A PROPOSED VIRTUAL LEARNING ENVIRONMENT (VLE) FOR ISABELA STATE UNIVERSITY (ISU)

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Abstract - The aim of this study is to propose a Virtual Learning Environment (VLE) for Isabela State University (ISU). The VLE was conceptualized based on the developed VLE approach model which originated from the Instructional Design ADDIE Model. In spite of problems related to management of ICT infrastructures, limited instructional materials, resistance to organizational change, issues on how to make course content more engaging, issues on effective learning pedagogy, and lack of skills and experience of instructors and students in virtual learning in the University, the results of the study revealed that students are satisfactorily ready to engage in virtual learning while instructors are highly capable of using the VLE as a teaching tool. The course content was assessed as an excellent VLE course and that it is highly acceptable as an online course material. In terms of usability, the VLE site complied satisfactorily on the usability issues encountered and that students were positive regarding its usability and support to learning. Also, the test of the gain score (posttest-pretest) indicates a significant variation between the two treatment groups which implies that the use of VLE is a significant factor in increasing the performance of the students. This further implies that the proposed VLE is a timely contribution to enhance and support the teaching and learning practices in the University by introducing a sustainable, effective technological and pedagogical virtual learning environment for students and instructors as well.

Keywords: blended learning, e-learning sustainability, higher education institution, state university and colleges, virtual learning environment

I. INTRODUCTION

Virtual Learning Environment (VLE) is an information system that facilitates e-learning. VLE processes, stores and disseminates instructional materials and supports communication associated with teaching and learning [1]. VLE provides several functionalities such as electronic distribution of course syllabi, teachers' grades and teachers' feedback to students, ability to post hyperlinks to websites, forum for the exchange of ideas, wikis which allows student to swap ideas and information on projects, chat rooms for real time discussion, facilitating emailing and messaging among the participants (teacher-to-students, students-to-students), facilities for students to submit work assignments electronically, and the means to administer quizzes and texts online [2]. Although VLEs have now become an essential component in the delivery of many higher education courses and have been instrumental in supporting and facilitating teaching and learning, studies have equally shown that there are issues and challenges that threaten the adoption and sustainability of e-learning especially in rural communities [3]-[4]. For instance, the challenges of using and propagating online learning in the Philippines are, among others, expensive Internet infrastructure, inadequate technical capabilities of teachers and computer staff, and more importantly, the lack of management support that is critically needed in order to make e-learning work [5].

This study aims to propose a Virtual Learning Environment (VLE) for Isabela State University (ISU) that supports the government's mandate to provide e-learning environment at all educational levels. This will also help strengthen the instructional thrust of the University by providing e-learning tool to its ICT curriculum. The proposed VLE is a timely contribution to enhance and support the teaching and learning practice in the University by introducing a sustainable and effective technological and pedagogical virtual

learning environment for students and instructors as well.

In this study, the researcher focuses on the following seven major areas: (1) Assessment of the University's e-learning sustainability; (2) Evaluation of students' perceived readiness to engage in virtual learning; (3) Evaluation of instructors' perceived knowledge on technology, pedagogy, and content domain areas; (4) Development of the VLE system and the development of the VLE course content; (5) Acceptability evaluation of the VLE course content; (6) Usability evaluation of the VLE and; (7) Evaluation of how effective the VLE is in terms of students performance between two groups.

1.1 e-Learning Thrusts

In the Philippines, the government has set priorities and necessary support for the promotion of e-learning as an innovative tool in developing a knowledge-based society. The Information Technology and E-commerce Council (ITECC) was created to explore e-learning and to actively promote it at all educational levels and support the collaboration of schools in the development of e-learning programs and instructional materials [6]. More recently, the Open Learning and Distance Education Act of 2011 which aims to expand access to quality education through open and distance learning has been approved. The Act applies to public and private higher education institutions (HEIs) and post-secondary technical/vocational schools in the Philippines which have existing open learning and distance education programs and to others which shall later be authorized as qualified implementers of open learning and distance education programs [7].

The Commission on Higher Education (CHED) circulated the Memorandum (*CMO No. 35, Series of 1995*) on Guidelines on Distance Education to help ensure the quality of education that people would receive through e-learning. In addition, the CHED through the Technical Committee of Reviewers for the Delivery on Open Learning and Distance Education has been developing a number of approaches to ensure quality e-learning. A Memorandum (*CMO No. 27, Series of 2005*) on "Updated Policies and Guidelines on Open Learning and Distance Education" has been issued specifying standards for distance education programs. Specifically, the memorandum requires institutions to prepare well-written, well-structured, well-tested, developmental and appropriate instructional materials for each course.

1.2 E-learning in Higher Education Institutions (HEIs) and other agencies in the Philippines

In the Philippines, e-learning has been gaining ground in the education sector with a big push from government efforts. The University of the Philippines Open University (UPOU) established in February 1995 hastened the development of the open learning and distance education in the country. They offered online courses via customized Integrated Virtual Learning Environment (IVLE) adopted from the National University of Singapore. Also, the implementation of competency-based Technical and Vocational Education and Training (TVET) system of Technical Education and Skills Development Authority (TESDA) has introduced new learning methodologies and new learning environment where teachers are facilitators of learning. This application combined self-learning approach and formal classroom instruction. The Department of Education (DepED) *e-Turo,* which is a network of free and open educational resources cover basic education, alternative education, and continuing education. It focuses initially on developing an online repository for basic education in the areas of Mathematics, Science, English, Filipino and Social Studies. The University of Sto. Tomas e-LeAP (e-Learning Access Program) provides learning materials online, the Dela Salle University, the Ateneo de Manila University, and other major universities offer some form of online courses.

However, when HEIs start the process of implementing e-learning, some factors related to technology, potential users, course contents, and local context of use come into play. Technological factors like internet bandwidth, hardware reliability, network security, and accessibility are taken for granted. The instructors' basic technical skill level, attitude towards ICT, and motivation are among the elements to address. The students'

learning maturity and readiness for e-learning must be considered. In developing course content, factors related to content, pedagogy and technology are issues to consider. Institutional readiness and support must be in place.

1.3 e-Learning in State University and Colleges (SUCs)

State University and College (SUCs) in the Philippines refers to any public institutions of higher learning that is fully subsidized by the national government.

E-learning among SUCs is indeed on its inception. The National Computing Center (NCC) reported that as of December 2012, of the 112 SUCs in the country, 89 SUCs or 79.46% have web presence while 23 or 20.54% have none. According to the UN-ASPA's Five Stages of e-Government, 32 SUCs or 35.96% are in Stage 3 (interactive web presence), 52 or 58.43% are in Stage 2 (enhanced web presence), and 5 or 5.62% are in Stage 1 (emerging web presence) [8].

The researcher accessed the different SUC websites and found out that only 16 or 14.29% have e-learning portals as of this writing. It should be noted that the Isabela State University also does not have e-learning portal.

The Isabela State University System is strategically located in the middle of the Cagayan Valley Region, with its 9 campuses and 2 extensions strategically located in the province of Isabela. In 2003, the ISU-Echague Campus was affiliated with the CISCO Networking Academy and in 2005, with the Yapster e-learning. Because of these affiliations, the 'e' trend for the instructional thrust of the University is significantly strengthened [9]. However, poor implementation and monitoring stunted the effort.

1.4 Blended Learning (BL)

Blended learning (BL) is a method to organize the learning environment that is facilitated by the effective combination of different modes of delivery, models of teaching and styles of learning. Significantly, blended learning environment is used to maximize the benefits of both face-to-face and online methods -- using the Web for what it does best, and using the class time for what it does best [10].

1.5 Goal and Research Questions

The researcher aims to propose a Virtual Learning Environment (VLE) for Isabela State University. The ISU-Echague main campus was selected to pilot the study to determine and assess the different areas involved. Blended learning approach will be implemented in the experiment. The researcher attempted to answer the following research questions: (1*) What is the status of the University's e-learning sustainability? (2) What is the perceived readiness of students to engage in virtual learning?; (3) What is the perceived knowledge of instructors in terms of technology, pedagogy, and content domain areas?; (4) What is the development process for VLE system development and VLE course content development?; (5) How acceptable is the VLE course content to provide online course?; (6) How do the students perceive the usability of the VLE in learning IT59 course?; and (7) How does the performance of the students in the pretest relate with their performance in the posttest after using the VLE*?

1.6 Conceptual Framework

The ADDIE model [11], a systematic instructional design model serves as basis in developing the framework for this study. *Figure 1* illustrates the conceptual framework of the study.

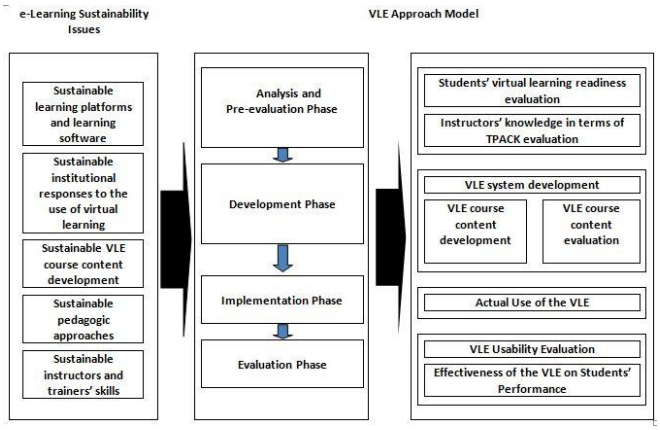

Figure 1. Virtual Learning Environment Approach Model

The researcher adapted the 5 e-learning sustainability issues [12]. The issues were used to assess the current status of the University to determine the problems that need to be addressed in the adoption of the VLE.

The **VLE Approach Model** consists of four phases: (1) *Analysis and Pre-evaluation phase*; (2) *Development Phase*; (3) *Implementation Phase*; and (4) *Evaluation Phase*.

The *Analysis and Pre-evaluation phase* addresses the virtual learning readiness of the students. The evaluation seeks to insure that students are prepared prior to utilization of the VLE in a classroom setting. The evaluation of instructors' perceived knowledge seeks to determine the instructors' level of knowledge in terms of technology, pedagogy, content and its intersection domains prior to the use of the VLE as a teaching tool. The *Development phase* involves the development of the VLE system and the VLE course content. The prototyping model serves as guide in the development of the VLE prototype, where a CMS particularly Moodle will be utilized in the customization and management of the VLE site, VLE course, and VLE content. On the other hand, the activities of the ADDIE model served as basis in developing the VLE course content. During the development process, acceptability evaluation of the VLE course content will be conducted in order to assess the content, pedagogical and technological aspects of the VLE course. The *Implementation phase* is the actual use of the VLE in the selected pilot College of ISU, in particular the course instructor and the students/participants of the experimental treatment (experimental group and control group). The *Evaluation phase* covers the usability evaluation of the VLE to ensure usability of the VLE interfaces in general, usability of interfaces specific to VLE site, student-centered instructional design to evaluate effective learning and the overall usability of the VLE site. Moreover, the comparison between the pretest and posttest scores of the students in the experimental treatment is measured to determine the effectiveness of the VLE.

1.7 Importance

This study provides answer to students' need for innovative learning venue with the aid of technology-based education facilitating greater student-centered learning. This provides instructors' a teaching tool to efficiently and effectively deliver learning resources and learning activities to students though newly acquired methodologies. On the part of the University, this strengthens the promotion and utilization of ICT, particularly e-learning technology responding to the challenge of the Government to promote e-learning and information literacy in the education sector. This will be realized with the possibility of adopting the proposed VLE for ISU. Moreover, the methodology used in this study can serve as guidelines in the adoption of the proposed VLE to other schools. Results of the study can be used by other researchers to improve the VLE approach model and find innovative ways to use the technology in teaching and learning practices.

II. METHODOLOGY

The researcher used assessment, survey questionnaires, interviews and internet data collection method in the conduct of this study.

2.1 Research Design

The VLE was conceptualized based on the developed VLE approach model which originated from the Instructional Design ADDIE Model. ADDIE consists of five phases: analysis, design, development, implementation, and evaluation. Evaluations were carried out as the study progresses using the descriptive type of research to provide accurate description and measurement of various observable facts. The quasi-experimental design using the two group (control and experimental group) pretest-posttest analysis was used to gather data related to the effectiveness of the VLE on students' performance.

2.2 Subject of the Study

A total of 142 participants were involved in the study. The participants in the experiment were 120 3rd year Bachelor of Science Information Technology students enrolled in IT59- Multimedia course for the 2nd semester, school year 2012-2013. 15 ICT instructors participated in the evaluation of instructors' perceived knowledge in the three domain areas. The VLE course content evaluation was performed by 5 subject matter experts selected based on their academic qualifications and experiences while 2 Administrative staffs from the Office of the Vice-president for Planning and Development and the

Office of the Dean, IICT of ISU were interviewed to determine problems in relation to e-learning sustainability of the University.

2.3 Assessing the E-learning Sustainability of the University

The five issues of e-learning sustainability such as sustainable learning platforms and learning software; sustainable institutional responses to the use of virtual learning/e-learning; sustainable VLE course content development; sustainable pedagogical approaches; and sustainable instructors and trainers' skills [12] were used as basis in assessing the present problems of the University in terms of e-learning sustainability. Documents and records from Management Information System (MIS) office and from the Office the Dean of IICT were retrieved and reviewed. Interviews were also conducted to support the review of documents. University e-Learning Sustainability Assessment documents checklist and interview guides were developed by the researcher.

2.4 Survey evaluation on Students' perceived readiness to engage in virtual learning

Prior to implementation of the VLE in the classroom, an evaluation was conducted to determine students' perceived readiness to engage in virtual learning as well as identifying practical study and technical skills that should be developed as deemed necessary in using the VLE. A students' readiness to engage in virtual learning survey questionnaire was adapted [13].

2.5 Survey evaluation on Instructors' perceived knowledge in terms of technology, pedagogy, and content domain areas

An evaluation was conducted to assess the domain knowledge level of the ICT instructor which is necessary in the use of the VLE as a teaching tool. The technology pedagogy and content knowledge (TPACK) questionnaire was used [14]. The instrument measures seven areas namely: (1) technology knowledge (TK), (2) pedagogy knowledge (PK), (3) content knowledge (CK), (4) technological pedagogical knowledge (TPK), (5) pedagogical content knowledge (PCK), (6) technological content knowledge (TCK) and (7) technological, pedagogical, and content knowledge (TPACK).

2.6 Development of the VLE System and VLE Course Content

In June 2012 the VLE development project was initiated in the Institute of Information and Communication Technology (IICT) in ISU. In order for the project to push through, a *VLE Project Management Plan* was created. The VLE project development team was put together to write the needed documents. In the initial stages of the project, the team included a VLE project manager, the VLE developer, a course content developer, subject matter expert, education specialist, and IT expert consultants.

Analysis stage involved the process of defining and analyzing both the work scenario and the requirements for the course/module to be built. The *requirements* pertain to the content, pedagogical, and technological elements of the VLE course used as input in designing the VLE. Course design was started by combining the course content, media elements and learning activities to attain a specific learning objective. A VLE course design document was written to provide details on how to build the course.

The information from the analysis and design phase was used as input in the development of the VLE. Moodle was used as the development tool. In the process, the course structure was built and prototypes were created, reviewed and validated by peers for improvement until a functional VLE prototype was finally developed. The VLE course content with the inclusion of multimedia elements to meet the learning objectives of the course was developed. Additionally, the VLE course resources were both developed and adopted from free resources online. Learning and assessment activities (assignment, quiz, glossary, database activity, forum and wiki) were created. Also, online policies, guidelines, procedures and rubrics were formulated to set standards for the course.

In the implementation, the following activities were set and conducted: putting in place the hardware and software needed, checking network connections, verifying computers/laboratories free time slots as well as consolidating students' free time during the week, and web hosting services

was availed. In addition, orientation and training for the users were conducted and user manuals were provided. The VLE course was also deployed containing the learning resources, the learning activities and assessment tools to carry out foreseen activities. During the use of the VLE, instructors and students were enrolled in the course. Students were required to access the VLE site, access learning resources, work with the different learning activities, take quizzes, interact and collaborate with other students. At the same time, the instructor monitored the VLE, the students, learning activities, performance on assessment and provided technical and instructional support. Access to the VLE site is done online using the Internet. The designated URL is isuvle.com. Also, evaluations of the VLE course content acceptability, VLE usability, and effectiveness of the VLE were carried out. *Figure 2* shows a screenshot of the VLE instructor's home page.

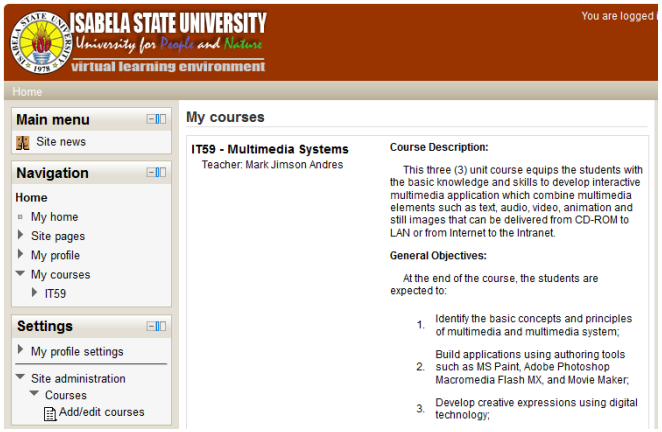

Figure 2. Screenshot of the VLE instructor's home page

2.7 Acceptability Evaluation of the VLE Course Content

Before the implementation of the VLE, acceptability evaluation of the VLE course content was performed by 5 subject matter experts selected from different academic institutions. An adapted VLE course evaluation rubric [15] was accessed online in Google Docs (https://docs.google.com/spreadsheet/viewform?formkey=dGpTeTJwUlF2eGN3WHZIZFRULTRydmc6MQ). The evaluation was conducted to assess the content, technological and pedagogical aspects of the VLE course to improve instructions and produce quality online course.

2.8 Usability Evaluation of the VLE Site

At the end of the course implementation, usability evaluation of the VLE was administered to 60 students in the experimental group. A usability evaluation questionnaire was used [16]. The purpose is to determine the general interface design, VLE-site specific design, student-centered instructional design, and the overall usability of the VLE site. Questions are structured using the 5-point Likert scale format (5=strongly agree, 1=strongly disagree) and open-ended questions were also asked to reinforce their answers and optional open-ended comments were also provided by the students.

2.9 Analysis of the Pretest and Posttest Results between the Two Groups

The pretest-posttest questionnaire constructed by the researcher started with 80 multiple choice questions (MCQ). After having it validated by two subject specialists using content validity, 45 items were left for the final questionnaire. To test the reliability, pilot testing was conducted to 30 BSIT students who were not enrolled in the course that is targeted in this research. The reliability of result was obtained using Kuder Richardson's KR-20 with a coefficient reliability of 0.77, thus the instrument was already affirmed "good" for a classroom test.

The quasi-experiment design using the pretest and posttest design involving two groups – the *experimental group* and the *control group* was conducted. The experiment involved 120 students enrolled in IT59 course for the 2nd Semester, school year 2012-2013. The students were divided into two groups – the control group and the experimental group. The control group is composed of 60 students who were observed in a traditional classroom setting. The experimental group consists of 60 students using blended approach (traditional classroom setting and the VLE). Some teaching techniques, evaluation methods, media and delivery modes were adjusted to conform to the activities in virtual learning environment. Class schedule (time and day) was modified. In their five-hour/week meeting 3 hours

were still allotted for their face-to-face meeting while access to the VLE site can be made anywhere (school, home, internet cafes) anytime of the day. Before the experiment, the students were oriented in using the VLE. Both groups were pre-tested before the start of the program and post-tested after completion of the course. Test scores were analyzed to determine students' level of performance before and after the treatment. The control and the experimental groups were given the treatment over a period of six weeks covering the preliminary period of the current term.

2.10 Data Gathering

The researcher gathered data from the reviewed documents and interviews with administrative staffs. Additional data from the IICT College and subject specialists were also obtained. Internet data collection method was used to gather function-related VLE requirements, user interface building and instructional design building through access to Moodle website (http://www.moodle.org) and other relevant and related sites. Survey questionnaires were floated before and after the implementation of the VLE. Pretest and post-test scores were also gathered in the conduct of the experimental treatment.

2.11 Data Analysis

The researcher used mean/weighted mean to describe the students' readiness to engage in virtual learning and instructors' perceived knowledge in 3 domain areas. Percentage and ranges were used to describe the acceptability of the VLE course content. Usability of the VLE was described using weighted mean while percent frequency was used to describe responses of students in the open-ended questions. The t-test was used to illustrate the pretest, posttest and gain scores of the two treatment groups. Kuder Richardson Coefficient of reliability (KR-20) technique was used to measure the reliability of the pretest-posttest questionnaire in IT59 course.

III. RESULT AND DISCUSSION

3.1 Assessment of University's e-learning Sustainability

The researcher designed a matrix of problem and recommended solutions to determine and address the current e-learning status of the University. Based on *Table 1*, issues related to learning platforms and learning software, the University has available computer hardware, Internet connection, and recently ICT infrastructures were set-up to initiate the interconnectivity of the 9 campuses. This indicates that the University is technologically ready to sustain e-learning. However, the current focus is to set-up the central technical infrastructures interconnectivity of the ISU system while acquisition of instructional programs is still being planned. It was also found out that there is minimal learning software available and no licensed software used for instructions due to budget limitations. To lessen the burden on the part of the university, it is recommended to avail web hosting services during the implementation of the VLE and to use FOSS LMS in particular Moodle to produce learning software.

Traditional method of teaching is extensively used in the classroom. Instructors', students' and the administrators' resistance to organizational change and high cost of VLE are the problems encountered under institutional responses to the use of virtual learning. To address the issue, the following are recommended: seek approval through the Executive Director to conduct the pilot implementation adapting blended learning approach, evaluate the overall usability of the VLE, evaluate the acceptability of the VLE course, evaluate how effective the VLE in terms of students' performance, conduct training to students and instructors, and prepare cost analysis to initially determine the implementation cost of the VLE.

In the findings, the researcher found out that result of the Usability evaluation confirmed that 95% of the students preferred to learn using both the VLE site and the classroom (blended learning). Also, the VLE course content was evaluated as "Excellent VLE course" which means that the VLE course for IT59 is highly acceptable for use as an online course material. In terms of its effectiveness, it was found out that the use of VLE is a significant factor in increasing the performance of the students in learning the IT59 course. In terms of development, implementation and evaluation, the total cost incurred amounted to

30,000 pesos. Evaluation results and activities will be presented to the management and encourage the University to adopt the VLE as a teaching and learning tool.

Sustainability issues on VLE course content development include course materials developed for online learning and cost of multimedia learning materials. At present, the University has no course materials for online learning and no plan yet of investing on multimedia learning materials due to high cost. The researcher recommended the use of Moodle learning activities (forum, wikis, online test, etc.), use of openly available web-based resources, and to develop smaller units of learning materials.

The researcher addressed the issues by developing the VLE course content design document which serves as a blueprint in the developing VLE course. Moodle tools like forum, wikis, online quiz, glossary and database activities were incorporated in the design and development of the VLE course in IT59. Based on the assessments of the SMEs, the VLE course in IT59 proves to be an acceptable online course delivery tool (total weighted mean score of 115.8 points or equivalent to Excellent VLE course). Similarly, the researcher has proven that the VLE site satisfactorily conformed to the different usability issues and students were positive regarding its usability and support to learning.

Sustainability issues on pedagogic approaches include issues on effective online learning. At present, instructions were based on Bloom's taxonomy of cognitive domain. It is therefore recommended to conduct analysis and review of course content (IT59 course) to include multiple pedagogical approaches to online learning; and develop learning activities that support collaborative learning, group work and use multimedia methodologies such as tutorials, simulations, links to other websites, and online tests; involve IT experts and content specialists to set the relationship between the development of the VLE site and the development of the VLE course content.

The researcher found out that in terms of pedagogic approaches, the inclusion of multiple pedagogical approaches in the design of the VLE course provides a venue for students to learn dependently and independently from the instructor. However, it shows that active learning, problem solving and authentic learning were least rated by the students in the evaluation of the VLE usability, an indication that students relied heavily on the available learning resources, learning activities provided in the VLE site. Yet, the overall evaluation of the VLE course content is highly acceptable and the positive usability outcome and its support for student-centered learning addressed the issue. The involvement of IT experts and education specialists set the relationship between the development of the VLE systems and the development of the VLE course content.

Limited instructional materials used for online learning correlates with instructors' lack of online skills and experience. Thus to address the issue on instructors and trainers' skills, it is recommended to conduct evaluation on instructors' knowledge in terms of technology, pedagogy and content domains, to conduct training and provide users' manual for reference.

The result of instructors' evaluation in terms of the technological, pedagogical and content knowledge level shows that instructors were highly capable of using the VLE as a teaching tool. The instructors and IT administrator's training, complemented with the user's manual for reference, allowed them to confidently use and manage the VLE.

Table 1. The e-Learning Sustainability Issues/Problems and Recommended Solutions for ISU-Echague

e-Learning Sustainability Issues/problems	Present status of the University	Recommended Solutions
1. Sustainability issues on learning platforms and learning software *Hardware and Learning Software Issues:* a. Issue related to availability of hardware and Internet connection b. Set-up and management of ICT infrastructures c. Learning software available for	• There are available computer hardware and ICT infrastructures and Internet connection. • In 2010, the University acquired ICT infrastructures. However, focus is on interconnectivity of the ISU system (9 campuses); acquisition of instructional programs is still being planned. • There is minimal learning software	• Determine existing hardware facilities, number of computers, computer laboratories, computer specifications, Internet line and bandwidth and other facilities used for teaching. • Identify computer servers, server specifications, different hardware and software infrastructure, budget/cost, and projects related to automation in the University. • To facilitate the pilot implementation of the VLE, initially, web hosting services is recommended. • The use of LMS, particularly Moodle CMS in the development of

instruction purposes d. Expensive cost of licensing learning software	available for instructions • There is no licensed learning software used for instructions	instructional technology tools like the VLE is recommended. Moodle is free open source software. under the GNU Public License.
2. Sustainability issues on institutional responses to the use of virtual learning a. Aligning blended learning with institutional goals and priorities b. Resistance to organizational change c. Cost of VLE	• Traditional method of teaching is extensively used in the classroom. • Administrators, instructors, and students are resistant to organizational change • High cost of VLE system	• Seek approval through the Executive Director for the pilot implementation of the VLE adapting blended learning approach • Evaluate the overall usability of the VLE and determine students' preferences in learning • Evaluate the acceptability of the VLE course content • Evaluate how effective the VLE is in terms of students' performance • Conduct training to instructors and students in the use of the VLE • Prepare cost analysis to initially determine the development, implementation, and evaluation costs of the VLE.
3. Sustainability issues on VLE course content development a. Issue on how to make VLE course content more engaging b. Cost of multimedia learning materials	• There are no course materials developed yet that can be used for online learning • The University has no immediate plans of acquiring multimedia learning materials due to high costs	• Design and develop learning activities using Moodle's forum, wikis, online quiz, glossary and database activities • Conduct VLE course content evaluation • Conduct VLE Usability evaluation • Use of openly available web-based resources and website links • Develop smaller units of learning materials (IT 59 course modules)
4. Sustainability issues on pedagogic approaches a. Issue on effective online pedagogy	• Instructions were based on the Bloom's taxonomy cognitive domain	• Conduct analysis and review of the course content to design multiple pedagogical approaches to learning • Involve IT experts and content specialists • Design and develop learning activities that support collaborative learning, group work and peer interactions • Use of multimedia methodologies such as learning tutorials, simulations, links to other websites, and online tests.
5. Sustainability issues on instructors and trainers' skills a. Lack of skills and experience of instructors related to virtual learning	• Since there were limited instructional materials used for online learning this correlates with instructors lacking skills and experience related to virtual learning.	• Conduct evaluation on instructors' technological, pedagogical and content knowledge level. • Conduct training to instructors and IT administrator who will manage and deploy the VLE system • Provide users' manual for reference.

3.2 Students' Perceived Readiness to Engage in Virtual Learning

An evaluation was administered to the experimental group before the actual implementation of the VLE in the classroom to measure their readiness to engage in virtual learning. The weighted mean for the 6 areas were as follows: Technology access (4.31), Online skills and relationships (4.35), Motivation (4.14), Online audio/video access (4.16), Online discussions (4.17) and Importance to students' success (4.47). The importance to students' success area has the highest weighted mean rating of 4.47 or equivalent to "Agree". This indicates that students perceived that the role of the instructors, quick technical and administrative support, frequent participation throughout the learning process, experiences with online technologies, and ability to immediately apply course materials were important for them to succeed with online coursework. With the same "Agree" description, motivation got a lower weighted mean rating of 4.14 but positively indicates that students remain motivated even if the instructor is not online at all times, and students would be able to complete work even when there are online and physical distractions. Overall, the grand mean was 4.30 or equivalent to "Agree". This revealed that students perceived that they are satisfactorily ready to engage in virtual learning. Similar results were found in the literature in support of the current findings [17]-[18]. In addition, students are well-versed in e-learning due to their Internet exposure, in terms of accessibility, students are well-equipped, and consistently exposed to e-learning environment [19].

3.3 Instructors' Perceived Knowledge in terms of Technology, Pedagogy and Content Knowledge (TPACK)

In order to evaluate the instructors' knowledge level in terms of technological, pedagogical, and content domain areas, instructors were asked to answer survey questionnaires. The weighted mean for the seven areas were as follows: technology knowledge (4.90), pedagogy knowledge (4.78), content knowledge (4.67), technological pedagogical knowledge (4.88), pedagogical content knowledge (4.72), technological content

knowledge (4.87), and technological, pedagogical, and content knowledge (4.79). All areas were rated "strongly agree". Overall, a grand mean rating of 4.81 or equivalent to "Strongly agree" indicates that instructors' perceived knowledge in terms of technology, pedagogy, and content domain areas were very satisfactory. The technology knowledge was rated the highest (4.90) which revealed that instructors were highly immersed in knowledge of technology for information processing, communications and problem solving, and focuses on the productive applications of technology in work. Similar results were found in the literature in support of the current findings [20]-[23]. With the same description as "Strongly agree", the least rated area with a weighted mean of 4.67 is the content knowledge area. Hence, the focus is on the improvement in this area is important which correlates with the findings of who which stated that regardless of the amount of technology and its sophistication, technology will not be used unless instructors have the skills, content knowledge and attitudes necessary to infuse into the curriculum [24].

3.4 Development of the VLE System and VLE Course Content

The VLE for ISU was conceptualized based on the developed VLE Approach Model which is patterned after the ADDIE instructional system design model [11]. The VLE approach model provided ways for analyzing the needs for instructions, students' e-readiness and instructors' technological, pedagogical, and content knowledge and reinforces the use of this information for the design and development of the VLE. The implementation of the VLE was participated by instructors and students. The evaluation phase was essential to the delivery of the VLE to respondents and ensured that the needs of users are met. Local researches, for instance [25] designed and developed an e-learning tool and used the ADDIE model as the framework. Furthermore, the ADDIE model has been widely used as a step-by-step procedural blueprint for the whole process in course material production [11],[26].

Moodle was used as the development tool. The researcher developed the VLE site taking into consideration the different components, general characteristics, features, and functionalities of Moodle version 2.1.2+ which is available at moodle.org site [27]. A research finding where Moodle is most used as a Learning Management System (LMS) was also instrumental [1].

The development of the VLE (both the system and the course content) is an answer to the call of the government to promote e-learning as an innovative tool through creation of e-learning environment and the development of instructional materials [6]. Also, the findings NCC on SUCs e-learning status [8] and as found out by the researcher that only 14.29% of them having e-learning portal clearly indicates that many SUCs, ISU included, greatly lack facilities for VLEs.

The works and findings of the different authors also serve as basis in developing the VLE system and the VLE course content. For instance, the guidelines and suggestions on features of web-based learning environment [16]; The resources that can be used to enhance web-based learning as a medium for teaching and learning [28]; The different interactive multimedia methodologies facilitating constructivist approaches to learning [29]; The concept on instructional content on which the VLE course content definition was formulated [30]; and Guidelines in developing e-learning [31].

3.5 Acceptability of the VLE Course Content

In the evaluation of the VLE course content, the scores of the 5 SMEs ranged from 109 points to 120 points (*Figure 3*). Overall, the weighted mean score for VLE course content evaluation was 115.8 points or equivalent to "Excellent VLE course". In brief, this means that the VLE course for IT59 is very acceptable for use as an online course material.

This is confirmed further by the SMEs' open feedbacks. For instance, (1) the course content displays interesting, challenging, and creative way of learning for the students; (2) the course contains variety of assessment and learning activities assessing the 6-domain areas of learning; (3) the course objectives display the essence of "SMART" criteria integrating variety of media

resources encouraging students to be interested in learning the course; (4) there are variations of learning resource from text files to video presentations; (5) the navigation is user-friendly; and (6) the graphics simplicity encourages more interest in the topics.

However, SMEs suggested improvements to be made on the following: (1) security measures during conduct of assessment. For instance, students should not be allowed to close the assessment window page while assessment is on-going. Warning messages should pop-up when the student attempts to close the window; and (2) more real-world issues related to the subject matter should be incorporated.

Similar results were found in the literature in support of the current findings [32]-[33]. In addition, basic reason for course evaluation is to find out the effectiveness, efficiency or acceptability of the course to provide quality course materials [34].

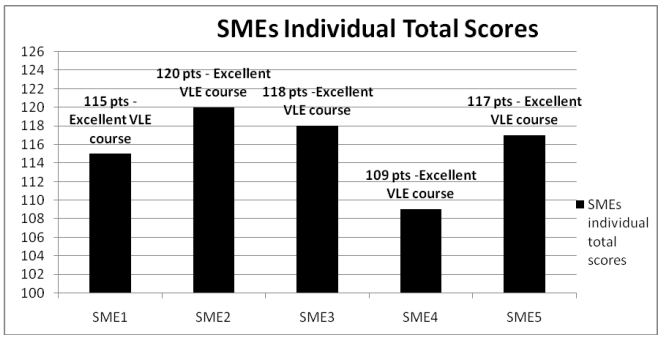

Figure 3. SMEs individual total scores

3.6 Usability evaluation of the VLE

The VLE usability evaluation questionnaire was administered to the experimental group at the end of the course implementation. The weighted mean scores for the four categories to measure the usability of the VLE were as follows: General interface design (4.38), VLE-site specific design (4.46), Student-centered instructional design (4.51), and Overall usability of the VLE site (4.42). Overall, the grand mean score was 4.44 or equivalent to "Agree" which revealed that usability of the VLE is satisfactorily complied. Also, 95% of students preferred to use both classroom and VLE site for learning, compared with 3% who would prefer the VLE site only and 2% who prefer classroom instruction only.

In general, the statistics in the previous paragraphs shows that students were positive regarding the usability of the site and its support to learning. This is confirmed further by some of their open-ended comments, for instance: "*I am attracted with the graphics, text and the GUI of the site*."; "*A pop-up dialog box informs me before and after taking an exam/quiz*.", and "*Regarding feedback to my activities, I feel worth when I read the appreciation of our professor in my activities*."

However, open-ended comments and feedback that should be addressed include: "*Some of the terms defined are somewhat confusing leading to the misunderstanding of the concept/topic*.", "*I am in control of my own learning but I get lazy because it is online*.", and "*There are some parts of images in the VLE systems which do not easily load due to the size of the image*."

The evidence from this study and others [35]-[36] indicate that perceived ease of use, along with perceived usefulness, teaching materials, design of learning content were identified as factors related to usability of the VLE site. However, instructor characteristics and teaching materials were the strongest predictors of usefulness in using VLE.

3.7 Effectiveness of the VLE on students' performance

The t-test was used to determine the pretest, posttest and gain scores test results. Table 2 shows the results. The findings from the pretest administered to both control and experimental groups showed that there is no difference between the pretest scores of the control and experimental group (t =1.50, df=118, P=0.14). Hence, pretest scores of the students under the two treatment groups are at a comparable level. As to the posttest scores, it was noted that the mean score of the experimental group (30.43) is significantly higher than the control group (23.94) (t= -4.95, df=118, p=0.00).

The test of the gain scores (posttest-pretest) revealed a significant variation between the two treatment groups (t= -6.53, df=118, p=0.00). The gain score of the experimental group $\bar{X} = 11.68$ is significantly higher than the gain scores from the control group $\bar{X} = 5.75$ which implies that the use of VLE is a significant factor in increasing the

performance of the students in learning IT59 course. This findings support similar results by [37]-[38].

Table 2. Analysis of Pretest, Posttest, and Gain Scores of the two Treatment Groups

Test	Group Mean Scores		Mean Difference	t-value	df	Prob.
	Control	Experimental				
Pre-Test	24.68	23.20	1.48	1.50[ns]	118	0.14
Posttest	23.94	30.43	-4.45	-4.95*	118	0.00
Gain Score	5.75	11.68	-5.93	-6.53*	118	0.00

*Significant [ns]Not Significant

IV. CONCLUSION

Based from the findings of the study, the following conclusions were drawn: This study examined the current status of the University in terms of e-learning sustainability through the 5 sustainability issues and initially found the implementation of the VLE in Isabela State University-Echague Campus sustainable.

The evaluation results on students' virtual learning readiness revealed that the overall mean score was 4.30 or descriptively equivalent to "Agree", which means that the students were ready to engage in virtual learning.

The evaluation results on instructors' knowledge in terms of technology, pedagogy and content domain areas shows that the overall mean score was 4.81 descriptively equivalent to "Strongly agree", showing that the instructors have high level of knowledge in the three domain areas and that they were ready to use the VLE as a teaching tool.

The use of Moodle as a development tool and the adaption of the ADDIE model systematically produce the deliverables of this study – the VLE system and the VLE course content.

The results on the evaluation of the VLE course content with a total weighted mean score of 115.8 points or descriptively equivalent to "Excellent VLE course" revealed that the VLE course in IT59 is excellent VLE course and is very acceptable to be used as online course material in teaching IT59.

The results from the usability evaluation of the VLE revealed that the overall weighted mean was 4.45 or descriptively equivalent to "Agree". This shows that the students were positive regarding the usability of the VLE and its support to student-centered learning.

The gain score of the experimental group is significantly higher than the gain scores from the control group which implies that the use of VLE is a significant factor in increasing the performance of the students.

Overall, it is clear that assessing the current status of the ISU using the 5 e-learning sustainability issues serves as a concrete foundation on the creation of a plan and solution in the adoption of a sustainable VLE for ISU. The assessment of students' e-readiness, the instructors' perceived knowledge in using the VLE as a teaching tool, the VLE course content acceptability as a course material, the usability of the VLE, and its effectiveness to students' performance, the development of the VLE system and VLE course content contributed to the successful implementation of the VLE.

V. RECOMMENDATION

The proposed VLE for ISU will strengthen the instructional thrust of the University; the researcher therefore highly recommends the adoption of the Virtual Learning Environment for Isabela State University in teaching ICT courses. In addition, gradual implementation of the VLE to other ISU campuses is proposed.

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