APPS school – returned/complied applications with deficiencies

The E-APPS EPS main page for the division has the menu to view applications and messages, a dashboard with the summary of applications, processed and in progress, a graph showing applications per month, and a list of applications from different schools in the division designated to EPS. The EPS division can view the details of the application submitted by the school by clicking the file name of the documents under the uploaded file, and then the PDF file will open in a new tab. Based on the validation, the user can select either validated or with a deficiency. If there is a deficiency, a remark needs to be indicated as shown in Figure 7. If the EPS division noted some requirements to have deficiencies, the application must be returned to the applicant school for them to comply with the remarks. If the application satisfies all requirements, it will be forwarded to the regional office by clicking the button. This will require the EPS division to upload an endorsement letter and a statistical narrative report.

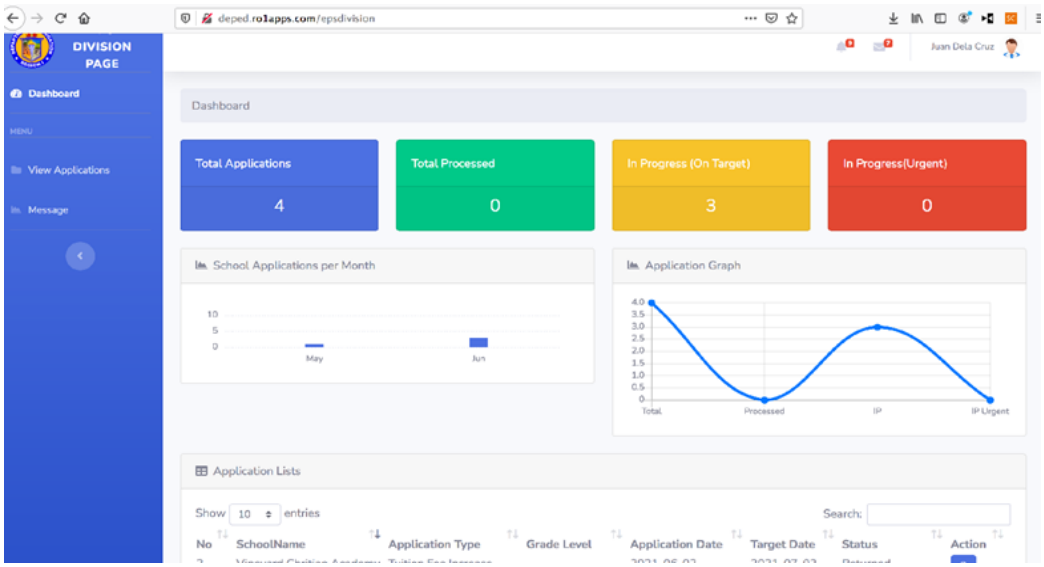


Figure 7. E-APPS EPS division/region – verification of evidence in the application

The forwarded application from the EPS division will also be verified by the EPS region. The user can save the validations made, and the application may be recommended for approval and signature of the CES, ARD, and RD. If the EPS region noted some requirements to have deficiencies, the application may be returned to the applicant school.

### 3.3. The software quality of the E-APPS

The researchers conducted a series of tests on the developed E-APPS. The system was first presented to the quality assurance division staff and IT experts of DepEd-RO1. The comments and suggestions were integrated to improve the system. After which, the system was presented to the school division offices of DepEd-R1. Finally, the E-APPS were presented to the private schools in the region. The end users were asked to create their accounts so that they could navigate the features of the system. Five IT experts tested the system prior to the deployment to determine its software quality in terms of reliability, security, and maintainability. The survey questionnaire was based on ISO 25010. Table 2 shows the summary of the software quality of E-APPS. In terms of functional suitability, the system garnered 100%. This implies that the E-APPS meet all the features needed, yield correct results, and the functions are capable of achieving specific goals and tasks. System quality can be evaluated based on its essential features, which include efficiency of the product, device compatibility, and functionality [26]. 100% of the respondents agreed that the system is usable. Usability refers to the ability of a system to be used by specified users to attain specified goals with effectiveness, efficiency, and satisfaction in a specified context of use. Overall, the system garnered 99.81%, which means that the developed system meets the software quality standards in terms of functional suitability, usability, reliability, security, maintainability, and portability. It also implies that E-APPS passed the software quality measures for the application process of private schools and records management of DepEd region 1.

Table 2. Summary of the software quality indicators for the E-APPS

| Indicator | Agree | Disagree | Descriptive interpretation |
|---|---|---|---|
| Functional suitability | 100% | 0% | Passed |
| Usability | 98.84% | 1.16% | Passed |
| Reliability | 100% | 0% | Passed |
| Security | 100% | 0% | Passed |
| Maintainability | 100% | 0% | Passed |
| Portability | 100% | 0% | Passed |
| Grand mean | 99.81% | 0.19% | Passed |

### 3.4. The test plan results of the E-APPS

Table 3 shows the summary of the test plan conducted to assess the technical performance of the E-APPS using JMeter. Indrianto [27], JMeter is also an effective tool for evaluating the functionality of web-based information systems for performance testing. For the first test plan, the researchers simulated 30 concurrent users each having five (5) requests for a total of 150 samples of HTTP requests to the server. The average response time was 933 milliseconds, with a minimum recorded response time of 291 milliseconds and a maximum recorded response time of 2545 milliseconds. The standard deviation of response time was 430.97 milliseconds. In addition, all requests returned 0% or no error, and the recorded throughput was at 20.90 transactions per second. The server was accessed to download 186.79 kilobytes of data per second.

For the second test plan, a total of 46 concurrent users each having five (5) requests for a total of 230 samples of HTTP requests to the server. The average response time was 1386 milliseconds, with a minimum recorded response time of 522 milliseconds and a maximum recorded response time of 3199 milliseconds. The standard deviation of response time was 588.76 milliseconds. All requests returned 0% or no error, and the recorded throughput was at 26.35 transactions per second. Regarding data volume, 235.46 kilobytes of data per second were downloaded from the server during the performance test.

The third test plan consisted of 59 concurrent users, each having five (5) requests for a total of 245 samples of HTTP requests to the server. The average response time was at 2032 milliseconds, with a minimum recorded response time of 533 milliseconds and a maximum recorded response time of 3311 milliseconds. The standard deviation of response time was 578.63 milliseconds. All requests returned 0% or no error, and the recorded throughput was at 24.67 transactions per second. As to the volume of data, 235.46 kilobytes of data per second were downloaded from the server during the performance test.

Overall, no errors were encountered for the three test plans conducted during the performance of the E-APPS. The error percentage is an important measure because it identifies the issues that affect the performance of the system. This implies that the E-APPS can handle 700 registered users or 59 concurrent users with five requests each and 1 1-second ramp-up period without any request error.

Table 3. Test plan result of the E-APPS

| Test plan | Label | #Of samples | Avg | Min | Max | Std. Dev | Request error % | Throughput | Received KB/sec | Sent KB/sec | Avg Bytes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Plan 1 | HTTP Request | 150 | 933 | 291 | 2545 | 430.97 | 0.00% | 20.90 | 186.79 | 2.43 | 9150.6 |
| Plan 2 | HTTP Request | 230 | 1386 | 522 | 3199 | 588.76 | 0.00% | 26.35 | 235.46 | 3.06 | 9150.6 |
| Plan 3 | HTTP Request | 295 | 2032 | 533 | 3311 | 578.63 | 0.00% | 24.67 | 220.49 | 2.87 | 9150.6 |

## 4. CONCLUSION

The use of E-APPS was in support of the strategic goal of the Department of Education – "Modernizing Education Management and Governance". Through this information system, DepEd region 1 was able to automate core systems and processes that would improve service delivery of the department's programs. The department contributes to the improvement of education governance guided by the principle of governance transparency and accountability. This study highlights the novelty of developing a dedicated online application and processing system explicitly tailored to the operational needs of private schools in the Philippine setting to improve efficiency, transparency, and accessibility. Unlike traditional manual approaches, the developed system demonstrates how digital technologies can ensure continuity of services even during disruptions such as pandemics. For future research, it is recommended to expand the system and conduct comparative studies across different regions or school sizes to validate its effectiveness and scalability further further.

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## AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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| Marylen De Guia Rodriguez | | | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | ✓ |
| Marydel Carrera Estira | | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | | ✓ | ✓ |

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

## CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

## DATA AVAILABILITY

The authors confirm that the data supporting the findings of this study are available within the article.

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