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Object Oriented Analysis and Design of e-Learning System

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Abstract: e-Learning is becoming a major component in academia today. There is a need for formalized guidelines in e-Learning that instruct the designer (course instructor) on how to design, maintain and manage a course. There are so many e-Learning systems available in the market. Content available for learning on the web is variable: some of it is excellent, much is mediocre. The content developers, educators and students needs can't be addressed and their will be a gaps. To bridge the gap an e-Learning system was developed to build fragmented lesson plans of full courses based on the syllabus of our University. The goal of this study is to discuss the overview of the learning object approach to create learning content using oriented analysis and design method and the evaluation results. It covers the performance and evaluation details of usability, designing the evaluation, the objectives and respondents, the study, the questionnaires questions asked and basic assumptions the execution of the evaluation, its results and conclusions.

Key words: Reusable learning objects, e-Learning, framework, object oriented analysis and design, design evaluation, statistics

INTRODUCTION

Strong support for a learner-centered e-Learning environment is essential in higher education where learning involves knowledge and skills acquisition. It is in this sector that e-Learning is believed to have considerable potential in the near future (Iahad and Dafoulas, 2004). As noted in CIPD (2002), one can argue that training is more effective when the e-Learning materials are specific to their own organization, rather than using generic or off_the_shelf materials. e-Learning is fundamentally an effective form of learning. Computing technologies can expand the reach and range of traditional residential colleges, universities and organizational training programs. They enable learners to synthesize traditional learning with online experiences. Initially, the shift from instructor-centered to learner-centered e-Learning was the immediate effect of the radical increase in student numbers and the struggle to find a sufficient number of experienced instructors with suitable skills. The instructor inevitably became a facilitator of the overall learning process (Lin and Hsieh, 2001). The aim is to create an International standard e-Learning system for our University based on standards. This study discusses the initial evaluation of the e-Learning System in Our University SCSVMV. The e-Learning Model in SCSVMV (Web Interactive Student e-Learning Model Fig. 1). The e-Learning system includes, OOPS-eLearn interactive e-Learning course, online assignments, e-Quizzes and multi-choice question and answer section indicates that the system a significant improvement to student learning. The development of a framework that supports pedagogical diversity and innovation, while promoting the exchange and interoperability of e-Learning materials, is one of the key challenges in the e-Learning industry today (IMS, 2003). There are widely adopted standards that allow learning objects to be described, assembled, delivered and tracked in a standardized way, regardless of their shape, size, or intended purpose. A draft specification for Learning Object Metadata (LOM) has been developed by a diverse group who working together on the IEEE Learning Technology Standards Committee (LTSC, 2002).

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Fig 1: Welcome screen of OOPS e-Learn course

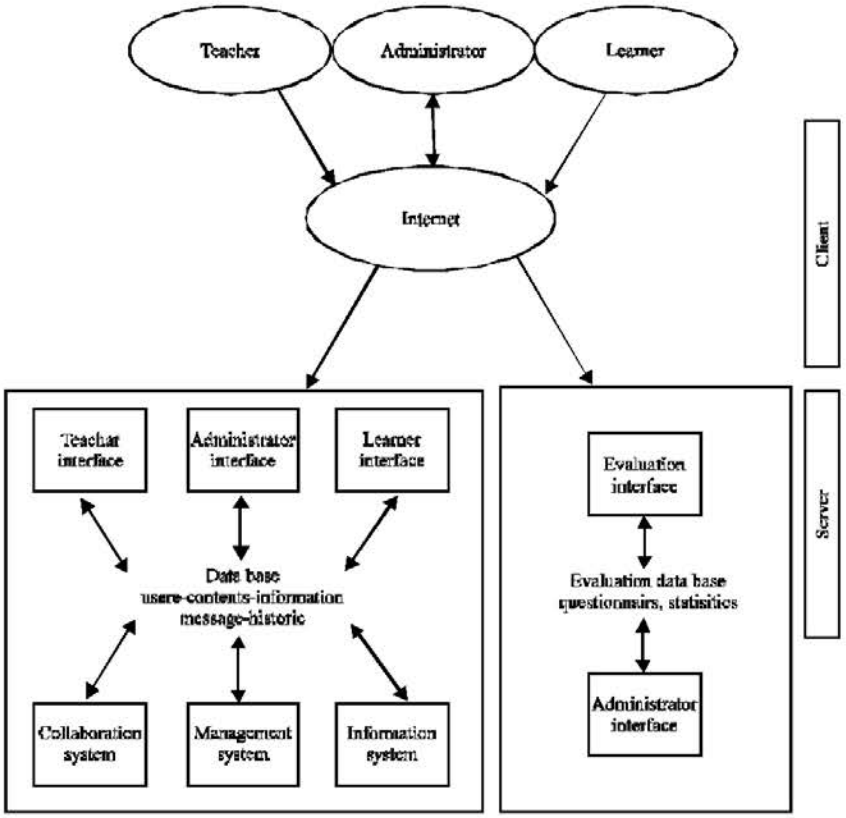

Fig. 2: OOPS e-Learning architecture and evaluation system

Learning architecture and Learning Technology Standards Committee (LTSC): LALO 101: the acronym for learning architectures and learning objects, LALO is a Computer Education Management Association (CEdMA) Task Force that was formed back in 1995. The VISION of the LALO task force is to enable new and existing learning content to be created as independent Learning Objects, such that they can be assembled in any combinations to meet an individual's learning needs, resulting in increased personal productivity. Our e-Learning System is based on IEEE P1484.1 Architecture and Reference Model Working Group and IEEE P1484.10 CBT Interchange Language Working Group and we tried to implement some of the Scope and purposes of it and the IMS Learning Design Best Practice are used. Perhaps the best way to summarize the key points of LALO is to have standards that will maximize the following bilities: interoperability, accessibility, reusability, discoverability, extensibility, affordability and manageability (Fig. 2).

Need for e-Learning system in SCSVMV: There are so many e-Learning systems available in the Market. Content available for learning on the web is variable: some of it is excellent, much is mediocre. The content developers, educators and students needs can not be addressed and there will be gaps. An e-Learning system was developed to find ways to build fragmented lesson plans of full courses based on the syllabus and it assure the quality of learning in this new environment. To create new and existing learning content to be created as independent learning objects, such that they can be assembled and disassembled in any combinations to meet an individual's learning needs. The real work and time required for the preparation of e-Learning system for our organization the specific strategy and implementation plan was developed. Deciding things such as which metadata elements to use, the content hierarchy for learning objects, articulating the appropriate sequencing for learning interactions and instructional design are completed and incorporated within the plans of our organization.

SCSVMV e-Learning system: turning the campus into a computer lab: As software systems become ever larger, the importance of re-use has grown. Object-orientated designs and languages offer good ways of encouraging software re-reuse. The design and development of education is an incremental process that systematically follows the stages of analysis, design, development, implementation and evaluation.

Our e-Learning model has an instructor initiate the learning process by identifying desired outcomes for a particular learner. By pre-assessing that individual's prior knowledge and understanding the student's strengths and special needs, the instructor is able to identify relevant activities and pull them together into an individualized unit of learning, which is then delivered to the learner (IMS, 2003). This use case addresses how a software system could automate parts of this process, bringing value to both instructors and learners.

Object-oriented analysis and design: In our e-Learning system the object oriented methodology is used for designing learning objects. Object-oriented analysis and design applies object-modeling techniques to analyze the requirements for a context- for example, a system, a set of system modules, an organization, or a business unit- and to design a solution. Most modern object-oriented analysis and design methodologies are use case driven across requirements, design, implementation, testing and deployment.

INSTRUCTIONAL SYSTEMS DESIGN

The most widely used methodology for developing new training programs is called Instructional Systems Design (ISD) (Fig. 3). It is also known as Instructional Systems Design and Development (ISDD), the Systems Approach to Training (SAT), or just Instructional Design (ID).

Why use a systems approach?: A system is any set of components that work together to achieve a specified outcome or goal. Think of the cruise control system on your car. You set the desired speed (or goal) and the cruise control sets the gas injection to the proper level. An important aspect of any system is the feedback mechanisms that ensure the goal is achieved or maintained. Using the cruise control analogy, the car does not just lock the gas pedal in one position. A systems approach with its requisite feedback makes cruise control a viable system to maintain driving speed, so, too, the systems approach provides the smoothest development means for training programs.

The ADDIE model and rapid prototyping phase: There are more than 100 different Instructional Systems Design (ISD) models, but almost all are based on the generic ADDIE model, which stands for Analysis, Design, Development, Implementation and Evaluation, as shown below. Each step has an outcome that feeds the subsequent step.

Analysis --> Design --> Development
--> Implementation --> Evaluation.

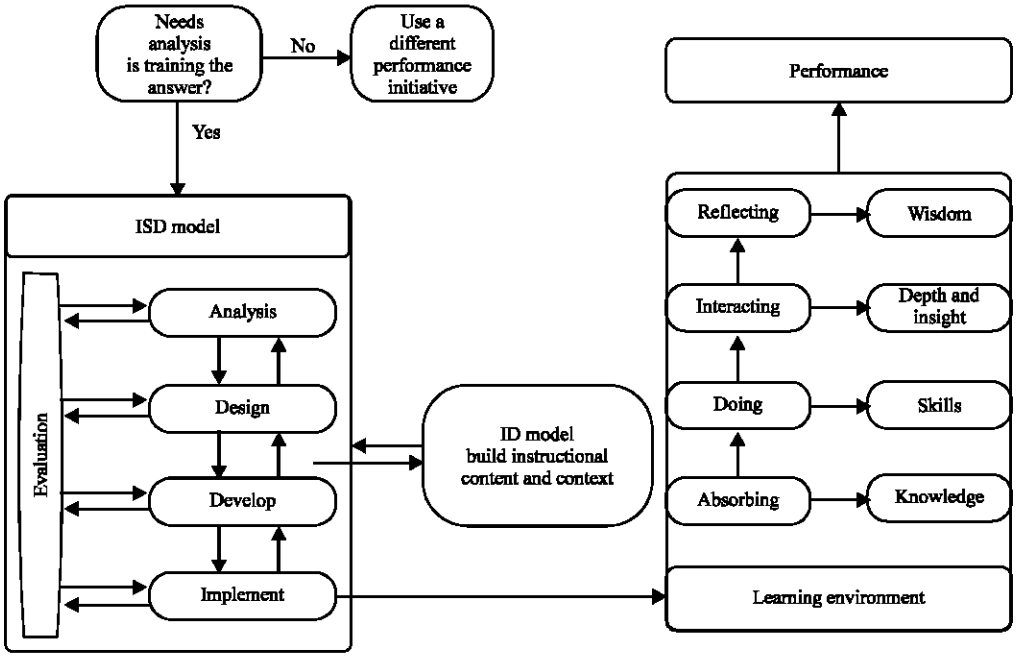

Fig. 3: Instructional system design concept map (Donald Clark, 2005)

For best results, so, we used a modified ADDIE model, which borrows from the most valuable aspects of the systemic approach. Specifically, a rapid prototype phase is inserted after, or as an extension of, the design phase. A rapid prototype is simply a quickly assembled module that can be tested with the student audience early in the ISD process.

The analysis phase of an e-Learning: The analysis phase simply we identified the gap between actual behaviors against desired outcomes and we obtained information about the learner, environment and technology that are relevant to closing the gap. It is used to uncover and document key items about learners, content and technology. Some of the tools that we used to gather analysis information include:

- Survey or questionnaire
- Direct observation
- Indirect observation
- Interviews
- Focus groups are some of the tools used in analysis phase.

Evaluate business and instructional goals: The first step in analysis is determining or clarifying the goals or desired outcomes. After understanding the business or instructional goal, further analysis is required of all the subordinate skills required to achieve the goal.

Analyze required tasks and behaviors: This is a critical step toward developing behavioral learning objectives and becomes the foundation for all of the content.

Assess learners: After understanding the desired goals and subordinate tasks, the target audience-students of SCSVMV are analyzed. Learner information impacts everything from appropriateness of metaphor to selection of content.

Conduct a technology assessment: Finally, We investigated the technology available to the students, The type of computers do they have? The kind of software is installed? The kind of network connection exists? The limitations will the information technology department put on the program?. Then the technologies that can be used are analyzed. Instructional designers consulted with the technical supervisors to gain an understanding of the limitations of the technology. Some common limitations include:

The design phase of e-Learning: In the design phase, the outcomes from analysis are used to create a blueprint for the instruction. This blueprint, called a design document or design report, covers the training need, instructional strategies, content and creative treatment. The document is used to communicate with all members of the development team and is invaluable for keeping the project on track and focused on the real training goals.

Determine learning objectives: The first step in the design phase is to examine the tasks or subordinate goals that were listed in analysis and from these create a set of behavioral learning objectives. Corresponding learning objectives, which are specific and testable, might be written as finishing the sentence: After completing this course students will be able to:

- List five product features and identify an associated benefit for each feature.

Content outline's developed: The outlines provides a lesson-by-lesson breakdown of topics, as well as a summary of any motivational strategies that will be employed.

Practice activities indicated: The design document includes brief descriptions of simple questioning (multiple choice, true/false, or fill-in), simulations, instructional games, on-the-job application exercises, or situational analysis activities.

Technology and media: The design document formally identifies the learners available technology, the organization's information technology department allows.

Determine user interface and creative treatment: The graphical user interface is the critical link between the student and content. The design document spells out the buttons and navigational features that will be available, what their labels or names will be and where on the screen they will be located.

The list below indicates commonly prescribed interface items:

- Next button, which advances to the next screen.
- Back button, which moves back to the previous screen.
- Menu button to jump directly to the Main Menu.
- Glossary to access an online glossary.
- Help to access context-sensitive information.
- Notepad for recording student notes.
- Bookmark to tag the existing screen for future quick access.

Final sign-off: Once all revisions are made, the e-Learning system was officially approved the design document as the blueprint for the entire program. This final acknowledgment step helps to communicate the importance of the design and the fact that changing the program at a later stage of development will be considered out of scope.

Creating rapid prototypes for e-Learning: In this phase of a project life cycle, an instructional software module is created for quick testing with a sample of the student audience. The rapid prototype creates an early iteration loop that provides valuable feedback on technical issues, creative treatment and effectiveness of instruction. The design document itself is changed to reflect this feedback and in some cases, a new prototype module is developed for subsequent testing of the refinements.

Value of a rapid prototype: With the addition of the rapid prototype phase, the value of the ADDIE model for technology-based training is greatly enhanced. The prototype overcomes the limitations of the traditional ADDIE approach in that it involves all team members earlier in the project cycle and enables both the Teacher and students to provide early feedback. This early review process is critical to software development and can catch actual errors, as well as identify Lecturer preferences. A detailed design document and prototype are the best insurance policies against last-minute alterations.

Create a vertical slice of the program: Some developers consider a prototype to be nothing more than a couple of screen designs that show the look and feel of the program. However, for reviewers to provide truly valuable feedback, the prototype must include a cross section of the entire program. This cross section is sometimes called a vertical slice. A vertical slice of the program typically includes the title screen, Main Menu, one complete lesson and sometimes a portion of the post-test. All features that will be available from within a lesson should be tested in the prototype phase. These often include glossary, notepad and bookmark. Make sure that all types of media, such as video or audio, are included to reveal any technical problems.

Evaluate the rapid prototype: Ideally, subject matter experts review the prototype because the reviewers must have a clear understanding of the learner population in terms of demographics, culture and level of technical expertise, to provide an accurate and useful evaluation. The main purpose of the review is not to evaluate the content or instructional design, but to evaluate the ease of navigation, the screen design and layout, appropriateness of metaphor and the technical performance.

Specific questions the designers should ask of the reviewers include:

- Did the program immediately capture your attention?
- Was the creative theme or metaphor engaging and appealing?

- Did program features such as the glossary, notepad and book-marking, perform flawlessly

Depending on the results of the prototype evaluation, adjustments may be made in the design document itself and incorporated into the script phase. If there is a lot of negative findings, it is common for the prototype itself to be re-created and evaluated for signs of improvement.

Creating scripts and storyboards for e-Learning: The development of scripts is the first step in the creation of programmer ready materials, called PRMs. The script or storyboard is simply a screen-by-screen description of what students will see, hear and do when running the program. Once the designer completes the script, it becomes the guidebook for all other team members: artists, audio/video producers and programmers.

- Project Information includes the name of the client, curriculum title, course title, date, draft or version number and script page number.
- Screen Label,
- Graphics,
- On-screen text section of the script describes which words will appear on the screen.
- Notes is the final section in a script that provides an area for any additional comments that do not fit easily into one of the above categories.

Force field analysis: At all stages the tenet of Force Field Analysis (Lewin, 1946) was used. Force Field Analysis (Fig. 4) is a method used to get a whole view of all the forces for or against some development. It helps to identify probable prioritized effective changes using the following steps:

- Describe Goals: Where do we want to be (Goals/Objectives)
- Describe position: Where are we now (Current Position)
- List all forces: two columns (for change | against change)
- Score each force: for likely effectiveness (1 weak to 5 strong)
- Draw Force Field Analysis diagram: show scaled forces for and against
- Analyse forces: in particular look for hidden agenda which will negate action
- Priorities change: list in practical change order

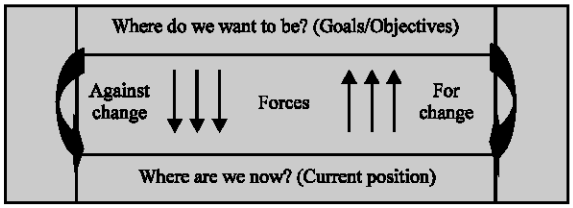

Fig. 4: Force field analysis

Once the prototype was sufficiently well developed to present to students, a definitive evaluation form was developed using Cognitive Walkthrough Evaluation. This provided the answers to: what methods should be used and why? What methods? = Personal Observation-Questionnaire-Interview are used.

Evaluation of e-Learning system: e-Learning effects on student learning in a class room lecture of Object Oriented Programming using C++ course were tested. Findings show on-line homework/quizzes significantly improve student exam scores. We infer proven small class techniques, participating in class and doing homework via technologies, can restore sound pedagogy in larger classes. In the first part, the Web part of OOPS_eLearn undergraduate course entitled Object oriented Programming Using C++ is described and the results of the assessment made by students are presented in Fig. 5.

The technology used and methodology: The technology used when producing the Web part of the OOPS_eLearn course was WebCT, Acrobat to produce the pdf and MS Word to produce the explanations. when a student registers to a web-based course, her or his personal account with password is automatically created within the WebCT managing facility depicted in. The WebCT platform also provides tools for the purposes of student evaluation: Student and page tracking provides detailed information on how and when the students are using the course, the assignment dropbox allows to have students submit the required files by a certain time and date and provides special instructions for the assignment.

A pilot study was undertaken for the entire academic year 2004-2005.

- WebCT was used in a blended way.
- Students were from the second year of the BE (CSE) in objected oriented programming using C++ communications
- Subjects taught were Programming and Theory and Lab. so this covered both practical and theoretical aspects of the curriculum.

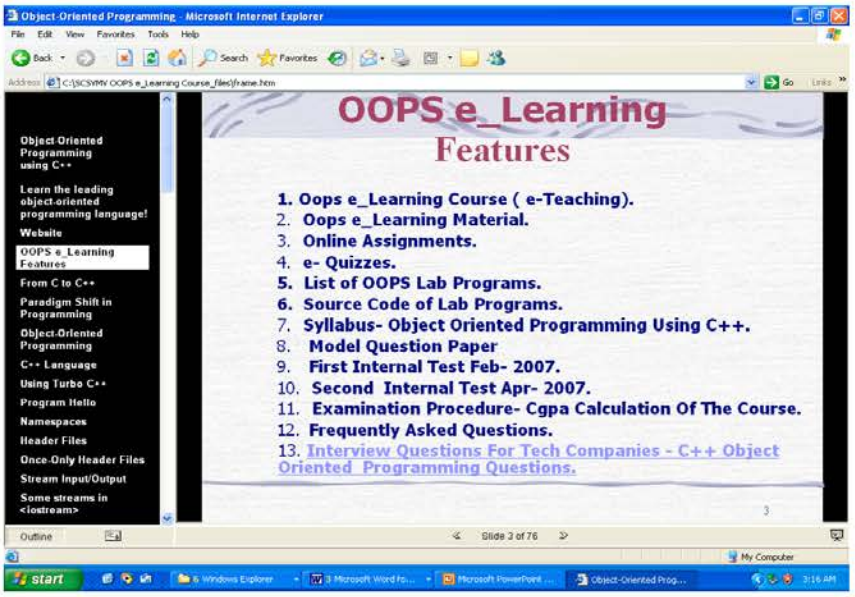

Fig. 5: Special features of OOPS e-learn course

- WebCT (Web Course Tools) is a suite of educational tools that allows an instructor/designer to create a web-based interactive learning environment.
- The learning environment includes:
  - Educational tools to facilitate learning, communication, collaboration and evaluation of learning.
  - Content tools for uploading, presenting, adding interaction, tracking page access.
  - Administrative tools for managing students and the course.
  - Design tools for constructing the course (colour schemes, page layout, etc.).
- WebCT can be used:
  - To create entire on-line courses, or
  - To enhance learning in classroom-based courses.
- The blended approach was used:
  - Marks for assignments are sent to each student individually-no one knows another student's marks so confidentiality is kept.

The prescriptions we had at the beginning of the process are: The prescriptions we had at the beginning of the process are (Anderson *et al*., 1993; Wright and Lickorish, 1994):

- The pictorial information must be presented clearly.
- The screen layout (screen elements-titles, text areas, navigation, buttons, etc.) must be easy to understand.
- The directions for using the courseware must be easy to understand for learners.
- The detailed lecture notes for each class must be available.
- The content must be presented clearly.
- The instructional objectives must be clearly stated.
- The purpose of the courseware and the instructional activities, tasks, exercises, etc. needed to complete the learning tasks must be made explicit.
- The practice activities provided in the courseware must actively involve the learner.
- The courseware must provide the basis to judge truth and validity of information.
- The courseware must use a clear, concise and unbiased language.
- The graphical information must be presented clearly.

DESIGN PRESCRIPTIONS TEST

Authors such as Anderson *et al*. (1993), Brown (1997), Ghaoui (2003) and Nielsen (2000) propose several prescriptions to design a web-based course. We referred to them when developing the Web part. It was compounded by a classroom teaching (6 h) each week during the semester (90 days).Web part produced with the WebCT platform.

WebCT (short for Web Course Tools) is an integrated set of tools for developing and delivering interactive course or course components over the web

Table 1: Results of the prescription assessment among students

Prescription	Percentage of students satisfied (%)
The pictorial information presented clearly.	96
The screen layout (screen elements-titles, text areas, navigation, buttons, etc.) are easy to understand.	97
A topic-screen, all other commands are variable.	
The directions for using the courseware was easy to understand for learners.	97
Scrolling list	
The detailed lecture notes for each class must be available in a printed format, before the classroom meeting	96
Before the classroom meeting, availability on the Web wart:	
• Several examples	92
The web content proposes visual synthesis of information.	0
The learning material provides the References.	87
The instructional objectives are clearly stated.	96
The purpose of the courseware and the instructional activities, tasks, exercises, etc. needed to complete the learning tasks are stated.	96
The practice activities provided in the courseware makes the learner active.	3
The courseware use a:	
• Clear	74
• Concise and	74
• Unbiased language	74
The graphical informations are presented clearly	92

(Friesen, 2000). Ninety nine students participated in a study which aimed at finding, through empirical data, the actual meaning of the qualitative attributes mentioned in the prescriptions listed before.

Concerning the prescription the pictorial information is presented clearly (Cochenour and Rezabek, 1998; Dwyer and Baker, 2001; Fontana, 1987), we interpreted that, in the case of the homepage, being the first page, the students see when accessing the course- its meaning both fits the students interest and the topic. Because of that, we imported OOPS icons and did not use the ones that come with the WebCT platform (Fig. 1). As shown in Table 1, 96% of the students were satisfied with this design choice. The second prescription mentioned above is the screen layout (screen elements-titles, text areas, navigation, buttons, etc.) must be easy to understand. We used the screen layout that comes with the WebCT platform 97% of the students said that it is easy to understand. Regarding the availability of detailed lecture notes for each class (the fourth prescription), Heines (2000) stated that students indicated in a survey it was the most valuable aspect of the web based course. After each lecture, the professor updated that days notes to accurately reflect exactly what was covered.

As shown in Table 1, 96% of the students found it was not at all convenient to have to download the lecture notes and then, to print it; moreover, they did not want to be forced to load on WebCT to have an access to these notes. At this time, they obviously don't have any access to computers. Ninety two percent of the students suggested adding several example that would complement, in a dynamic way several aspects of the printed course content. Only 3% of students state that practice activities provided in the courseware makes the learner active. Concerning the tenth prescription. The courseware use a clear, concise and Unbiased language 74% students found it was good. And 92% of students found the graphical information's are presented clearly.

CONCLUSIONS

The results are expected to be useful for teachers applying ICT in their daily work and also for digital content developers. The teachers will be able to correct their attitude towards computer tools for instruction. Developers will be able to reconsider the importance and efficiency of particular instructional solutions. The learners might benefit from the work indirectly, when their expectations and needs are met in a better way (Fedulov, 2005). This study has provided a quick overview of some key issues to consider in Systematic Analysis and Design of e-Learning System. It has been argued here that participant oriented Design is ideal for eLearning Design because e-Learning System is a tool for empirically exploring how learners and instructors use learning objects in a variety of subject areas and across age groups. Finally, the systematic use of e-Learning as part of the instructional design process will improve the learning process. The Evaluation Results states that the Students were happy with OOPS e-Learn system and suggested that its use be continued next year. All students said they found the use of OOPS e-Learn to be very helpful for the following reasons like Access to course materials out of hours and from home, Ability to submit assignments from home, The automated acknowledgment of assignments and the best features of are how it handles assignments and its availability out of college hours.

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