

Development and Usability Evaluation of Proposed E-Learning Platform for Teaching ICT Courses in Isabela State University



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ABSTRACT

A proposed e-learning platform in delivering and teaching courses was conceptualized based on the developed instructional approach model which was patterned from the ADDIE Model. In spite of problems related to ICT hardware and software, limited instructional materials, resistance to organizational change, issues on how to make course content more engaging, and issues on effective learning pedagogy, the result of the study revealed that the e-learning platform satisfactorily complied with the usability issues and students were satisfied in using the platform as support to learning. Also, the test of the gain score (posttest-pretest) indicates a significant difference between the two treatment groups which reveals that increasing the academic performance of the students through the e-learning is an important factor. Furthermore, the proposed e-Learning platform is a timely contribution to improve and support the academic practices of both teaching and learning practices at the University.

Key words: ADDIE model, blended learning, e-learning, MOODLE, sustainability issues, usability

1. INTRODUCTION

In the delivery of many higher education courses, e-learning platforms are becoming an essential component and instrumental in supporting and facilitating teaching and learning practices. Appropriate e-learning principles according to [1] are related to general information, course information, schedule/calendar of activities, course materials, multimedia presentation of contents, the virtual classroom like discussion, a forum, chat rooms and email, assessments, and online drill or practice tests.

However, there were issues and challenges facing the adoption and maintaining the sustainability of e-learning particularly in the public education sector [2], [3]. For instance, the challenges of using and propagating online learning in the Philippines include expensive internet infrastructures, inadequate technical capabilities of teachers, and management support [4].

This study supports the government's mandate to provide an e-learning environment at all educational levels. It also helps

strengthen the instructional thrust of the University by providing an e-learning tool to its academic courses offered. Moreover, the proposed e-learning platform is a timely contribution to support the academic practices in the University by introducing an effective technological and pedagogical learning environment.

This study focuses on major areas such as (1) assessment of the University's e-learning sustainability, (2) development of e-learning platform, (3) e-learning platform usability evaluation, and (4) evaluation of how effective the e-learning in terms of students' academic performance.

1.1 e-Learning thrusts in the Philippines

The direction in developing a knowledge-based society is to promote e-learning as an state-of-the-art tool, set priorities, and provide necessary support.

For instance, the Information Technology and E-commerce Council promotes e-learning through development and collaborations of programs and instructional materials in all educational levels [5]. On the other hand, the Open Learning and Distance Education Act of 2011 was enacted to expand access to quality education through open and distance learning to Universities and schools which have existing open and distance education program [6]. Moreover, the Commission on Higher Education (CHED) on Distance Education helps ensure the quality of education through e-learning by requiring institutions to come-up with well-written course package.

1.2 e-Learning in higher education institutions and other agencies in the Philippines

In the Philippine education sector, e-learning has been gaining ground. Top university like the University of the Philippines Open University hastened the development of open learning and distance education offering online courses via customized virtual learning environment.

Also, the Technical Education and Skills Development Authority (TESDA) has introduced a new learning methodology and environment system where teachers are facilitators of learning. This application combined the self-learning approach and formal classroom instruction.

The network of free and open educational resources called “e-Turo” of the Department of Education (DepED) focusing on basic education like Filipino, English, Science, Mathematics, and Social Studies was developed as an online repository. The University of Sto. Tomas e-Learning Access Program (e-LeAP) provides learning materials online. Other major universities and colleges offer some form of online courses.

However, when HEIs implement e-learning, some factors related to technology, potential users, course contents, and a local context of use come into play. Technological factors like bandwidth, hardware reliability, network security, and accessibility are taken for granted. In developing course content, factors related to content, pedagogy, and technology are issues to be addressed. Institutional readiness and support must also be in place.

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

The e-learning implementation among State Universities and Colleges (SUCs) is 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 Five Stages of e-Government UN-ASP, 32 SUCs or 35.96% are in Stage 3, with interactive web presence, 52 or 58.43% are in Stage 1, with enhanced web presence, and 5 or 5.62% are in Stage 1, with emerging web presence [7].

The researcher accessed the different SUC websites and found out that only **16 or 14.29%** have e-learning portals in the year 2013. It should be noted that the Isabela State University does not have an e-learning portal.

The Isabela State University is strategically located in the middle of the Cagayan Valley Region, with its nine (9) campuses 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 [8]. However, poor implementation and monitoring stunted the effort.

1.4 Blended learning (BL)

Blended learning is introduced to maximize the benefits of both face-to-face and online methods. According to [9], blended learning method effectively combines different modes of teaching, delivery, and styles of learning to organize the learning environment.

1.5 Objectives

This study aims to develop and evaluate the proposed e-learning platform used in teaching ICT courses at Isabela

State University. Specifically, (1) determine the status of the University’s e-learning sustainability; (2) design and develop an ISU e-learning platform; (3) evaluate usability of the e-learning platform, and (4) determine relationship of students’ performance before and after using the e-learning platform in learning IT59 course.

1.6 The conceptual framework of the Study

The e-Learning Approach Model is illustrated in *Figure 1*. The five e-learning sustainability issues [10] were considered to measure the current e-learning status of the University and determine the problems that need to be addressed in the adoption of the e-Learning platform. The **e-Learning Approach Model** consists of four phases, the analysis and pre-evaluation phase; development phase; implementation phase; and evaluation phase.

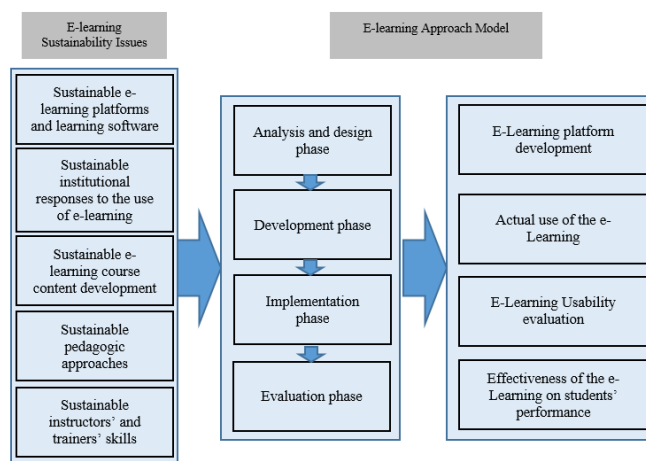


Figure 1: e-Learning approach model

The analysis and design phase involved the process of defining, analyzing, and designing the work scenario and the requirements for the course/module to be built. *The development phase* involved the e-learning platform and e-course contents design and development. The prototyping model serves in the development of the prototype, where the Moodle Content Management System (CMS) was utilized in the customization and management of the portal, course, and content. *The implementation phase* is the actual use of the e-learning in ISU, the course instructor and the participating students of the experimental treatment while the *evaluation phase* covers the usability. Moreover, the comparison between the pretest and post-test scores of the students in the experimental treatment is measured to determine the effectiveness of the e-learning implementation.

2. METHODOLOGY AND PROCEDURES

2.1 Research design

The study was conceptualized based on the developed e-learning approach model patterned from the Instructional Design ADDIE model [11]. The evaluation was 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 pretest-posttest design was used to gather data related to the effectiveness of the e-learning on students' performance.

2.2 Respondents of the study

The Isabela State University Echague campus was selected to pilot the implementation of the study. There were one hundred twenty participants involved. The participants were third-year Bachelor of Science in Information Technology (BSIT) students enrolled in multimedia courses for the second semester, the school year 2017-2018.

2.3 Assessing the e-Learning sustainability of the University

The University's e-learning sustainability issues related to sustainable learning platforms and learning software; sustainable institutional responses to the use of e-learning; sustainable e-learning content development; sustainable pedagogical approaches; and sustainable instructors' and trainers' skills [10] were assessed and solutions and recommendations were determined. A University e-Learning sustainability assessment document checklist and an interview guide were developed serving as instruments. Documents and records from Management Information System office were retrieved and reviewed and interviews were also conducted to support the review of documents.

2.4 Development of the ISU e-Learning platform

A project management plan was created where a project team was organized to write the needed documents. It contains the project overview, setting, managerial process plans, and technical process plans.

The 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-related elements, pedagogical approaches, and technological elements of the e-course. **Course design** development combines the contents, multimedia elements, and learning activities to attain a specific objective. Also, an e-learning course content design document was developed which provides details on how to build the course. Specifically, the document contains the course contents, general objectives, module objectives, and learning outcomes, the overall learning approach, instructional media choices, instructional delivery method, description of course activities and assessment, activities, and implementation policies, guidelines, procedures, and rubrics were formulated to set standards for the course. The different content, pedagogical, and technological elements are enumerated in Table 1.

Table 1: Content, pedagogical, and technological elements in the analysis and design of the e-course

Content	Pedagogical	Technological
- course module	- learning theories	- web
- topic and sub-topics	- instructional design	- internet services
- learning resources	- teaching methodologies	- multimedia
- activities	- learning strategies	
- assignment	- assessment methods	
- assessment		

The information from the analysis and design phase were used as inputs in the development using the Moodle CMS. In the customization and management of the e-learning platform, the activities involved were [13]:

- **Managing the e-learning platform.** It involves authentication, managing accounts, enrollment, roles, security, performance, backup, and site appearance.
- **Managing the e-learning courses.** It involves managing courses, editing text, activities, resources, blocks, questions, course enrolment, grouping users, tracking progress, and reusing activities.
- **Managing the e- contents.** It involves working with files and folders, editing text, and working with media.

Additionally, the course resources were both developed and adopted from free resources online. The learning and assessment activities like assignment, quiz, glossary, database activity, forum, and wikis were created.

In the implementation phase, the following activities were conducted: putting in place the hardware and software needed, checking network connections, verifying laboratory rooms' free time slots, consolidating students' free time during the week, and web hosting service was availed. In addition, orientation and training for participants were conducted and user manuals were also provided for reference purposes.

2.5 Usability evaluation of the e-Learning platform

At the end of the course implementation, usability evaluation was administered to 60 students in the experimental group. A questionnaire was used to evaluate the general interface design, e-learning portal specific design, student-centered instructional design, and the overall usability of the portal adopted from the work of [12].

2.6 Analysis of the pretest and post-test results between the two groups

In the preparation of the pretest-posttest questionnaire, using content validity, there were 80 multiple choice questions constructed validated by two subject specialists where 45 questions were left for the final questionnaire. In testing the

reliability, 30 students were tapped to pilot test the questionnaire. Using the Kuder Richardson’s KR-20, the final result of 0.77 coefficient reliability revealed that the instrument was “good” for classroom test

During the experiment, 120 students enrolled in IT59 course for the Second Semester, School Year 2017-2018 were involved. 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 a blended learning approach. Some teaching techniques, evaluation methods, media, and delivery modes were adjusted to conform to the activities in the e-learning environment. The class schedule (time and day) was modified. In their five-hour/week meeting three (3) hours were still allotted for their face-to-face meeting while access to the e-learning site can be made anywhere (school, home, internet cafes) any time of the day. Before the experiment, the students were oriented in using e-learning. Both groups were pre-tested before the start of the course and post-tested after completion of course. Test scores were analyzed to determine the level of performance before and after the treatment. Moreover, the control and the experimental groups were given the treatment over a period of six weeks covering the preliminary period of the current term.

2.7 Data gathering

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

2.8 Data analysis

The usability of the e-learning platform was described using weighted means while the percent frequency was used to describe responses of students in the open-ended questions. Kuder Richardson Coefficient of reliability (KR-20) technique was used to measure the reliability of the pretest-posttest questionnaire in the IT59 course.

3. RESULTS AND DISCUSSION

3.1 Assessment of University’s e-learning sustainability

A matrix of the issues/problems and recommended solutions to determine and address the current e-learning status of the University was designed.

3.1.1 Sustainability issues on e-learning platforms and educational software

Table 2: Sustainability issues on e-learning platforms and educational software

e-Learning Sustainability Issues/problems	Present status of the University	Recommended Solutions
a. Hardware and Internet connection	There are limited computers, ICT infrastructures, and Internet connection	<ul style="list-style-type: none"> Determine existing hardware facilities, computers, laboratories, internet line, and bandwidth and other facilities used for teaching
b. Set-up and management of ICT infrastructures	In 2010, the University acquired ICT infrastructures intended for interconnectivity	<ul style="list-style-type: none"> Identify computer servers, specifications, different hardware and software, budget/cost, and projects related to automation in the University
c. Educational software available for instruction	There is minimal educational software available for instructions	<ul style="list-style-type: none"> To facilitate the pilot implementation of the e-learning. Web hosting services are recommended
d. Cost of licensing learning software is expensive	There is no licensed learning software used for instructions	<ul style="list-style-type: none"> Development of e-learning using Moodle CMS.

In Table 2, analysis indicates that the University is not technologically ready to sustain e-learning. The current focus is to set-up centralized interconnectivity of the ISU system while the acquisition of instructional programs is still being planned. It was also found that there is minimal educational 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 e-learning and to use FOSS CMS, in particular, Moodle to produce educational software.

3.1.2. Sustainability issues on University responses to the use of e-learning

Table 3: Sustainability issues on the institutional responses to the use of e-learning

e-Learning Sustainability Issues/problems	Present status of the University	Recommended Solutions
a. Aligning blended learning with University goals and priorities	A traditional method of teaching is extensively used in the classroom	<ul style="list-style-type: none"> Seek approval from the management for the pilot implementation of the e-learning adopting blended learning approach

b. Resistance to organizational change	Administrators, instructors, and students are resistant to organizational change	<ul style="list-style-type: none"> ▪ Evaluate overall usability of the e-learning and determine students' preference in learning ▪ Evaluate the effectiveness the e-learning is in terms of students' performance ▪ Conduct training to participants in the use of the e-learning
c. Cost of e-learning	The high cost of the e-learning platform	<ul style="list-style-type: none"> ▪ Prepare cost analysis to initially determine the development costs of the e-learning

In Table 3, analysis shows that the traditional method of teaching is extensively used in the classroom; the instructors, students, and administrators' resistance to organizational change is high; and the high cost of e-learning platforms were the problems encountered. To address the issues, the following were recommended: seek approval from the management to conduct the pilot implementation adopting blended learning approach, evaluate the overall usability of the e-learning, evaluate how effective the e-learning in terms of students' performance, conduct training to students and instructors, and prepare cost analysis to initially determine the implementation cost of the e-learning.

3.1.3. Sustainability issues on e-learning content development

Table 4: Sustainability issues on e-learning content development

e-Learning Sustainability Issues/problems	Present status of the University	Recommended Solutions
a. The issue on how to make course content more engaging	There are no course materials used for online learning	<ul style="list-style-type: none"> ▪ Design and develop learning activities using the Moodle ▪ Conduct usability evaluation
b. Cost of multimedia learning materials	The University has no immediate plans of acquiring multimedia learning materials due to high costs	<ul style="list-style-type: none"> ▪ Use of open web-based resources and website links ▪ Develop smaller units of learning materials/modules

Table 4 shows the sustainability issues related to content development. At present, the University has no available course materials for online and no plan yet of investing multimedia learning materials due to high cost. The use of Moodle learning activities, the use of open web-based resources, and the development of smaller units of learning materials was recommended.

3.1.4. Sustainability issues on pedagogic approaches

Table 5: Sustainability issues on pedagogic approaches

e-Learning Sustainability Issues/problems	Present status of the University	Recommended Solutions
a. An issue on effective online pedagogy	Instructions were based on Bloom's taxonomy cognitive domain	<ul style="list-style-type: none"> ▪ Conduct analysis and review on the content to design multiple pedagogical approaches to learning ▪ Develop learning activities that support collaborative learning, group work, and peer interactions ▪ Use of methodologies such as learning tutorials, simulations, links to other websites, and online tests

Table 5 presents the sustainability issues on pedagogic approaches including issues on effective online learning. At present, instructions were based on Bloom's taxonomy of the cognitive domain. It is therefore recommended to conduct analysis and review of course content 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.

3.1.4. Sustainability issues on instructors and trainers' skills

Table 6: Sustainability issues on instructors and trainers' skills

e-Learning Sustainability Issues/problems	Present status of the University	Recommended Solutions
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 e-learning	<ul style="list-style-type: none"> ▪ Conduct training to instructors and staff who will manage and deploy the e-learning ▪ Users' manual for reference are provided

Table 6 presents issues related to instructors' skills where there are limited instructional materials used for online learning correlates with instructors' lack of online skills and experience. Thus, to address the issue of instructors' skills, it is recommended to conduct training, and provide users' manuals for reference.

3.2 Development of the proposed ISU e-learning platform

The e-learning platform was developed taking into consideration the different components, general characteristics, features, and functionalities of Moodle version 2.1.2+ which is available at moodle.org site [13]. A

research finding where Moodle is mostly used as a Learning Management System was also instrumental in the development of the e-learning platform for the Isabela State University [14].

The e-learning course was deployed containing learning resources, learning activities, and assessment tools to carry out foreseen activities. During the implementation, instructors and students were enrolled in the course. Students were required to access the site, access learning resources, work with different learning activities, take quizzes, interact, and collaborate with other students. At the same time, the instructor monitored the site, the students, learning activities, performance on the assessment, and provided technical and instructional support. Access to the e-learning site is done online, the URL is isuvle.com. Figure 2 shows the e-learning instructor's home page.

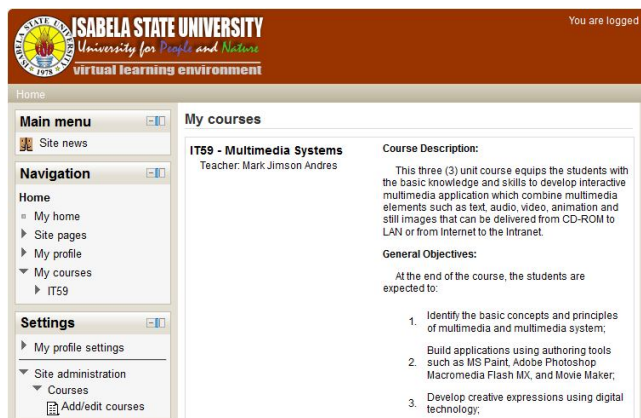


Figure 2: The e-learning instructor's home page.

The development of e-learning is an answer to the call of the government to promote e-learning as an innovative tool in the classroom [5]. Also, the findings of NCC on SUCs e-learning status that only 14.29% of them having portal clearly indicates that many SUCs, ISU is included, greatly lack facilities for e-learning [7].

The works and findings of the different authors also serve as bases in developing e-learning. For instance, [12] the guidelines and suggestions on features of a web-based learning environment. The resources that can be used to enhance web-based learning as a medium for teaching and learning [15]. The different multimedia methodologies facilitating constructivist approaches to learning [16]. The concept of instructional content in which the e-course content definition was formulated, [17] and guidelines in developing e-learning [18].

3.3 Usability evaluation of the proposed e-learning platform

At the end of the course implementation, the usability evaluation was administered to the experimental group. Table 7 presents the results of the evaluation.

Table 7: Usability evaluation of the e-learning portal

Criteria	Weighted Mean	Interpretation
General interface design	4.38	Strongly Agree
e-Learning portal specific design	4.46	Strongly agree
Instructional design that is student-centered	4.51	Strongly agree
Overall usability	4.42	Strongly agree
Grand Mean	4.44	Strongly agree

Overall, the grand mean was 4.44 or equivalent to “Strongly Agree” revealed that the usability of the e-learning satisfactorily complied.

The use of both classroom and e-learning was preferred by 95% of the students compared with three percent (3%) who preferred the e-learning only, and two percent (2%) who preferred classroom instruction only. In general, the result shows that students are interested and willing to use the e-learning portal as support to learning.

Further, some of their comments include: “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 worthy when I read the appreciation of our professor in my activities”. However, comments like: “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 images in the e-learning portal which do not easily load due to the size of the image” should be addressed to further improve the e-learning portal.

The evidences from this study and other authors [19], [20] indicate that factors related to usability had something to do with perceived ease of use, usefulness, e-contents as teaching materials, and design of e-contents. Moreover, instructors readiness to e-learning and well-developed e-course were the strongest predictors of usefulness in using e-learning.

3.4 Effectiveness of the e-learning on students' performance

The t-test was used to determine the pretest, posttest, and gain scores test results as shown in Table 8. The findings from the pretest administered to both control and experimental groups showed that there is no difference between the pretest scores of control and experimental group ($t = 1.50, df = 118, P = 0.14$). Hence, pretest scores of 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 e-learning is a significant factor in increasing the performance of the students in learning IT59 courses. These findings support similar results by authors [21], [22].

Table 8: 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

4. CONCLUSION

Based on 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 sustainability issues and initially found the implementation of the e-learning in Isabela State University-Echague Campus is sustainable. 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.

The use of Moodle as a development tool and the adoption of the ADDIE model systematically produce the deliverables, the **e-learning platform**, and the **course contents**. The results from the usability evaluation revealed the students were positive regarding the usability of e-learning and its support to student-centered learning. The gain score of the experimental group is significantly higher than gain scores from the control group which implies that the use of e-learning is a significant factor in increasing the performance of the students in learning IT59 courses.

Overall, it is clear that assessing the current status of the ISU using the 5 e-learning sustainability issues serves as a concrete foundation in the creation of a plan and solutions in the adoption of a sustainable e-learning for ISU, the usability of the e-learning platform, and its effectiveness to students' performance, the development of the e-learning platform and course contents contributed to the successful implementation of the e-learning to ISU.

5. RECOMMENDATION

The proposed e-learning for ISU strengthens the instructional thrust of the University. The researcher therefore highly recommends the adoption of the e-learning for Isabela State University in teaching ICT courses. In addition, gradual implementation of the e-learning to other ISU campuses is highly proposed.

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