International Journal of Computing Sciences Research (ISSN print: 2546-0552; ISSN online: 2546-115X)
Vol. 5, pp. 663-678
doi: 10.25147/ijcsr.2017.001.1.66
https://stepacademic.net

Short Paper

e-XTENSION: A Virtual Learning Environment (VLE) System for a State University

Chester L. Cofino
Central Philippines State University, Philippines
chestercofino@gmail.com
(corresponding author)

Guilbert Nicanor A. Atillo
Negros Oriental State University, Philippines

Severina P. Velos
Cebu Technological University, Philippines

Date received: October 28, 2020
Date received in revised form: December 20, 2020
Date accepted: December 25, 2020

Recommended citation:

> Cofino, C. L., Atillo, GN. A., & Velos, S. P. (2021). e-XTENSION: A virtual Learning Environment (VLE) system for a state university. *International Journal of Computing Sciences Research*, 5, 663-678. doi: 10.25147/ijcsr.2017.001.1.66

Abstract

Purpose - This study aimed to develop a virtual learning environment system for a state university extension office that captivated and stimulated learners' imagination anytime, anywhere, using any device. The design provided distance training to the community in livelihood/technical-vocational/skills training, basic education training, communication and dissemination of knowledge, and gender sensitivity training.

Method - The development followed the CDIO Framework known as conceive, design, implement, and operate. An evaluation process was conducted using the ISO/IEC 9126-1 or the Software Evaluation Criteria rated by the IT experts.

Results –Both experts strongly agreed on the system's usability, maintainability, and sustainability and are easy to use with robust functions and support. The study found out that both experts recommended the utilization as they believed the system is beneficial in terms of academic learning objectives for the extension programs.

Conclusion – The assessment of the IT experts from industry and academe helped in the rating of quality software. The CDIO framework is very efficient and effective that produced quality software products. Lastly, the system allows users to boost their training to upland areas fully and maximize time.

Recommendation – It is highly recommended that other techniques may be used to improve the system. This would upgrade the developed system's current features, especially on video conferences, as it found out that the institution must have a suitable server for video conferences upon utilization. Thus, improvement or integration of available video conferencing platforms is recommended.

Practical Implication - University may use the system for other academic activities such as classes, video conferences, and a different process that uses any of the communication tools. The University may formulate a policy on the usage of the system and how it is being used to any unit of the school.

Keywords – *v*irtual learning environment, community extension programs, distance learning, CDIO framework

INTRODUCTION

The field of education is undergoing a profound change as a result of digital innovation. It developed massive improvement, a breakthrough in communication. It improved society's way of learning and living (Ciolacu et al., 2017). These massive changes create learning opportunities that challenge universities and colleges all over the globe. This new learning allows individuals to pursue their education on their terms. People worldwide are taking their education out of school into their homes' comfort to decide what they want to learn and how they want to know (Collins & Halverson, 2018).

Education 4.0 supports the needs of Industry 4.0, where society and technology are associated with enabling new opportunities. They learned together from each other, while the educators assumed the facilitators' role in the learning process (Hussin, 2018). This is because the improvement of the current technology affects educators and allowed them to view education from different outlooks (Uzunboylu, Bicen, & Cavus, 2011). One of the main features of Education 4.0 is an e-learning system called Virtual Learning Environments (VLEs), which comprises more spaces and practices in which digital resources, tools, and applications were used. These were developed under constructivism and embedded personalization learning functions that can meet different requirements of different learners, thus increasing e-Learning effectiveness (Xu et al., 2015). This technology is already utilized in the workplace and education (King & Boyatt, 2014). These current e-learning systems may improve by developing a new e-learning technique that includes communication tools such as video conferencing, SMS messaging, emails, chat

features, and integrating calendar activities for proper management of virtual classes and training. These became more very effective, and it connects other resources on the internet for knowledge creation (Niemi et al., 2014).

In addressing the situation of extensionists in every University traveling from a far distance and took too much time to reached their venue and in the health issue, with the new strain of novel coronavirus spreading throughout the globe that killed thousands of people which gave panic to the community, especially in the education sector. The government advised to suspend classes and suggested looking for electronic means for instructions, training, and communication. Universities must comply with this call from the national. They just looked for an alternative way to keep attached to the academic and extension community learners.

As for extension services concerned, it is this paper aimed to develop and utilized a virtual learning environment (VLE) for the extension office. The system is designed to complement face-to-face training activities and build a blended learning-teaching experience by including computers in the learning process. The system's principal components include instructional tools, assessment tools, and electronic communication, such as chat, emails, SMS messages, and video/audio conferences).

LITERATURE REVIEW

In education, the use of technology becomes essential for schools in terms of instruction, and this proven the value every technology utilizes by the education sector. According to (Sharma, 2016), it is crucial to integrate technology into effective and efficient learning. The article (Aldunate & Nussbaum, 2013) titled "Teacher adoption of technology" concluded that teachers who adopted early in using technology in their teaching have more likely better outcomes for their learners.

The findings of (Genius et al., 2014) suggested explicitly in the area extension services to adopt technology to conduct their training and seminars to improve their processes. In the part of extension educators, they can help the community cope with the massive transformation using technology process for motivations and adoption of such practices is more effective (Dewald et al., 2019). Extension educators can provide more information about technology to reduce uncertainty about regulations and rules. Extension educators can improve this through the use of a virtual learning environment. It is said that conducting community services is about the linking between the communities. It is designed for individual and community growth (Rubio et al., 2016). The study of (Ganesh & Ratnakar, 2016) on agricultural extension stated that it depends on the degree of information exchange between and among the community in which ICTs can provide essential roles.

Virtual learning environments (VLE) have more space and can provide more resources, tools, and other applications that users can utilize. Technology-mediated

learning has been established over the last years. According to Songkram (2015), VLE systems consist of technology to support learning, the learner's and educators' responsibilities, self-direct, and evaluation. One prominent feature of the VLE system is the video conferencing in which it is a real-time web communication that promises to deliver such a solution (Jang-Jaccard et al., 2014). This feature can support numerous users accessed simultaneously (Lu et al., 2016). Another is the chat feature that can be integrated into the system the same as the system of (Rogers, 2010) that can provide real-time messaging. It is stored in the database that can be viewable even as a user scrolls the Web page or opens a new tab.

There is an existing promising VLE system such as the iSocial, but it only provides limited communication to the learners, resulting in low learning effectiveness (Zizza et al., 2018). An e-learning system like "Alice as a Collaborative Virtual Learning Environment" developed by (Al-Jarrah & Pontelli, 2014) allows two students to share a virtual world remotely. This platform may not be suitable for more than two learners and can be upgraded into a more improved system that can cater to more learners in one virtual class. Many e-learning systems have been developed and published over the Internet. Most of these platforms have the same features, such as uploading of topics and presentations through audio/video.

Today, there the so-called Moodle's Learning Management System (LMS) and become part of the educator's toolkit for teaching tools (Phungsuk, Viriyavejakul, & Ratanaolarn, 2017). The paper presented by Oproiu (2015) about using e-learning aimed to give relevant results. It was identified how the Moodle platform could grow the learning enthusiasm and how much they are interested learners to develop learning activities using the system.

METHODOLOGY

CDIO Framework

The development is based on the CDIO Framework, and its purpose is to deliver a quality system based on the user's requirement. This framework was used to design the system's process or the conceive stage, design, implementation, and operation to the extension office's educational program (Figure 1). Table 1 shows different activities conducted in every phase of the CDIO framework.

Software and hardware requirements in the development of the system

The system runs on any 32-bit and 64-bit operating system computers. In accessing the design in any computer, a switch is needed as a local area network (LAN) with internet connectivity and access using a browser like Google Chrome. Table 2, Table 3, Table 4, and Table 5 show the requirements needed in the system's development.

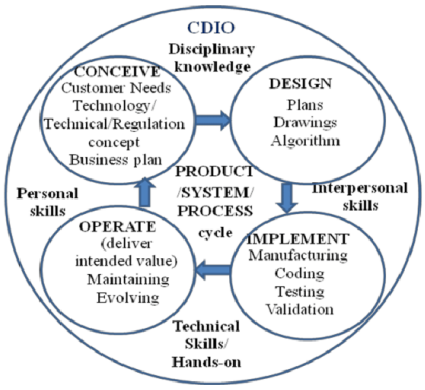

Figure 1. CDIO process Cycle in learning Environment (Nor Hayati S., 2013)

Table 1. Activities in every phases

Phases	Activities
Conceive	Defining the solution in detail on building and making the system. Collection of the necessary materials needed for the study. It includes such items as new features to be implemented and areas redesign of the existing solution. Software and hardware requirements are also identified for the development of the system.
Design	The conceptual design, activity diagram, and network design was created. The user interface was created to conceptualize the system's process to be able to deliver each requirement.
Implement	The implementation started by coding the system. The system was evaluated through ISO/IEC 9126-1 or the Software Evaluation Criteria as rated by the IT experts. The developed method was tested for bugs and errors and fixed for operation.
Operate	Orientation and webinars are scheduled for utilization. Maintenance of the system was done by upgrading the server, monitoring database storage, and security scanning.

Table 2. Software Requirements (Minimum)

Software	Description
Sublime Text Editor v3.2.2 Build 3211	Used for the development of the system in terms of the coding process
XAMPP DBMS Server v3.2.4	Serve as the local environment for the system
Google Chrome or Any Browser	Browser used in accessing the system for developing the testing
Composer	Dependency management in PHP programming language
Node JS v12.14.0-x64	Used to integrate real-time messages such as chat, comments, and notifications

Table 3. Hardware Requirements (Minimum)

Device	Specifications
Central Processing Unit (CPU)	Processor: Quad-Core
Monitor	17" 1024x768 resolution
Keyboard	Standard Keyboard
Mouse	Standard Mouse
Hard Disk Drive (HDD)	500GB
Random Access Memory (RAM)	2 GB
Switch	5 Port 10/100Mbps Mini Switch
Network Cable	UTP Cable Straight Through type
Web Camera	Compatible to all desktop/laptop device
Modem	For Internet Connectivity

Table 4 shows the online platform subscription used in hosting the system through an online environment that can be accessed by the users anytime, anywhere. Table 5 shows the list of open-source tools used in the development of the system.

Table 4. Subscription Requirements

Device	Description
Hosting	Used to host the system for online availability
Mail	Used to deliver email messages to its recipients via Internet
Pusher	An API for real-time messaging

Table 5. Open-Source Tools

Device	Description
Laravel Framework 5.7	Used to host the system for online availability
Bootstrap Framework 3	Used to deliver email messages to its recipients via Internet
RTCMultiConnection	Used for Single and Group video conferencing

System Design

Figure 2 is the activity diagram of the system that identifies the activities of the system's users from start to end. Users would sign-in their credentials, and once validated, they can access the multimedia resources, communication tools, or the assessment tool.

Figures 3 and 4 illustrate the system's conceptual and network design from the university to the community. The system is hosted in a cloud server controlled by the IT Office. The extension office can set-up two or more computers in a strategic area in the identified communities or accessed the system through learner's personnel devices such as smartphones, laptops, and desktops.

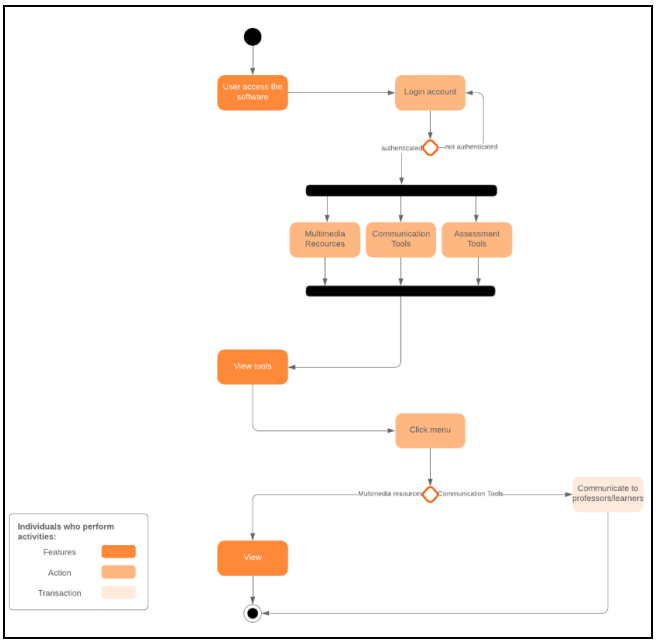

Figure 2. Activity Diagram

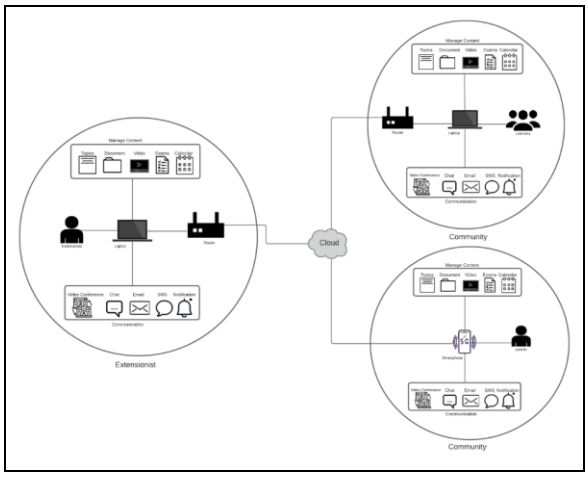

Figure 3. Conceptual Design

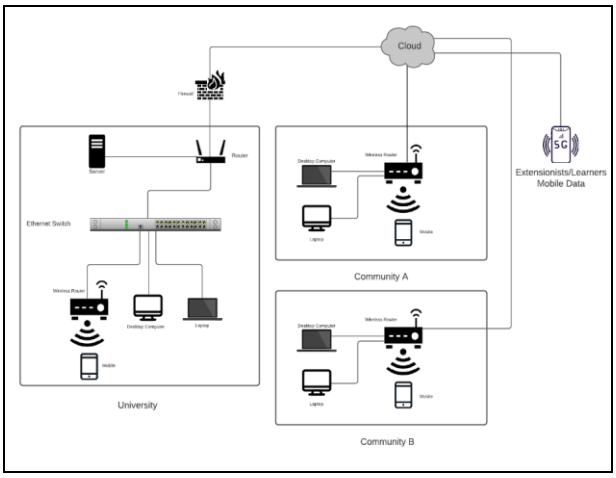

Figure 4. Network Design

System Implementation

The respondents are IT experts coming from the industry who are computer programmers and well experienced in software/web development and experts from the academe who are faculty teaching IT related subjects. The instrument is an adopted questionnaire from ISO/IEC 9126-1 or the Software Evaluation Criteria to test the system's usability, sustainability, and maintainability. The tool was evaluated using the 4-Likert scale.

Table 6. Evaluation Instrument

Criteria	Indicator
Usability	Understandability (Easily understood) Documentation (Comprehensive, appropriate, well-structured user documentation) Buildability (Straightforward to build on a supported system?) Installability (Straightforward to install on a supported system?) Learnability (Easy to learn how to use its functions?)
Sustainability and maintainability	Identity (Project/software identity is clear and unique?) Copyright (Easy to see who owns the project/software?) Licensing (Adoption of appropriate license?) Community (Evidence of current/future community?) Accessibility (Evidence of current/future ability to download?) Testability (Easy to test correctness of source code?) Portability (Usable on multiple platforms?) Supportability (Evidence of current/future researcher support?) Analysability (Easy to understand at the source level?) Changeability (Easy to modify and contribute changes to developers?) Evolvability (Evidence of current/future development?) Interoperability (Interoperable with other required/related software?)

Scale	Range	Description	Interpretation
4	3.26-4.00	Strongly Agree (SA)	The system is highly usable, sustainable and maintainable when assessed by the experts
3	2.51-3.25	Agree (A)	The system is usable, sustainable and maintainable when assessed by the experts
2	1.76-2.50	Disagree (D)	The system is less usable, sustainable and maintainable when assessed by the experts
1	1.00-1.75	Strongly Disagree (SD)	The system is not usable, sustainable and maintainable when assessed by the experts

RESULTS

Presentation of the system output

Figure 5 shows the register an account link if no account is created. The user may select between the two options (figure 6). The dashboard may access using your email address and password as credentials (Figure 7). If forgot password was encountered, password recovery could be used (Figure 8).

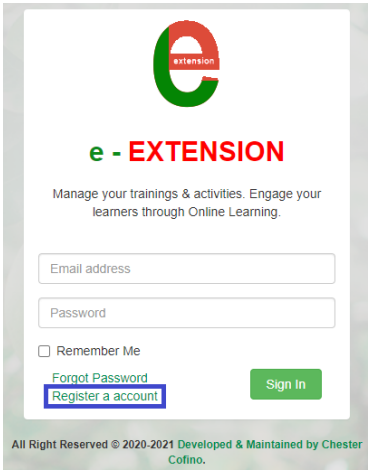

Figure 5. Register Link

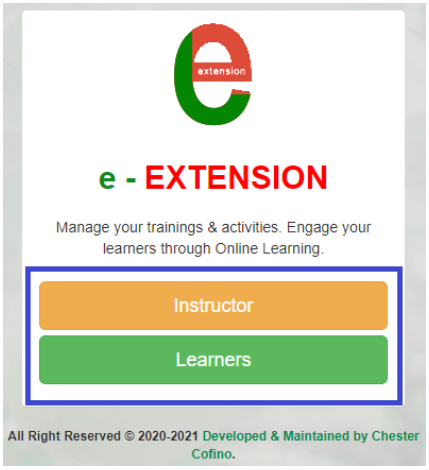

Figure 6. Register Page

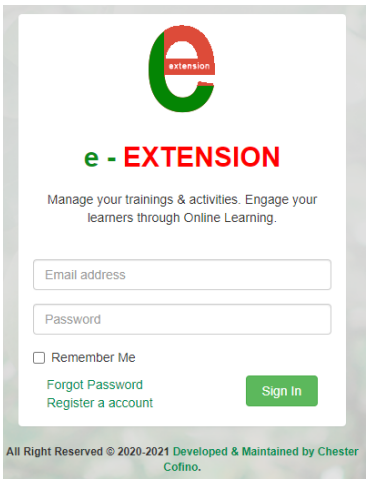

Figure 7. Login Page

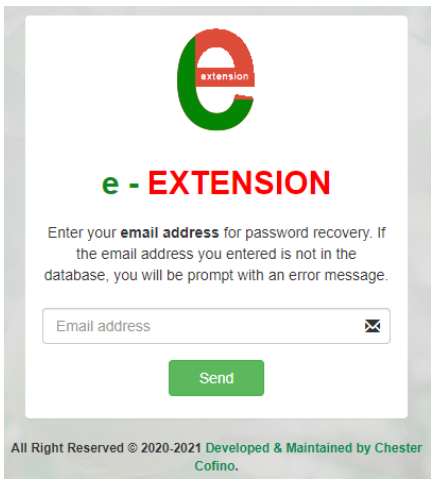

Figure 8. Forgot Password Page

Once successfully authenticated, a dashboard page is displayed (Figure 9).

Extensionists Account

For the extensionists account, different tools can be used in the left corner, such as classroom, conduct video broadcast, create, assessment, calendar, communication tools, and support. You can use this feature in the conduct of your online classes. To create a classroom, click the plus symbol button, and a box will appear. Input the required information for the desired classroom (Figure 10).

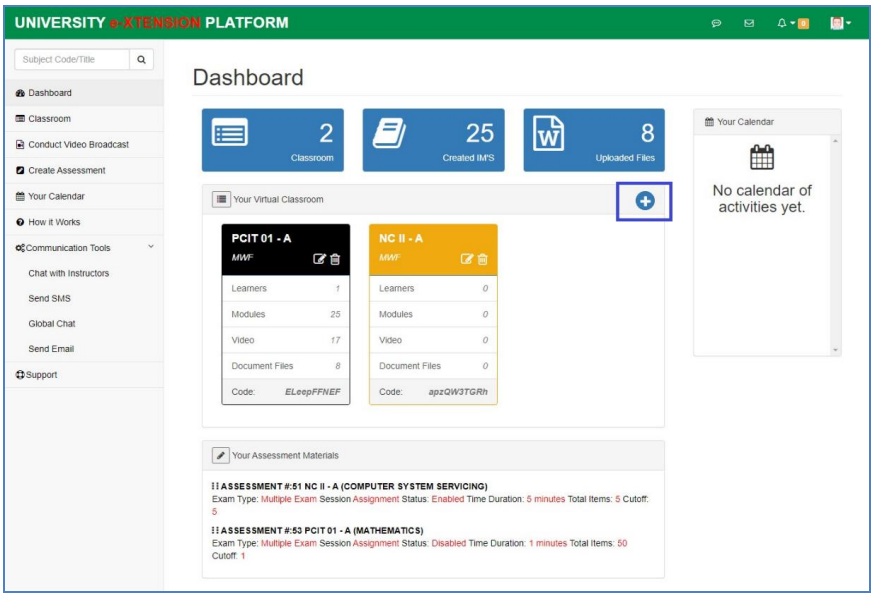

Figure 9. Dashboard Page

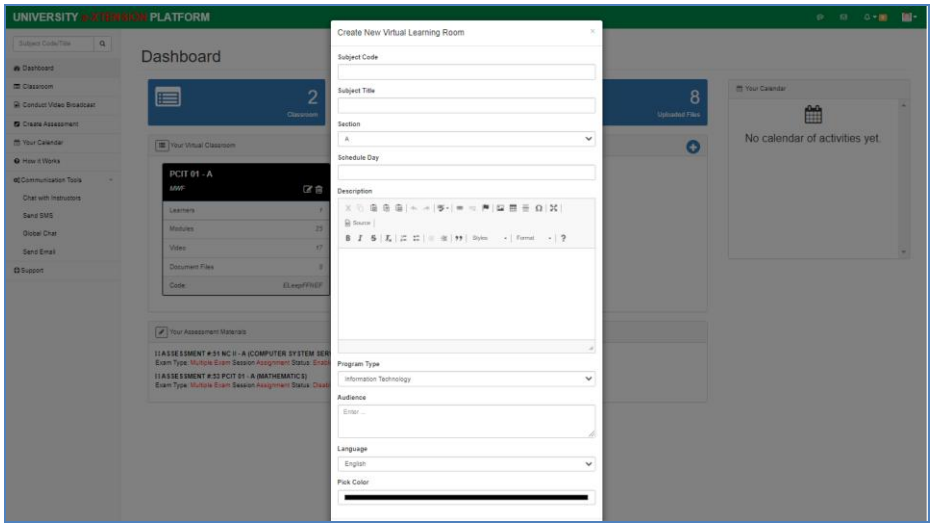

Figure 10. Create classroom

Figure 11 shows the section for uploading of topics, creating an assessment, viewing submitted activities, and viewing exam results. It displayed the list of students accepted in your classroom. Before the learner can access the classroom, the extensionists accept it or decline the application. In uploading of topics, choose between uploading the video file, document file, or slide presentation. On the other hand, extensionists can conduct a video conference with the learners using the conduct video broadcast menu (Figure 12). Figure 13 shows the Assessment Page. Extensionists can create assessments such as Multiple Exam or Problem or Case-Based Exam.

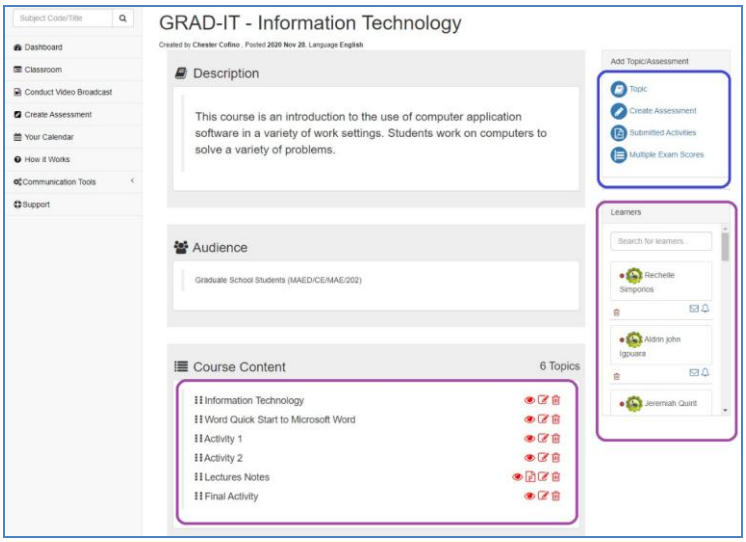

Figure 11. Classroom Page

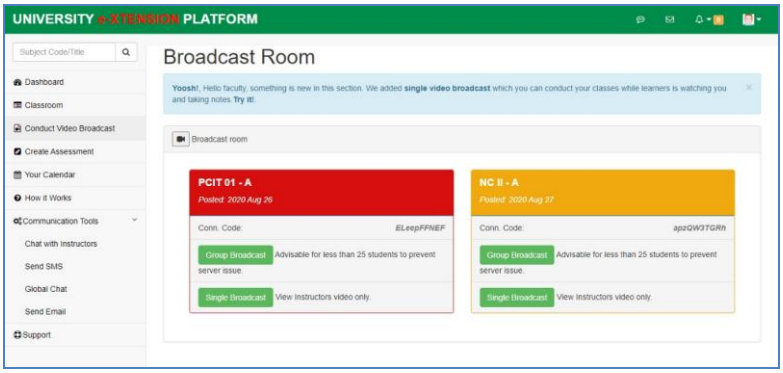

Figure 12. Broadcast Room

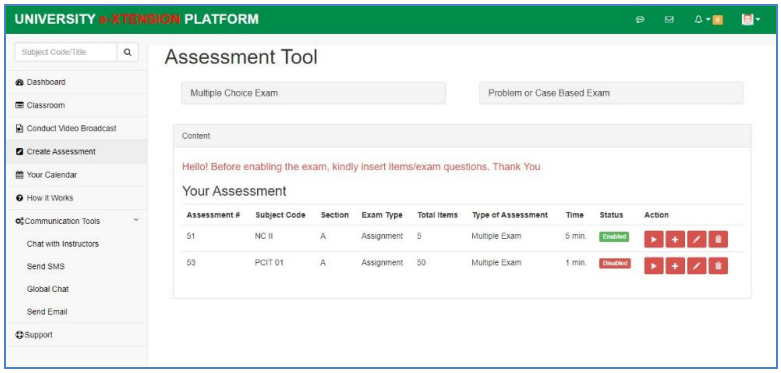

Figure 13. Assessment Page

Learners Account

When a learner logs in using his/her credentials, it is redirected to the dashboard page (Figure 14). Learners can search for subjects and may join the classroom.

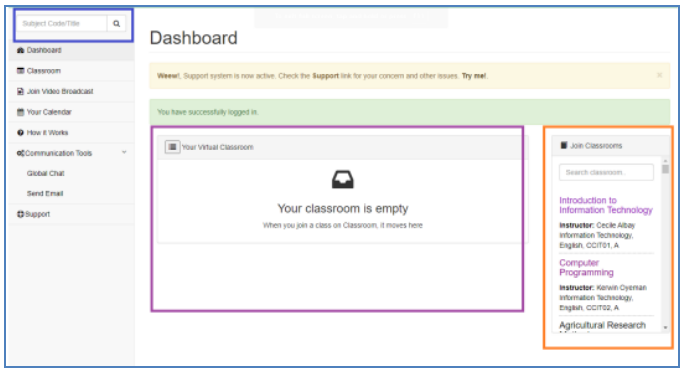

Figure 14. Learners Dashboard

Evaluation Result

The table below shows the assessment level of the virtual learning environment (VLE) system for the usability and sustainability and maintainability as rated by the experts. Table 7 shows that both experts from the academe and IT Industry "Strongly Agree" that the VLE system for community programs is easy to use with robust functions and support.

Table 7. Usability as rated by IT Experts

Items	**Weighted Mean**				**Average**	**Description**
	Academe		Industry			
	Perception	Description	Perception	Description		
1. Easy to learn how to use its functions	4.00	SA	3.90	SA	3.90	SA
2. Straightforward to build on a supported system	3.80	SA	3.80	SA	3.80	SA
3. Straightforward to install on a supported system	3.80	SA	3.80	SA	3.80	SA
4. Comprehensive, appropriate, well-structured user documentation	3.80	SA	3.80	SA	3.80	SA
5. Easily understood	3.80	SA	3.70	SA	3.70	SA
Composite Mean	**3.84**		**3.80**		**3.80**	**3.81**
Description	**SA**		**SA**		**SA**	**SA**

The result in table 8 presents that both experts “Strongly Agree” that the VLE system has all the characteristics of quality software as defined by Graham and Johnston (2008).

Table 8. Sustainability and Maintainability as rated by Experts

Items	Weighted Mean				Average	Description
	Academe		Industry			
	Perception	Description	Perception	Description		
1. Project/software identity is clear and unique	3.80	SA	3.80	SA	3.80	SA
2. Easy to see who owns the project/software	3.80	SA	3.80	SA	3.70	SA
3. Adoption of appropriate license	3.80	SA	3.80	SA	3.70	SA
4. Evidence of current/future community	3.80	SA	3.80	SA	3.90	SA
5. Evidence of current/future ability to download	3.80	SA	3.80	SA	3.70	SA
6. Easy to test correctness of source code	3.60	SA	3.60	SA	3.70	SA
7. Usable on multiple platforms	3.80	SA	3.80	SA	3.60	SA
8. Evidence of current/future researcher support	3.60	SA	3.60	SA	3.70	SA
9. Easy to understand at the source level	3.40	SA	3.40	SA	3.50	SA
10. Easy to modify and contribute changes to developers	3.80	SA	3.80	SA	3.70	SA
11. Evidence of current/future development	4.00	SA	4.00	SA	4.00	SA
12. Interoperable with other required/related software	4.00	SA	4.00	SA	3.90	SA
Composite Mean	**3.71**		**3.76**		**3.74**	**3.74**
Description	**SA**		**SA**		**SA**	**SA**

DISCUSSION

The findings discussed that the VLE system is comprehensive with a well-structured user interface for easy navigation and access. It confirmed the results of (Isaias & Issa, 2013) that educators are delighted that the VLE system was being utilized in their teaching and learning approaches. Furthermore, the study confirmed that the system's uploading of assessment tasks is more comfortable, inexpensive, convenient, and less

time-consuming than the traditional submission and feedback methods. This means that the VLE system's identity and objective are clear, can quickly adapt to future systems development, and can be easily understood by future developers at the source code level. Experts from the academe evaluated the VLE system that effectively delivers extension activities because it is usable and portable on any platform.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings, the following conclusion was drawn. Firstly, the IT experts' assessment from industry and academe helped in the rating of quality software. The CDIO Framework process is very efficient and effective that produced quality software products. Video conferencing needs to access a stable internet connection and is limited to more than 25 users in one room to avoid server issues. It does not support an offline connection. Both experts recommended the system for implementation as they believed the system is beneficial in terms of the university's learning objectives.

For further improvement of the system, the following are recommended, such as implementing the system for the University extension office is advisable. The system's current features may be improved to cater to more complex transactions for the extension office, such as simulation, 3D virtual learning, and other latest virtual learning tools. The video conferencing features of the system may be enhanced by integrating available video conference platforms for stable conduct of training. Other technology may be used to improve the system. This would upgrade the current features of the developed system.

IMPLICATIONS

The system can sustain any advancement and can be maintained by any programmers or developers who are fully aware of the methods. Experts from industry and academic institutions have the same thoughts in evaluating the system. University may use the system for other educational activities such as classes, video conferences, and a different process that uses any of the communication tools. The University may formulate a policy on the usage of the system and how it is being used to any unit of the school.

ACKNOWLEDGEMENT

The authors are grateful to Central Philippines State University for the support and financial assistance for the publication of the paper and support extended during the conduct of this research.

REFERENCES

Al-Alwani, A. (2014). Evaluation Criterion for Quality Assessment of E-Learning Content Abdulkareem Al-Alwani. *E–Learning and Digital Media, 11*, 532–542.

Aldunate, R., & Nussbaum, M. (2013). Teacher adoption of technology. *Computers in Human Behavior*, 29, 519-524.

Al-Jarrah, A., & Pontelli, E. (2014). "AliCe-ViLlagE" Alice as a Collaborative Virtual Learning Environment. *2014 IEEE Frontiers in Education Conference (FIE) Proceedings.* Madrid, Spain: Institute of Electrical and Electronics Engineers.

Ciolacu, M., Tehrani, A., Beer, R., & Popp, H. (2017). Education 4.0 — Fostering student's performance with machine learning methods. *2017 IEEE 23rd International Symposium for Design and Technology in Electronic Packaging (SIITME).* Constanta, Romania: Institute of Electrical and Electronics Engineers (IEEE).

Collins, A., & Halverson, R. (2018). *Rethinking education in the age of technology: the digital revolution and the schools.* New York: Teachers College Press.

Dewald, S. S., Murphrey, T. P., Leggette, H. R., Berthold, A., & Wagner, K. (2019). Landowner Adoption of Water Quality Best Management Practices: Motivations and Barriers. *Journal of Extension*, 57(6). Retrieved from https://tigerprints.clemson.edu/joe/vol57/iss6/13

Djouab, R., & Bari , M. (2016). An ISO 9126 Based Quality Model for the e-Learning Systems. *International Journal of Information and Education Technology, 6*(5), 370-375.

Ganesh, K. P., & Ratnakar, R. (2016). A Scale to Measure Farmers' Attitude towards ICT-based Extension Services. *Indian Research Journal of Extension, 11*(1), 109-112.

Genius, M., Koundouri, P., Nauges, C., & Tzouvelekas, V. (2013). Information Transmission in Irrigation Technology Adoption and Diffusion: Social Learning, Extension Services, and Spatial Effects. *American Journal of Agricultural Economics*, *96*(1), 328–344. doi:10.1093/ajae/aat054

Hussin, A. A. (2018). Education 4.0 Made Simple: Ideas For Teaching. *International Journal of Education & Literacy Studies, 6*(3), 92-98.

Jang-Jaccard, J., Nepal, S., Celler, B., & Yan, B. (2014). WebRTC-based video conferencing service for telehealth. *Journal of Cryptographic Engineering*, *98*, 169–193.

Isaias, Pedro and Issa, Tomayess. 2013. E-Learning and sustainability in higher education: An international case study. *The International Journal of Learning in Higher Education*, *20*(4), 77-90.

King, E., & Boyatt, R. (2014). Exploring factors that influence adoption of e-learning within higher education. *British Journal of Educational Technology, 46*(6), 1272–1280. doi:10.1111/bjet.12195

Lu Y., Zhao Y., Kuipers F., Van Mieghem P. (2010) Measurement Study of Multi-party Video Conferencing. In: Crovella M., Feeney L.M., Rubenstein D., Raghavan S.V. (eds) NETWORKING 2010. NETWORKING 2010. Lecture Notes in Computer Science, vol 6091. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-12963-6_8

Niemi, H., Harju, V., Vivitsou, M., Kirsi , V., Multisilta, J., & Kuokkanen, A. (2014). Digital Storytelling for 21st-Century Skills in Virtual Learning Environments. *Scientific Research Open Access, 5, 657-671.*

Oproiu, G. C. (2015). A study about using e-learning platform (Moodle) in university teaching process. *Procedia - Social and Behavioral Sciences , 180*, 426 – 432.

Phungsuk, R., Viriyavejakul, C., & Ratanaolarn, T. (2017). Development of a problem-based learning model via a virtual learning environment. *Kasetsart Journal of Social Sciences*, *38*(3), 297-306.

Rogers, J. C. (2010). *United States Patent No. US 2010/0037153 A1 .*

Rubio, J.-A. M., Pentinio, C. P., Ascan, J. C., Mendoza, M. D., Vito, J. V., & Encio, H. A. (2016). Involvement in Community Extension Program of Business Administration Students in one Higher Education Institution in the Philippines. *Asia Pacific Journal of Multidisciplinary Research, 4*(1), 109-122.

Songkram, N. (2015). E–learning system in virtual learning environment to develop creative thinking for learners in higher education. *Procedia - Social and Behavioral Sciences*, *174*, 674 – 679 .

Uzunboylu, H., Bicen, H., & Cavus, N. (2011). The efficient virtual learning environment: A case study of web 2.0 tools and Windows live spaces. *Computers & Education*, *56*(3), 720-726.

Xu, D., Huang, W. W., Wang, H., & Heales, J. (2014). Enhancing e-learning effectiveness using an intelligent agent-supported personalized virtual learning environment: An empirical investigation. *Information & Management*, *51*(4), 430-440.

Zizza, C., Starr, A., Hudson, D., Nuguri, S., Calyam, P., & He, Z. (2018). Towards a Social Virtual Reality Learning Environment in High Fidelity. *2018 15th IEEE Annual Consumer Communications & Networking Conference.* IEEE.