

Development and Evaluation of Researches Data Analysis and Records Management System (DERDARMS): A Tool for Management Decision Making

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Abstract - *One of the initiated programs with the Research Development and Extension (RDE) is the Appropriate Technology particularly, ICT innovation. In compliance with the defined particular program, the study generally aimed to Develop and Evaluate Researches Data Analysis and Records Management System (DERDARMS) as a tool for the management decision making. Specifically, develop a system to show the data on researches submission by different campuses and colleges in its homepage; provide functions on researches proposal, completed and published classifications; generate reports on different submissions particularly on SUC leveling and accreditation requirements; set setting for user accounts and researches submission targets by different campuses and colleges; provide archive for the upload and download of the current and previous records; and evaluate the system using ISO 9126 criteria. The system observed the phases in the System Development Life Cycle (SDLC), particularly Rapid Application Development (RAD) methodology in its development. Descriptive research was employed for the system's evaluation. The result showed that the system conformed to the defined system's development objectives. It was evaluated as highly functional, highly reliable, highly usable, highly efficient, highly maintainable and highly portable system's characteristics by the respondents. It implied that the system's development particularly the default portrayal of the researches submission of the different colleges and campuses served as a tool for the management decision making. Likewise, this particular system's development is an evidence of evolving the culture of ICT innovation towards an ethical knowledge-based society. Further data gathering is hereby recommended to make this independent stand-alone system into an online one with utmost security.*

Keywords: *Data Analysis, Development and Evaluation, RAD Methodology, Record Management System*

INTRODUCTION

The Research Development and Extension (RDE) office regularly responded to different concerns like the regulatory requirements align to research and development like CHED on SUC leveling, KRA: research capability and outputs; accrediting bodies on accreditation; and initiated activities like in-house paper presentation, research capability building, and other RDE related activities. With these concerns, the office is having difficulty in the management of these records, because it requires storing for future purposes or retrieval later.

Research and Development (R&D) is a combination of fundamental and applied research to find answers to problems or create new goods and knowledge Petralba,

J. [1]. In the generation of the new knowledge, Surigao State College of Technology (SSCT), RDE office, initiated programs beginning the year 2017 until the year 2022. One of the initiated programs is Appropriate Technology, particularly innovations for ICT.

The study of Petralba, J. [1], added that R&D has more significant indirect effects on innovation and human development than direct effects. That is, R&D can contribute more to innovation and human development through ICT. Information and communication technology according to Murdic and Ross, as cited in the study of Chidobi, R. [2], is the process in which information (input) is recorded, stored and retrieved (processed for decision (output) on planning, coordination and controlling). They said

further, effective management of records can be achieved with sound knowledge of ICT. In the study of Miah and Samsudin [3], they resonated that many universities nowadays use specific software applications for their effective mechanism in records management. In like manner, the study of Saman, Haider, and Bahador [4], emphasized that organizations which employ a comprehensive information and records management system successfully transform their information and tacit knowledge into a high-value business commodity.

Almost every working day, records increase, it becomes inefficient to store and process data and uses the derived information to make decisions. Storing and retrieving of records could still be managed, but it required more people in the management. There are instances that records are accidentally deleted or not yet saved. As a support, Ngulube and Tafor [5], stressed that electronic records were in danger of being lost due to benign neglect. Similarly, in the study of Saman, W., Haider and Bahador [4], further acknowledged that the lack of control over records could cause organizations to breach the law which can result in heavy fines and damaging reputation. Further support from Miah and Samsudin [3], higher education institutions, like universities, suffer from a range of issues in managing their academic records and relevant digital contents. With this, system development, answered the gap.

With the concerns, compensatory measures can be designed to address the identified concerns. The development may lead to the alignment with the RDE defined programs. It is a tool for the management decision making. In like manner, innovations to ICT make transactions easier most especially on storing and retrieving of records. Besides, may contribute to the global competitiveness. This development as a compensatory measure is an evidence of evolving the culture of ICT innovation towards an ethical knowledge-based society.

OBJECTIVES OF THE STUDY

The general objective of the study aimed for a Design and Evaluation of Researches Data Analysis and Records Management System (DERDARMS): A Tool for Management Decision Making. Specifically, the study aimed to design a system to show the data on research submission; clickable functions like researches detail; reports; settings with archives; and evaluate the system using ISO 9126 criteria.

METHODS

Research Design

In this study, the researcher observed the phases in the System Development Life Cycle (SDLC), particularly four phases of Rapid Application Methodology (RAD) on (Figure 1), such as requirement planning phase, user design phase, construction phase and cut-over phase.

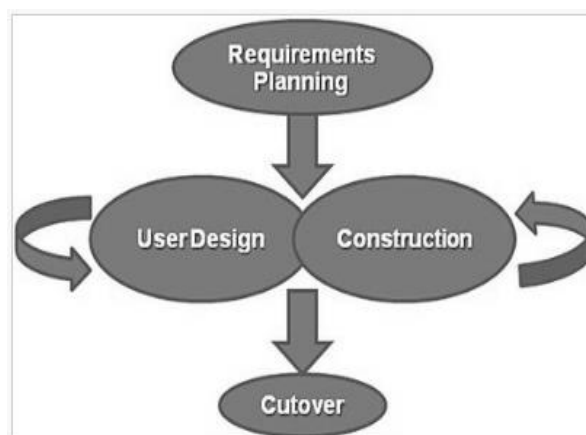


Figure 1. Phases in the James Martin Approach to RAD

In the website available at <https://www.forbes.com>, titled Rapid Application Development (RAD): A Smart, Quick And Valuable Process For Software Developers [6], emphasized that the late James Martin, a British information technology consultant and author, is attributed with developing and introducing the modern RAD approach in 1991 based on intensive iterative development and the construction of prototypes.

The researchers observed the phases during initialization to completion of the study. In the requirement planning phase, the institutional requirements on DERDARMS are identified and planned out. In the study of Tejas, S. and Patelba, S. [7], stated that many errors can originate/propagate from the requirements phase, caused by poorly written, ambiguous, unclear or missed requirements. Failure to specify the requirements correctly can lead to major delays, cost overruns. Thus, in the present study, researchers carefully planned out and identified the institutional requirements. The design specifications are finalized to conform to the institutional requirement specifications. During the construction phase, the codes had been generated with PHP language and MySQL database, to realize the identified and planned out

institutional requirements and the user-designed specifications in the user design phase. Finally, the researcher actualized the system's design based on the preset objectives in the cutover phase.

Respondents of the Study

The researcher conducted an evaluation with the key officials of the college and selected personnel as the evaluators. There were 7 administrators with 3 RDE staff who served as the first set of evaluators. The office staff, responsible for the manual recording, and retrieving of data relative to research activities. The second sets of evaluators were 5 from Management Information System (MIS), and 5 selected IT professionals. They were chosen because they belonged to the MIS team who specialized on system's development and at the same time the IT faculty. There were 20 total evaluators.

Instruments

The questionnaire as the main instrument was validated by the IT experts, researchers and systems' developers. The questionnaire conformed to the ISO 9126 standard. There were items on the questionnaire came from the study of Omorog [8], particularly on maintenance and portability of software characteristics. However, modifications were done to suit the defined objectives. The researcher responded to the monthly system presentation sets forth by the college president to get their feedback. The recommendations and suggestions noted in the presentation, the brainstorming conducted, and softcopy given from the RDE unit were the bases for the realization of the study. There were two sets of questionnaires designed for evaluators' acceptability.

The first set of questions classified into functionality, reliability, usability, and efficiency. This set was answered with the key officials and RDE staff as the qualified individual to check the essential purpose or service of the system. The second set of questions classified into maintainability and portability system's characteristics. This set was answered with the MIS head, MIS members and selected IT professionals as the right individual to check the technicalities of the system. Challa et al. [9], resonated that the quality of the software is checked with three different perspectives, as follows: the developer, user, and project manager perspectives.

Procedure

The researcher firstly defined the system objectives before gathering the necessary information.

Brainstorming with the RDE office members was done to get the information of their needs in the management of different submissions like storing, classifying, retrieving, reporting, and releasing to the requested clients. The researcher was emailed with a soft copy of all the reports filed at RDE office for further analysis. After which, the system objectives were finalized based on the institutional need. A computer, installed with PHP and MySQL, used to develop the system. An initial system presented to the key officials and selected personnel of the college. During system presentation, feedbacks noted for further improvement and acceptance. There were two monthly system's testing to check if it conformed to the institutional requirements. Finally, key officials and personnel were asked to answer the questionnaire before the system document. Before the administration of the questionnaire, the researcher asked permission first to the top management. The questionnaire was validated by the experts at the same time researchers on system's development before its administration.

Data Analysis

The researcher used descriptive statistics to determine the frequency and mean as the basis for evaluation of functionality, reliability, usability, efficiency, maintainability, and portability. Each system characteristics was rank as well. Questions were put a five-point Likert scale with responses ranging as Strongly Agree, SA (5 points); Agree, A (4 points), Moderately Agree, MA (3 points); Disagree, DA (2 points) and Strongly Disagree, SDA (1 point). The numerical rating scale used in the study to interpret the result of the evaluation of acceptability: Highly Effective (HE)/ Strongly Agree (SA): 4.50 – 5.00; Effective (E)/Agree (A): 3.50-4.49; Moderately Effective (ME)/Moderately Agree (MA): 2.50-3.49; Ineffective (I)/Disagree (D): 1.50 – 2.49; Very Ineffective (VI)/Strongly Disagree: 1.00 – 1.49.

Evaluation

The systems development needs evaluation to check its quality as defined in ISO 9126 criteria. The criteria encompass functionality, reliability, usability, efficiency, maintainability and portability. According to Padayachee, I. Kotze, P. and van Der Merwe, A. [10], the functionality of the system refers to the capability of the system to perform the necessary functions which meet the stated requirements of the users. In the present study, functionality talks system functions; presentation of information; functions with

security measures; produces result and observes compliance to standards. Whereas the reliability is the capability of the software product to maintain its level of performance under stated conditions for a stated period of time. In the present study, the reliability talks on its capability to function for a long time; recovery from environmental failure; prompts and gives message for the wrong input.

According to Losavio et. al [11], the usability of the system is the capability of the software product to be easily understood, learned, and used under specified conditions. In the study, it refers to storing and retrieving of data; its operations; functions understanding; learning the system; and the user interface. Efficiency is the capability of the software product to provide appropriate performance, relative to the amount of resources used, under stated conditions. The DERDARMS talks on downloading of files; logging in and out; entering of data; functions and printing.

Maintainability on the other hand, in the study of Fahmy, Haslinda, Roslina, Fariha (2012), as cited in the study of Tacuban and Tuazon [12], refers to the capability of the software product to maintain its performance under specified conditions. This includes the capability of the system to be corrected and improved to adopt changes in the environment or requirements. DERDARMS maintainability focuses on programming codes. The portability, according to Bath and Mckay (2014) as cited by Tacuban and Tuazon [12], is a capability of the software product to be transferred into its intended environment. In the present system, DERDARMS, concentrates on installation; database; utilization; conformity to standards; and exportation.

RESULTS AND DISCUSSION

This part presents Figures 2-7 and Tables 1-8. The Figures are discussed based on its functions and capabilities. The Tables show the result of the evaluation ratings and the interpretation of data.

Figure 2 as shown, presents the research submission to the RDE office. It shows a number of the published researches by campus and by colleges expressed in percentage. As shown on the left side the bar graph of the published researches of the different campuses with the corresponding percentage based on the number of publications. SSCT has 4 campuses: The City; Malimono; Del Carmen; and the Mainit campus. The right-side graph presents the published researches

by colleges. SSCT is composed of 4 colleges: The College of Engineering and Information Technology (CEIT); the College of Technology (COT); College of Teacher Education (CTE); and the College of Arts and Sciences (CAS). The default display of the percentages will give the management an idea which campuses and colleges have reached the target on research submission. It is where the management makes decision making relative to research.



Figure 2. Home Page

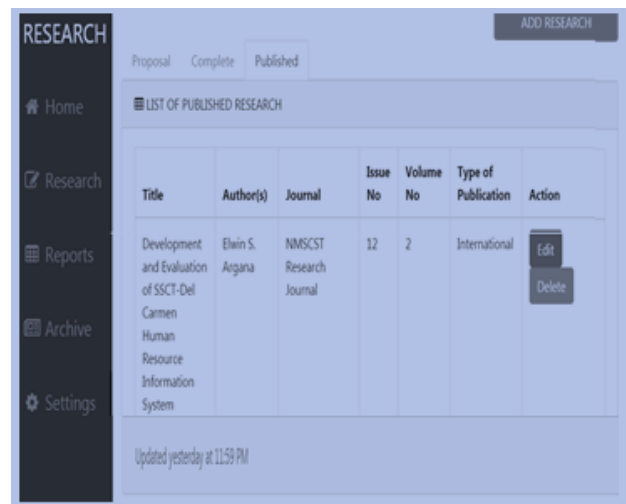


Figure 3. Research Classification

Figure 3. as shown provides the option classified into a proposal, completed and published researches. This page shows the data entry in 3 classifications. It allows adding of research based on the required fields.

Table 1. CEIT Published Researches

Category	Project/Study Title	Author(s)	Journal Title	Vol. No.	Issue No.	Number of Pages	Year of Publication	Publication		
								Regional	National	International
Not Funded	A regression Analysis on Access Points for Closer Family Interlinks	Unife O. Cagas & Alicia Z. Maghuyop	Journal of Higher Education Research Discipline	2	2	8	2017			
Not Funded	A Fuzzy Expert System for Tomato Classification based on Computer Vision and Images Processing	Monalee A. dela Cerna	SSCT Science and Technology	2	2	5	2018			

Table 1. is the CEIT published report for SUC leveling requirement. The system allows report generation of the proposal, completed and published researches by campus and by colleges.

Table 2. Referred Publication

Category	Project/Study Title	Author(s)	Journal Title	Vol. No.	Issue No.	Number of Pages	Year of Publication	Publication		
								Regional	National	International
Not Funded	Development and Evaluation of SSCT-Del Carmen Human Resource Information System	Elwin S. Argana	NMSCST Research Journal	2	12	8	2018			
Not Funded	A Regression Analysis on Access Points for Closer Family Interlinks	Unife O. Cagas & Alicia Z. Maghuyop	Journal of Higher Education Research Discipline	2	2	8	2017			

Table 2. shows the report of the different campuses. This report will be used for SUC leveling requirements. The system allows printing by campuses and by colleges.

In the Figure as shown is the output after the data entry for published researches. The page shows notification of the last data entry.

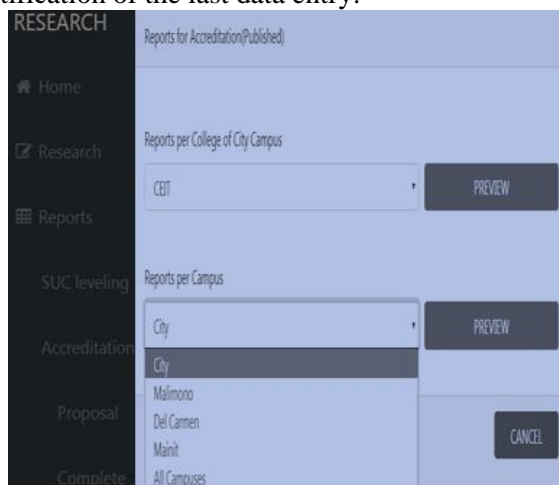


Figure 4. Accreditation Report Page

Figure 4. shows a report page for the accreditation requirement. The system allows choosing as to what campuses or colleges to be printed with the reports. Once the preview button is clicked, the system displays report automatically as shown in Table 1 for the College of CEIT.

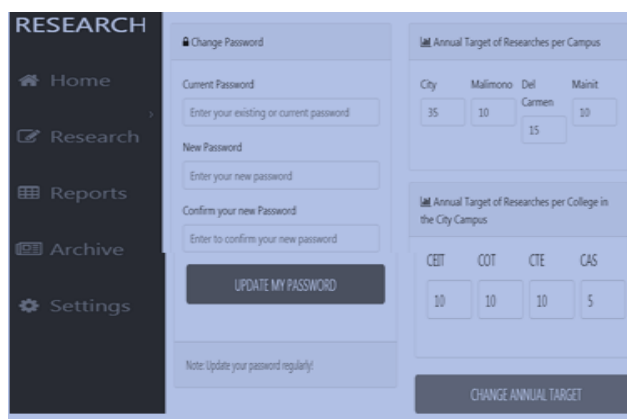


Figure 5. Setting Page

Figure 5. shows the setting page. This page accepts the modification, particularly on the username and password as shown in the left side. It is capable to update both username and password with a message to regularly update for security purposes. As shown on its right is the entry for the target submission of researches per campus. This entry of the target can be changed anytime as the need arises. The percentage display in Figure 2 served as the basis for the management decision making. It is based on the defined target of submission by campuses and colleges.

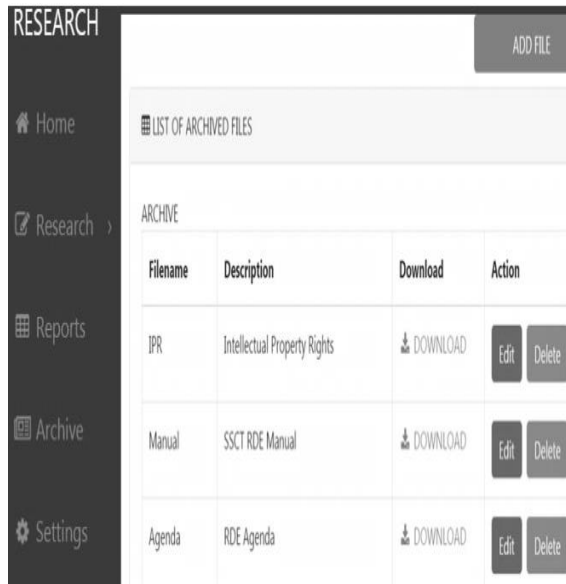


Figure 6. Archive Page

Figure 6 as shown allows uploading and downloading of different files. As observed, the system provides filename with a description for easy retrieval. The filename and description are entered before the upload process is clicked. These uploaded files can be downloaded anytime whenever needed.

Table 3. Systems Evaluation on the Level of System Functionality

The respondents perceive/accept that:	Mean
1. The system functions appropriately.	4.60
2. The information such as the number of researches by campuses and by programs are presented accurately based on submissions	4.50
3. The system functions with security measures particularly in the username and password requirement	5.00
4. The system produces accurate result and functions without errors or problems.	4.60
5. The system observes function compliance to standards.	4.70
Weighted Average	4.68

Table 3 shows the result of the mean rating evaluation on the level of Functionality of the system by the respondents. As shown, the system obtained (WM = 4.68), deemed as Highly Effective. It connotes that the system functions appropriately according to its defined features.

As shown in Table 3, respondents perceived that the system designed functions are highly secured, given with the highest mean evaluation rating (M = 5.00). It is highly secured because it requires username and password before directing to the main page. Both

username and password should be given more attention because the security of information posed challenges to any users. As confirmed by Enamait [13], that to maintain the security of information contained within computer systems posed challenges for users and administrators. Attacks on information systems continued to rise, more specifically, attacks that target user authentication. On the other hand, the system where information such as the number of researches by campuses and by colleges are presented accurately based on submission got the lowest mean evaluation rating (M = 4.50), but it is still deemed as Highly Effective. It connotes further that the modification of the presentation may be for quick analysis of data. In general, the overall evaluation was Highly Effective. It shows that the system provides functions as designed. It is consistent with the claimed that Apache field support system functions effectively Lakhani and Hippel [14]. It refers to the essential purpose of any product or service (ISO 9126).

Table 4 shows the results of the mean rating evaluation on the level of Reliability of the system by the respondents. As shown, the system obtained (WM = 4.64), deemed as Highly Effective. It means that the system is capable to function for a long time with no service disruptions, manages and/or recovers from component or environmental failure, revives and become fully operational even in the event of failure, prompts the user if input is wrong and gives error messages which prompt the user on what to do.

Table 4. System's Evaluation on the Level of Reliability

The respondent perceives/accepts that:	Mean
1. The system is capable to function for a long time with no service disruptions.	4.60
2. The system manages and/or recovers from the component or environmental failure.	4.80
3. The system revives and becomes fully operational even in the event of failure.	4.40
4. The system prompts the user if an input is wrong.	4.90
5. The system gives the error messages which prompt the user on what to do.	4.50
Weighted Mean	4.64

As revealed in Table 4, that the system prompts the user if an input is wrong got the highest mean rating of (M = 4.90), deemed as Highly Effective. It is noted primarily in the username and password where the system shows error message once the input is wrong.

However, an item like the system revives and become fully operational even in the event of failure garnered the least mean rating (M = 4.40) deemed as Effective. This item needs to consider because the system has to revive and fully operational whatever failures that may happen while in operation to make it more reliable. But still, the general result implies that the evaluators still perceived that the system is highly reliable of its services. Haque and Bansal [15], specified that Software reliability is one of the important factors in software quality evaluation. ISO 9126-1 defines reliability as the capability of the system to maintain its service provision under defined conditions.

As depicted in Table 5, the results of evaluation on the level of Usability of the system as perceived by the respondents. As shown, the system garnered (WM = 4.78), deemed as Highly Effective. The weighted mean rating connotes that the system offers an easy way of storing and retrieving of data, is easy to operate, functions are easily understood, can be learned with less effort and provides the user with friendly interfaces.

Table 5. System’s Evaluation on the Level of Usability

The respondent perceives/accepts that:	Mean
1. The system offers an easy way of storing and retrieving of data.	4.80
2. The system is easy to operate.	4.80
3. The system functions are easily understood.	4.70
4. The users learn the system with less effort.	4.90
5. The system provides the user with a friendly interface.	4.70
Weighted Mean	4.78

The result implies further that the system can be learned with less effort as the highest mean rating (M = 4.90), deemed as Highly Effective. It is learnable with less effort because of its organization and presentation particularly in its main menu and corresponding sub-menus. Accordingly, usability needs to address in the early stage of development. The result was supported in the study of Golden [16]. According to her addressing usability early in the software development process is a non-trivial problem. In order for usability to be a first-class citizen among software quality attributes, usability design must be made cost-effective for development organizations. Usability needs to be addressed early in the design process in ways that enable it to be successfully incorporated into software

architecture designs and software engineering implementations.

On the other hand, it is noted that the system functions are easily understood, and it provides the user with friendly interface got the lowest mean ratings (M = 4.70), deemed as Highly Effective. The results are not alarming considering that garnered mean is still in its Highly Effective. According to (Minovic, Stavijanin, Milovanovic and Starcevic, 2009; Imtihan, Chang and Issa, 2013) in the study of Tijani [17], any software or applications which failed with usability evaluation may record low patronage from potential users. And so, usability should be given more attention in the early stage of development for the user satisfaction.

Table 6 presents the system evaluation ratings on the level of acceptability of Efficiency. As shown, the system garnered (WM = 4.70), deemed as Highly Effective. It shows that system consumes lesser time when downloading of files, responds speedily during logging in and out, efficient in entering data, provides the function which can be carried out easily and quickly, and quick in printing requested reports. With highly effective items as shown in Table 4, the system which claimed to be quick in printing SUC Leveling reports and other requested reports obtained the highest mean rating (M = 4.90), with the least mean rating (M=4.50) on the item which claimed to consume lesser time when downloading of files. Results revealed that the system is more efficient in the generation of reports. These reports are following primarily to the SUC leveling and accreditation requirement reports on researches submissions.

Table 6. System’s Evaluation on the Level of Efficiency

The respondent perceives/accepts that:	Mean
1. The system consumes lesser time when downloading of files.	4.50
2. The system responds speedily during logging in and out.	4.60
3. The system is efficient in entering data.	4.70
4. The system provides a function which can be carried out easily and quickly.	4.80
5. The system is quick in printing SUC Leveling reports and other requested reports.	4.90
Weighted Mean	4.70

Krubu and Osawaru (2011), Palmén (2011), Adebayo (2012), and Zambuk and Ya“uGital (2012) as cited in the study of Tijani [17], vouched that ICT facilitates effective and efficient educational administrative processes. Nonetheless, needs to

consider in downloading of files, this may primarily cause hardware specification particularly memory spaces, yet not alarming to note since result still on highly effective efficiency characteristics.

Table 7. System’s Evaluation on the Level of Maintainability

The respondent perceives/accepts that:	Mean
1. The code displays the use of basic commonly used techniques and structures.	4.6
2. The system code is made simpler by using a high-order programming language.	4.7
3. The system code is easy to identify the cause of error or failure.	4.4
4. The system code observes organization to follow easily.	4.5
5. The system code is easy to change and modify whenever necessary.	4.5
Weighted Mean	4.54

Table 7 as shown, depicts the system evaluation ratings on the level of acceptability on Maintainability as perceived by the respondents. As shown, the system garnered (WM = 4.54), deemed as Highly Effective. Results guaranteed that the system is maintainable in the use of basic commonly used techniques and structures; made simpler and used high-order programming language; easily identified the root cause of error or failure; observed organization; easily followed, changed and modified whenever necessary.

Furthermore, respondents believed that the system code is made simpler with a high-order programming language and reusable codes rated highest (M = 4.70). Haeffliger et al. [18], vouched that open source software developers reused code because they want to integrate functionality quickly; write preferred code; operate under limited resources on time and skills; and mitigate development costs through code reused. Whereas, an item like “easy to identify the root cause of error or failure with this kind of code” garnered lowest (M = 4.40) rating, but still on its Effective level of acceptability. When an error occurs, the more requires an analysis. It must be analyzed because changes may affect other aspects of the system.

Table 8. shows the level of acceptability of Portability. As shown, the system obtained the (WM = 4.60), deemed as Highly Effective. Results have noted that the system can be installed easily by any IT-Professional on site, the database used relates to Open SQL conformance, the system can be utilized in

different operating environments, and conformed to the standard and current hardware requirements and can be exported to any platform.

Table 8. System’s Evaluation on the Level of Portability

The respondent perceives/accepts that:	Mean
1. The system can be installed easily with just a few mouse clicks.	4.8
2. The database used relates to Open SQL conformance.	4.7
3. The system can be utilized in different operating environments.	4.4
4. The system conforms to the standard and current hardware requirements.	4.5
5. The system can be exported to any platforms	4.6
Weighted Mean	4.6

Further, the evaluators perceived that the system can be installed easily with just a few mouse clicks as evident of the rating (M = 4.80). Installation of the system is just easy, there is no need of IT expertise before the system is usable. On the other hand, the system can be utilized in different operating environments garnered the lowest (M = 4.40) rating but still in the Highly Effective acceptability level. Result acquired the least mean on “utilization with other operating systems”, possibly because there was no testing conducted on cross-platform. Conceptually, however, the software used in the design can be utilized in different operating systems. In the study of Khan [19], claimed that PHP runs on different operating systems, like Windows, UNIX, Linux and supports different databases like MySQL, Microsoft Access, and Oracle. This idea ensures that the system can be utilized in different operating systems.

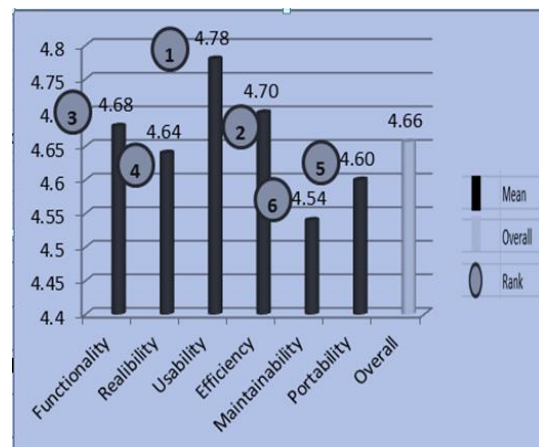


Figure 7. Mean, Overall and Rank Distribution of the Acceptability Level

Figure 7. shows the mean, overall mean rating and rank distribution of the system's evaluation of the system compliance with the ISO 9126 standards as evaluated by the respondents. IEEE 610.3 standard [20], stated that the software is defined on the basis of the fulfillment of the requirement, meeting the expectation of the customer and meeting the requirement specification. The quality of the software is measured by the capability to fulfill the needs of the users and also its ability to achieve the developer's goals.

The result revealed the overall evaluation rating equals (WM=4.66), deemed as Highly Effective. It means that the evaluators are strongly agreed on the overall performance of the system. The obtained mean rating of the following characteristics: usability (M = 4.78), ranked first; efficiency (M = 4.70), ranked second; functionality (M = 4.68), ranked third; reliability (M = 4.64), ranked fourth; portability (M = 4.60), ranked fifth and maintainability (M = 4.54) as the last ranked, with all mean ratings as Highly Effective. The result showed that the system's design is very effective, that is, highly usable, highly efficient, highly functional, highly reliable, highly portable and highly maintainable system's characteristic.

CONCLUSION AND RECOMMENDATION

It is concluded that the system met the defined objectives, responded to the RDE requirements and concerns. The overall result of the system evaluation was highly effective. It ensured that the system met the criteria for the system quality. It implied that the development particularly the default portrayal of the researches submission of the different colleges and campuses serve as a tool for the management decision making. It may lead to the generation of new knowledge and may become contributory to the global competitiveness. Petralba [1], vouched that R&D can only be seen to contribute to global competitiveness, provided that it will drive ICT. Likewise, this particular system's development is an evidence of evolving the culture of ICT innovation towards an ethical knowledge-based society.

Since this development is an independent stand-alone system only in the RDE office, conduct further studies to connect to the Online Journal System (OJS). Further data gathering is hereby recommended thereby this independent stand-alone system will become an online one with utmost security.

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