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E-Learning Indicators: A Multidimensional Model For Planning Developing And Evaluating E-Learning Software Solutions

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1. Introduction

Many current e-learning initiatives follow the "one-size-fits-all" approach just offering some type of Learning Management System (LMS) to learners or Learning Content Management System (LCMS). Typically, this approach is related to lack of knowledge of the learner audience or factors influencing that audience and e-learning project overall and therefore fail to provide satisfactory support in the decision making process (Fetaji, 2007a).
In order to address this issue, an approach dealing with e-learning indicators is proposed, assessed, measured and evaluated. The proposed E-learning Indicators Methodology enables successful planning, comparison and evaluation of different e-learning projects. It represents an empirical methodology that gives concrete results expressed through numbers that could be analysed and later used to compare and conclude its e-learning efficiency. With the application of this methodology in e-learning projects it is more likely to achieve better results and higher efficiency as well as higher Return on Investment ROI.
The purpose of e-learning indicators was to raise the awareness of the factors influencing e-learning project in order to identify the nature of obstacles being faced by e-learners. This research argues that if such obstacles could be recognized early in the process of planning and development of e-learning initiatives then the actions that remedy the obstacles can be taken on time. We believe that the absence of appropriate on-time actions is one of the main reasons for the current unsatisfactory results in many e-learning projects.
The e-learning indicators approach is a multidimensional model used in planning, developing, evaluating, and improving an e-learning initiative. Thus, the model comprises e-learning projects as iterative development processes where at each iteration step appropriate actions to improve the initiative outcomes can be taken. The iteration steps of this development process include:

- Planning phase with the initial measurement of e-learning indicators. The obtained results influence all the other phases.
- Design phase where (group or so called "collective") personalisation issues and pedagogical and instructional techniques and aspects are addressed.

- Implementation phase where a number of e-learning experiments are conducted based on the results from the previous phases.
- Evaluation phase to obtain precise results of the initiative outcomes.
- Analysis phase where guidelines and recommendations are written down.

The proposed model defines 18 indicators that were practically applied in a number of case studies including their application with Angel LMS and a number of self developed and implemented e-learning interactive tools.

E-learning indicators have been defined with help of different focus groups, realised literature review and a web based survey of academic staff and students in the framework of South East European University. In addition, the approach was revised closely with experts in the field during participation in several research projects (mentioned in acknowledgement).

The experiences from these projects show that a more successful e-learning is not possible only if a generic approach or generic guidelines for the learners are applied. Rather, individual learning services are needed in supporting learners according to their personal preference profile.

However, although not the focus of the research because of the interconnection with the above identified issues several projects and research initiatives that deal with personalization have been shortly reviewed. The reviewed projects are the OPen Adaptive Learning Environment (OPAL), (Dagger, et al 2002) and ADELE-Adaptive e-Learning with Eye Tracking (Mödritscher, et al 2006). The OPAL research shows personalization as difficult to achieve and "… are often expensive, both from a time and financial perspective, to develop and maintain." (Dagger, et al 2002). Therefore, a conclusion is drown that learner personalisation should not bee addressed at to finely grained level. Typically, personalisation at that starting level is not practical based on the findings of OPAL project (Dagger, et al 2002) and since it has too include all of those learners preferences that change each time the learner uses the system clearly does not represent a constant factor that can be addressed (Fetaji, 2007g). Instead, a recommendation is to use the defined approach with e-learning indicators as starting point when developing an e-learning initiative. Then after the measurements the learners are divided into groups so called "collectives" (in Universities these are the departmental levels) were personalisation is offered to the specifics of the collectives majority primarily based on learning style categorization and type of learner they are (indicator 4, 4). We have adopted the Felder-Silverman model for learning style categorization (Felder, 1993). After that learner personalisation can be designed and offered tailored to each collective (Fetaji, 2007g). Furthermore, based on the measurements of these e-learning indicators a design of a sustainable e-learning initiative can be supported. Each e-learning initiative is unique and involves specifics that can not be taken under consideration in the form of "one-size-fits-all" solution.

However evaluating e-learning indicators in the planning phase is only the first step in more successful e-learning. E-learning indicators can be used in other phases as well in particular in evaluating different e-learning initiatives in conjunction with ELUAT methodology to assess e-learning effectiveness. Comparison of different projects can be realised comparing e-learning indicators measurements in conjunction with the evaluated e-learning effectiveness (how effective they have shown measured using the ELUAT methodology) (Fetaji, 2007g).

2. E-Learning Indicators Methodology

E-learning indicators are defined as the important concepts and factors that are used to communicate information about the level of e-learning and used to make management decisions when planning an e-learning strategy for an institution or University according to the study of (Fetaji et al 2007a). The purpose was to raise the awareness of the factors and concepts influencing e-learning in order to enhance learning and identify the nature of obstacles being faced by e-learners and therefore proposed is a methodological approach in developing any e-learning initiative. Because there are too many factors, personalization and specifics related to each situation and circumstances it is considered that would be wrong offering one size solution for all.

It is of great importance to have standardised guide of e-learning indicators accepted by scientific community to be able to compare and to evaluate the different initiatives regarding e-learning in a standardised manner.

In order to define and assess the e-learning indicators the data have been gathered from interviews with e-learning specialists, 2 focus groups (one student and one instructors), web based survey of academic staff and students and literature review of similar previous research work found at (Bonk, 2004). The web based survey was realised through questionnaire that was developed in three cycles. In the first cycle the questions were developed based on the e-learning indicators. For most of the e-learning indicators there was just one question to cover it, while for some 2 (two) or more questions. At the beginning developed were more questions but after thorough consultations with survey experts shortened and come up with 23 questions. In the second cycle the developed survey questionnaire was tested on a 2 different focus groups. One group consisting of students and the other group from instructors. After analyses of the survey data they were presented to the focus groups and confronted to them how much do they agree and consider this results as realistic and accurate. The initial response was that although the survey captures in substantial level the real situation there were a lot of discussions especially on the student focus group regarding the appropriateness of the survey questions. In discussion with both of the focus groups most of the questions have changed according to the discussions and proposals of the group. In the third cycle both of the focus group were filled the new survey and after the survey data were given to them both of the focus groups agreed that it really gives an accurate clear picture of the participants.

The survey was designed following the rule of thumb for all communications: Audience + Purpose = Design. This survey was divided into 18 (eighteen) sections to cover al the e-learning indicators previously defined and had 23 (twenty three) questions in total. It was communicated to the participants and provided as link in the message board of the eservice system of the University.

As e-learning indicators defined are: (1) learner education background; (2) computing skills level (3) type of learners they are, (4) their learning style and multiple intelligence, (5) obstacles they face in e-learning (e-learning barriers), (6) attention, (7) content (suitability, format preferences), (8) instructional design, (9) organizational specifics, (10) preferences of e-learning logistics; (11) preferences of e-learning design; (12) technical capabilities available to respondents; (13) collaboration; (14) accessibility available to respondents; (15) motivation, (16) attitudes and interest; and (17) performance-self-efficacy (the learner sense their effectiveness in e-learning environment); (18) learning outcomes. Recommendation is to use the defined e-learning indicators as starting point when developing e-learning

initiative and based on the measurements of these e-learning indicators to tailor the specifics of e-learning. Each e-learning initiative should measure the provided indicators and based on them to design and build their e-learning sustainability.

3. Research Methodology

The research methodology used was a combination of qualitative and quantitative research as well as comparative analyses of factors influencing e-learning. Background research consisted of an in depth literature review of e-learning. The background research consisted of analyses of e-learning trends, e-learning technologies and solutions, e-learning standards, learning theories, concepts and factors that influence e-learning. Then grounded theory research was realised through exploratory research to determine the best research design and then constructive research was undertaken to build the software solution followed by empirical research to describe accurately the interaction between the learners and the system being observed. The data for this research was gathered from research interviews with e-learning specialists and participants, focus group and a web based survey as well as printed hard copy survey of academic staff and students.
In order to develop a systematic methodology, either substantive or formal, about improving and enhancing e-learning by addressing the deficiencies from the findings and in this manner to contribute in enhancing e-learning effectiveness. In order to achieve this, the following research objectives have been tried to be addressed:

- Review key authoritative literature on e-learning trends, e-learning standards, technologies and e-learning systems provided as e-learning solutions, and evaluation of e-learning effectiveness in order to provide a thorough understanding of e-learning in general and associated knowledge dissemination.
- Discuss the advantages and disadvantages of different approaches to e-learning solutions.
- Analyses of different e-learning environments and solutions
- Asses, measure and evaluate concepts and factors influencing e-learning defined as e-learning indicators
- Design, develop and conduct experiments in order to asses the best modelling approach to developing e-learning software solutions
- Connect e-learning indicators with each e-learning software solution approach and learning theory and design
- Analyse and discuss the data gathered from the experiments
- Conclude and deliver recommendations for enhanced learning and future improvements.

Key variables and themes that have been studied are: students needs analyses, usage environment feasibility analyses, e-learning indicators, e-content and learning processes issues, feasibility analyses of authoring issues, assessment of e-learning effectiveness, and discussion of the purpose and evaluation of results of the research and proposed recommendations for e-content and e-learning processes issues, applications specifics and requirements in correlation with the environment and situation of the Communication Sciences and Technologies Faculty at south East European University, accessibility and learning specifics based on learners needs, deployment, testing and evaluation of the solution.

Interviewed and realised direct observation of students as program implementation case study for the three subjects: Advanced Elective course "Object Oriented Programming in Java" and the two core courses "Software Engineering" and "Algorithms and Data Structures". There implemented the solutions proposed under the part of the research study on e-content issues and e-learning processes.
Developed is a novel e-learning indicators-(ELI) model to be used for developing information retrieval courseware's by concentrating on previously assessed e-learning indicators. Secondly, the research is conveying the need for close correlation of software development and e-learning pedagogy. Recommend that technology should adapt to theories of learning and e-learning indicators assessed earlier. This process modelling based on e-learning indicators should be used as guidelines in similar developments.
A pilot study was conducted on e-learning interactive courseware applying network analyses method in order to find the critical activities and assess the risks. The main focus and aim of research was set on software development proposed and based upon the e-learning indicators and the design of the courseware in compliance with theories of learning and didactical pedagogical approach. For the assessment of e-learning effectiveness proposed a methodology, called ELUAT (E-learning Usability Attributes Testing), for which developed an inspection technique the Predefined Evaluation Tasks (PET), which describe the activities to be performed during inspection in the form of a predefined tasks, measuring previously assessed usability attributes.

4. The Experiments

In order to investigate the implementation strategy and try to address the above identified issues 7 (seven) experimental case studies were developed and evaluated.
The experiments have been separated in 3 (three) groups based on their research nature and investigation focus. The first 2 (two) experiments concentrate on e-learning indicators and their usage in planning as well as evaluating e-learning projects. In the next 4 (four) experiments various e-learning software solutions as interactive tools are designed and developed in order to test several hypotheses as well as to investigate the new e-learning indicators methodology approach in developing e-learning software solutions and at the same time to investigate instructional strategies discussed and reviewed earlier. The final experiment is devised in order to investigate and analyse the e-content and attention correlation and conjunction in the e-learning process. Each case study experiment is tailored based on the information collected in the first step, evaluated e-learning indicators.
The technological part of the research involved analyses of software engineering issues in designing e-learning environments. Proposed is ELI (E-Learning Indicators) model - as methodology for developing e-learning software solutions (Fetaji, 2007e).
Further, the experiments also investigated applications of different instructional techniques and pedagogical learning models and how they are reflected in the software development process according to different devised scenarios in supporting instructional strategy. An analysis of Project, Problem, Inquiry-based and Task based learning instructional techniques and their appropriateness for different scenarios was realized. In the final step, each experiment and its underlying pedagogical model was once more evaluated using the evaluation methodology developed for this purpose. The developed methodology is called ELUAT (E-Learning Usability Attributes Testing) through the PET (Predefined Evaluation

Tasks) inspection technique (Fetaji, 2007c). The developed 4 (four) e-learning software solutions as case study experiments were created under two research projects realised in a time framework of more than two years and later evaluated:

- Intranet Gateway research project and
- E-Learning Framework research project,

The e-learning software solutions developed for the needs of the experiments are:

- XHTML and XML e-learning Interactive tool,
- E-learning interactive mathematical tool,
- Information Retrieval Courseware system-Intranet Gateway.
- Online Dictionary of Computer Science terms and nomenclatures.

The results of this research show that e-learning indicators approach is of primary importance (Fetaji, 2007e). Having a standardised set of e-learning indicators accepted by scientific community enables comparison and evaluation of different e-learning initiatives and their e-learning projects in a systematic manner. Moreover this approach combined with experimental approach to e-learning brings new insights into the specifics of e-learning that might help in increasing the learning outcomes, especially knowledge transfer. Therefore, conclusion is that no new systems are needed but a series of experiments has to be conducted to see what does and does not work in a particular situation and to provide guidelines and recommendations for that situation.

Furthermore, an investigation of issues in authoring e-learning content (e-content) was realised. The main purpose was to effectively identify the vehicles into increased knowledge dissemination and efficient knowledge transfer and thus improve the overall e-learning process. Preparing quality e-content delivered digitally is probably the major aspect for long term success of any e-learning endeavour. It is the content, however, that learners care for and judge how much they learn from it. Therefore we have identified and addressed most important authoring issues by analyzing different courses using an Learning Management System.

5. Data Collection and Analysis

Depending from the Software Lifecycle used for each e-learning software solutions developed in particular for the given experiment used is the ELUAT methodology and PET testing as described thoroughly at (Fetaji et al 2007a). Questionnaires, surveys, focus groups, usability testing and other software testing groups were used. Groups of students filled out different surveys discussing e-learning indicators, barriers to distance education and usability surveys of e-learning software solutions modelled and developed. The return rate for the surveys for each experiment was different and the highest was for distance education with 64.89 %, (The distance education program at the moment has 81undergraduate full time students, and 13 part time students, or in totals 94 students) while for the e-learning indicators the response rate was 9.7 % (There were in total 701 student surveys filled. The University at the moment of the research survey has 6.386 undergraduate and 188 postgraduate full time students, and 643 part time students, or in total 7217 students). The majority of the participants (63.8%) have used the e-learning software solutions discussed. Ten percent of the participants took fewer than all of the courses mentioned previously since Object Oriented Programming in Java was an elective subject. Large amount of data was collected and used from the literature reviews and inputs from other related projects.

Several statistical procedures were conduct for data analysis. First, the zero-order correlations were computed among all variables. The aim of this operation is to have an initial test of whether there were relationships among the variables. The interaction of technology with teaching or social presence was considered if including those items would increase the power of the regression model substantially. The standard multiprogression procedures were conducted with course subjective satisfaction through the perceived learning outcome, learning engagement assessed through time to learn and time of performance as dependent variables. All assumptions of normality, usability, of residuals were checked in those regression analyses. In order to handle those data the triangulation technique from Dumas and Redish (1999) was used, were we look at all data at the same time to see how the different data supports each other.

6. E-Learning Indicators Specification and Analyses

(1) Learner education background together with his cultural background is set as indicator since it is a direct factor that is associated and impacts e-learning. According to Gatling et al, (2005), students today come from a variety of cultural backgrounds and educational experiences outside of the traditional classroom. How do students construct meaning from prior knowledge and connect it with the new experiences? Based on this facts and interviews with e-learning specialist It was set it as important indicator.
(2) Computing skills level of the learner is set as indicator since it directly influences the way e-learning is conducted with the use of Information and communication technologies (ICT) and use of computers and the computing skills requirements are essential in learning. "As we move toward the 21st century, anyone who is not "computer literate" will find themselves at a disadvantage when competing in the job market." (Johnson, Gatling, Hill, 1997).
The indicator (3) type of learners they are depends primarily on the balance in the two dimensions of the Learning Style scale model formulated by Richard M. Felder and Linda K. Silverman of North Carolina State University according to Felder & Soloman (n.d) based on four dimensions (active/reflective, sensing/intuitive, visual/verbal, and sequential/global). According to Felder & Soloman (n.d) "students preferentially take in and process information in different ways: by seeing and hearing, reflecting and acting, reasoning logically and intuitively, analyzing and visualizing, steadily and in fits and starts. Teaching methods also vary. Some instructors lecture, others demonstrate or lead students to self-discovery; some focus on principles and others on applications; some emphasize memory and others understanding. Active learners tend to retain and understand information best by doing something active with it, discussing or applying it or explaining it to others. Reflective learners prefer to think about it quietly first. Sensing learners tend to like learning facts; intuitive learners often prefer discovering possibilities and relationships. Visual learners remember best what they see: pictures, diagrams, flow charts, time lines, films, and demonstrations. Verbal learners get more out of word, written and spoken explanations. Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly getting it". Therefore assessing and knowing the learning audience is crucial in order to know whom to support and there is an extensive need for this input data in order for the e-learning initiative to be successful and effective. Then after the measurements the learners

are divided into groups so called"collectives" were personalisation is offered to the specifics of the collective majority (in Universities these are the departmental levels) primarily based on learning style categorization and type of learner they are according Felder-Silverman model for learning style categorization (Felder, 1993).
The importance of the type of learner and (4) their learning style and multiple intelligence is for the both sides: instructor and student. For instructors it is of importance since it reflects the preferences of Learning style in their teaching and delivery style to students. We advise to tend to use each learning style to teach also in a delivery type suited to other types of learners and truing to bring it closer and generalize to include all the types using visualization and verbal communications, as well as other communication tools. According to Tomas Armstrong (n.d.) Multiple Intelligences are eight different ways to demonstrate intellectual ability. 1) Linguistic intelligence ("word smart"), 2) Logical-mathematical intelligence ("number/reasoning smart"); 3) Spatial intelligence ("picture smart"); 4) Bodily-Kinesthetic intelligence ("body smart"); 5) Musical intelligence ("music smart"); 6) Interpersonal intelligence ("people smart"); 7) Intrapersonal intelligence ("self smart"); 8) Naturalist intelligence ("nature smart"). Again assessing the audience and having this input data is very important e-learning indicator in planning and developing e-learning initiative.
The indicator (5) obstacles they face in e-learning (e-learning barriers) is set as important based on interviews and speaking with e-learning specialists. Each e-learning project has different barriers and they are specified as learner input and depend from a situation.
Assessing what the learner audience faces as barrier is crucial in achieving effective e-learning. Indicator (6) attention is set as very important. Attention cues when the learners begin to feel some mental workload, Ueno, M. (2004).
(7) e-content (suitability, format preferences), e-learning content (e-content) considered as vehicle of the e-learning process and knowledge construction. The quality of the virtual learning environment is mainly depending on the quality of the presented e-learning content. Fetaji, B. (2006).
Indicator (8) Instructional design has gained significant prominence in e-learning for a number of compelling reasons. One of them is the possibility for instructional design to systematically address the need for creating and evaluating students' learning experience as well as learning outcome. The other is instructional design can help faculty to focus on using the appropriate format and tools for the appropriate learning objectives. Fetaji, B. (2006).
Indicator (9) organizational specifics - every instituion has its specific business processes that influences and impacts e-learning, Galotta et. al. (2004)
(10) preferences of e-learning logistics - targeted at learners of different experience levels and organizational background/hierarchy, based on the ELA model-the European Logistics Association (ELA), (Zsifkovits, 2003). The following 7 (seven) variables have been set as priority in determining viable learning environment and its e-learning logistics: 1) Interoperability; 2) Pricing; 3) Performance; 4) Content development; 5) Communication tools; 6) Student Involvement Tools; 7) Evolving technology.
(11) indicator preferences of e-learning design; designing instruction that acknowledges that students differ in their learning preferences and abilities and that instruction needs to be flexible to address these differences, (Kumar 2006).
The next indicators (12) technical capabilities available to respondents (13) collaboration; (14) accessibility available to respondents, ares defined as important indicators in discussions with e-learning specialist and experts. They represent the essential influencing

factors on e-learning mentioned in different studies such as (Coleman, B., Neuhauser, J. & Fisher, M. 2004).
(15) Motivation is essential to learning and performances, particularly in e-learning environments where learners must take an active role in their learning by being self directed (Lee, 2000).
(16) Attitudes and interest. A review of studies on attitudes toward learning and using information technology in education has revealed that most studies have shown that students' attitudes toward technology are critical, (Liu, et. al. 2004);
(17) performance: self-efficacy (the learner sense their effectiveness in e-learning environment); Self-efficacy refers to people beliefs about their capabilities to perform a task successfully at designated levels, (Bandura, 1997).
(18) According to Jenkins, A. and (Unwin, 1996) learning outcomes are defined as statements of what is expected that a student will be able to do as a result of a learning activity. Learning outcomes are usually expressed as knowledge transfer, skills, or attitudes (Unwin, 1996). Therefore, it is a very important indicator in planning, designing and evaluating e-learning.

7. E-Learning Indicators Assessment, Measurement and Evaluation

7.1 Definition

E-learning indicators have been defined with help of different focus groups, realised literature review and a web based survey of academic staff and students in the framework of South East European University as well as revised closely with experts in the field during participation in several research projects. In order to investigate e-learning indicators in planning phase of e-learning projects a case study was initiated in order to asses, measure and evaluate e-learning indicators a web based survey has been used. The survey was designed following the rule of thumb for all communications: Audience + Purpose = Design. The survey was divided into 18 (eighteen) sections to cover al the e-learning indicators previously defined. It was communicated to the participants and provided as survey in Angel LMS. It was offered to two different department from two different Universities. One using angel LMs as e-learning platform and the other using Moodle as learning platform. There were in total 701 student surveys filled. The answer rate was 30.48%. There were 701 filled survey, and the total number of students in using Angel platform was 2300. The data was collected using Angel Learning Management System and further analyzed in Excel. The second e-learning project that is using Moodle as e-learning platform was focused on computer Science Faculty and in total 44 surveys were filled and the answer rate was 9.78%.

7.2 Analyses of indicator: Self efficacy in e-learning

Please rate your self efficacy in e-learning. How effective and efficient you are?

Bad	Not so good	OK	Good	Very good
□ 1	□ 2	□ 3	□ 4	□ 5

7.2.1 ANGEL LMS - Findings for indicator: Self efficacy in e-learning

Most of the respondents, 43.7% have rated them self's as good their efficacy in e-learning. While 24.1 % have rated them self's as very good.

On the other hand 1% of them were not satisfied with the e-learning environment and their efficacy and have rated them self's as bad, 4.7 % not so good, and 26.5% rated them self's as OK, meaning they are partially satisfied with the e-learning system and their effectiveness in it.

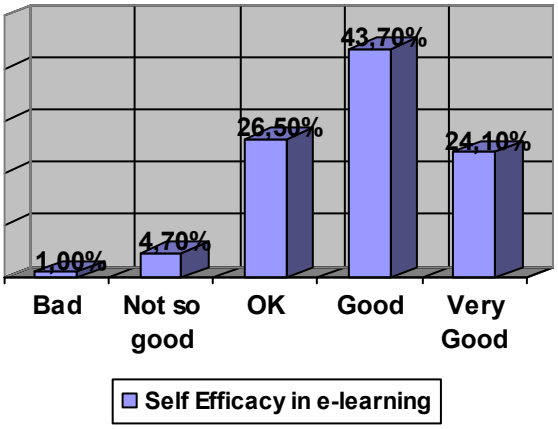

Fig. 1. ANGEL LMS - Findings for indicator

7.2.2 Moodle LMS- Findings for indicator: Self efficacy in e-learning

Most of the respondents, 33.17%, have rated them self's as good their efficacy in e-learning. While 26.54 % have rated them self's as very good.

On the other hand 1.12% of them were not satisfied with the e-learning environment and their efficacy and have rated them self's as bad, 9.7 % not so good, and 29.47% rated them self's as OK, meaning they are partially satisfied with the e-learning system and their effectiveness in it.

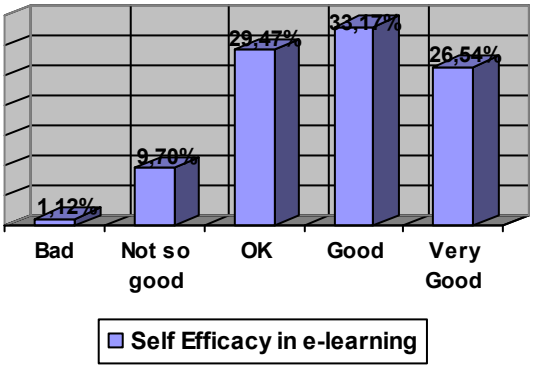

Fig. 2. Moodle LMS - Findings for indicator

7.2.3 Discussion of the Findings for Indicator: Self Efficacy in E-learning

As Bandura (1997) defined it, self-efficacy refers to people beliefs about their capabilities whether or not they can perform successfully at designated levels using the e-learning environment. From the analyses of the findings it indicates that there is an increase in student's achievement after their engagement in an e-learning environment. Overall 94.3% of the students in Angel and 89.18 % of students in MOODLE are satisfied with their self-efficacy and have shown progress moving in the new e-learning environment from the traditional classroom. However there are 5.7 % of the students (ANGEL) and 10.82 % (MOODLE) that are not satisfied with their achievement. The main reason among others for this result is identified in the usability issues of the two offered e-learning systems. Other reasons will be discussed in conclusions. However in general students rated their self efficacy as better in using ANGEL compared to MOODLE.

7.3 Analyses of Indicator: Type of Learner

What type of learner you are? (Please Circle one option: a) or b) for each row)

a) ACTIVE or **b) REFLECTIVE Learner**

(Explanations: Active learners tend to retain and understand information best by doing something active with it--discussing or applying it or explaining it to others. Reflective learners prefer to think about it quietly first.)

7.3.1 ANGEL LMS - Findings for Indicator: Type of Learner

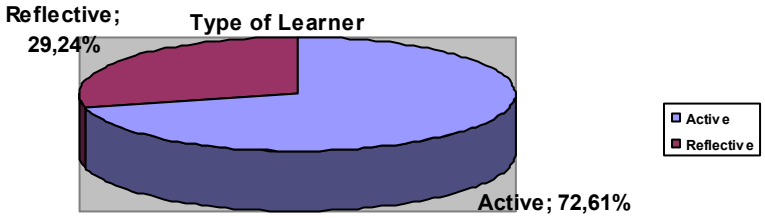

Fig. 3. ANGEL LMS - Findings for indicator

On the whole, 72.61 % of respondents rated them self's as Active learners while the others 29.24 % as Reflective learners.

7.3.2 MOODLE - Findings for indicator: Type of Learner

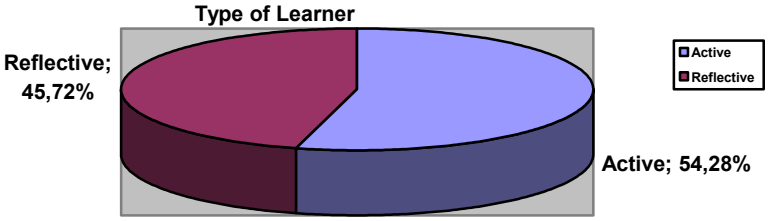

Fig. 4. Moodle LMS - Findings for indicator

On the whole, 54.28 % of respondents rated them self's as Active learners while the others 45.72 % as Reflective learners.

7.3.3 Discussion of the findings for indicator: Type of Learner

The indicator (3) type of learners they are depends primarily on the balance in the two dimensions of the Learning Style scale model formulated by Richard M. Felder and Linda K. Silverman according to Felder & Soloman (n.d). The findings indicate that students in using ANGEL are primarily of the Active type of learner 72.61% in comparison to 29.24% Reflective type of a learner. The students in using MOODLE are primarily of type reflective learners 54.28% in comparison to 45.72 %. These findings indicate that the structure and curriculum of the studies should change and embrace this type of learner more by preferring and choosing a hands on approach in comparison to the theoretical approach for the learners using ANGEL and the opposite for the learners using MOODLE were learners should be provided more reading materials and solved examples so they can reflect this and learn by doing this.

7.4.3 Analyses of indicator: Type of Learner

a) SENSING or b) INTUITIVE Learner

(Explanations: Sensing learners tend to like learning facts; intuitive learners often prefer discovering possibilities and relationships.)

7.4.3.1 ANGEL LMS - Findings for indicator: Type of Learner

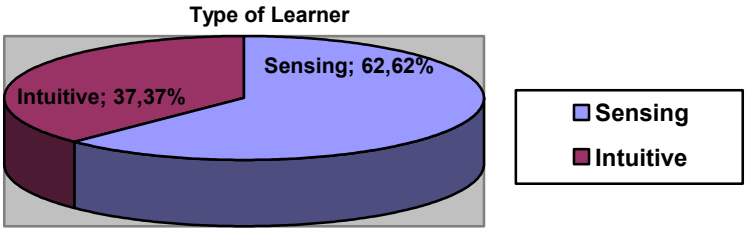

Fig. 5. ANGEL LMS - Findings for indicator

On the whole, 62.62 % of respondents rated them self's as Sensing learners while the others 37.37% as Intuitive learners.

7.4.3.2 MOODLE - Findings for indicator: Type of Learner

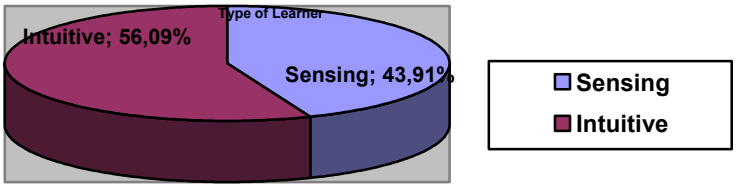

Fig. 6. Moodle LMS - Findings for indicator

On the whole, 43.91 % of respondents rated them self's as Sensing learners while the others 56.09% as Intuitive learners.

7.4.3.3 Discussion of the findings for indicator: Type of Learner

The findings indicate that ANGEL LMS students are primarily of type sensing and they tend to learn by learning facts 62.62%. The minority group of the students are of type intuitive learners 37.37% and they prefer discovering possibilities and relationships for them self's. These finding suggests that the content created and used in the e-learning environment should be concentrated around facts and detailed descriptions rather then on living this to students to discover for them self's. MOODLE students are primarily of type Intuitive 56.09% compared to the sensing group with 56.09%. For the students of this type the recommendations are to provide more information and case studies for students in order to intuitively learn and find the answers.

7.4.4 Analyses of Indicator: Type of Learner

a) VISUAL or b) VERBAL LEARNER

(Explanations: Visual learners remember best what they see--pictures, diagrams, flow charts, time lines, films, and demonstrations. Verbal learners get more out of words-written and spoken explanations.)

7.4.4.1 ANGEL LMS - Findings for indicator: Type of Learner

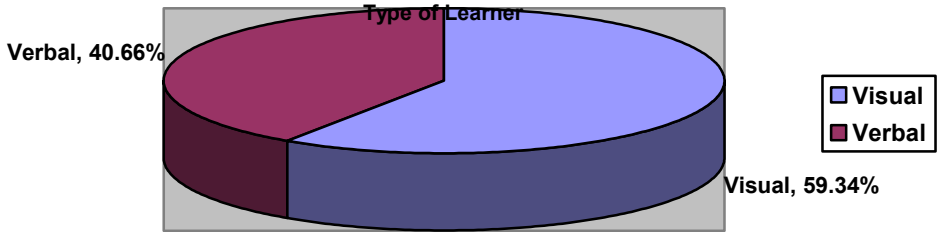

Fig. 7. ANGEL LMS - Findings for indicator

On the whole, 59.34 % of respondents rated them self's as Visual learners while the others 40.66% as Verbal learners.

7.4.4.2 MOODLE - Findings for indicator: Type of Learner

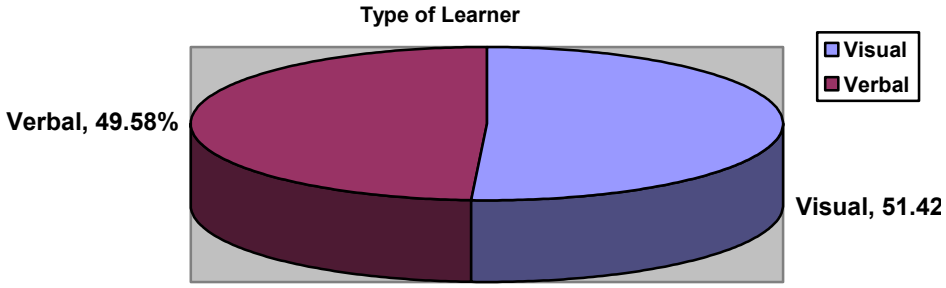

Fig. 8. Moodle LMS - Findings for indicator

On the whole, 51.42 % of respondents rated them self's as Visual learners while the others 49.58% as Verbal learners.

7.4.4.3 Discussion of the findings for indicator: Type of Learner

The findings indicate that ANGEL students are 59.34% while MOODLE 51.42% primarily of type Visual learners and they tend to learn by pictures, diagrams, flow charts, time lines, films, and demonstrations. The other group of the students is of type verbal learners Angel 40.66% and MOODLE 49.58% and they prefer to learn out of words, written and spoken. This findings suggests that the e-content created and used in the e-learning environment should contain more multimedia elements like pictures, diagrams, flow charts and demonstrations rather then just text explanations.

7.4.5 Analyses of indicator: Type of Learner

a) SEQUENTIAL or b) GLOBAL LEARNER

(Explanations: Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it.")

7.4.5.1 ANGEL LMS - Findings for indicator

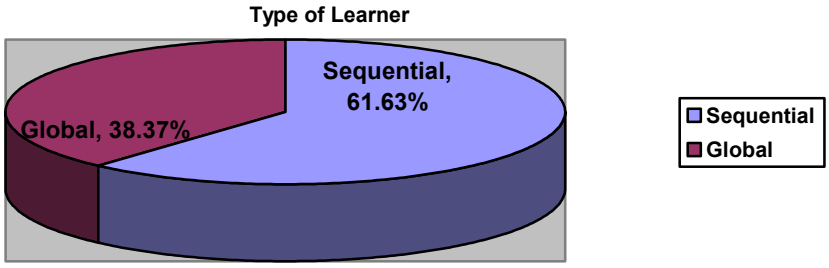

Fig. 9. ANGEL LMS - Findings for indicator

On the whole, 61.63 % of respondents rated them self's as Sequential learners while the others 38.37% as Global learners.

7.4.5.2 MOODLE - Findings for indicator

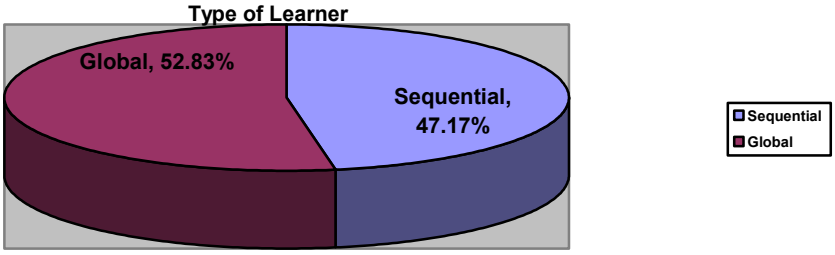

Fig. 10. Moodle LMS - Findings for indicator

On the whole, 52.83 % of respondents rated them self's as Sequential learners while the others 47.17% as Global learners.

7.4.5.3 Discussion of the findings

The findings indicate that 61.63 % Angel students and 47.17% Moodle students are primarily of type Sequential learners and they tend to learn in linear steps, with each step following logically from the previous one. The other group of the students are of type Global learners 38.37% Angel students and 52.83% Moodle students and they prefer to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it.". This findings suggests that the e-content created and used in the e-learning environment should present the subject sequentially and then progressing step by step to the global and general issues for Angel environment students while for the Moodle environment students the content provided should contain information that provides global picture of the content.

7.4.6 Analyses of indicator: Learning Style and intelligence

1) Linguistic ("word smart", sensitivity and ability to spoken and written language):
2) Logical-mathematical ("number/reasoning smart", analyze problems logically, investigate issues scientifically)
3) Spatial ("picture smart", potential to recognize and use the patterns of wide space)
4) Bodily-Kinesthetic ("body smart", mental abilities to coordinate bodily movements)
5) Musical ("music smart", skill in the performance, composition, and appreciation of musical patterns)
6) Interpersonal ("people smart", capacity to understand the intentions, motivations and desires of other people)
7) Intrapersonal ("self smart", capacity to understand oneself, to appreciate one's feelings, fears and motivations)
8) Naturalist ("nature smart", recognize, categorize certain features of the environment)

7.4.6.1 ANGEL LMS - Findings for indicator

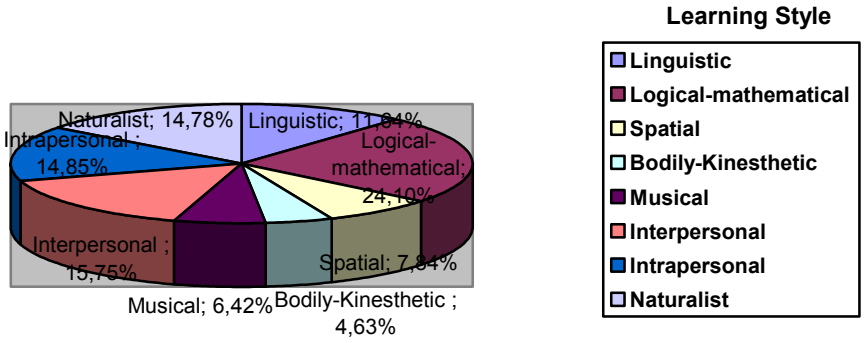

Fig. 11. ANGEL LMS - Findings for indicator

7.4.6.2 MOODLE - Findings for indicator

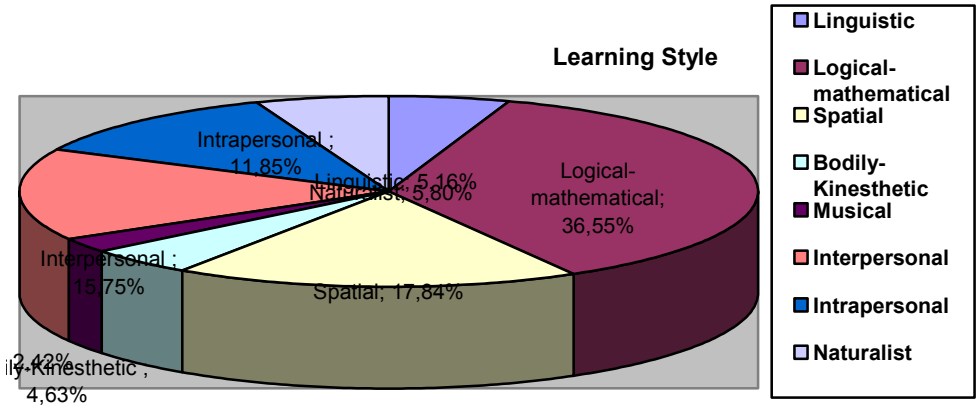

Fig. 12. Moodle LMS - Findings for indicator

7.4.6.3 Discussion of the Findings

The findings indicate that Angel and Moodle students are more or less with a balanced and similar learning style and intelligence were slightly prevails the Logical-mathematical, and linguistic style and intelligence preferences.

7.4.7 Analyses of indicator: Obstacles - Borders

Please define the obstacles you face in e-learning?

7.4.7.1 ANGEL LMS - Findings for indicator

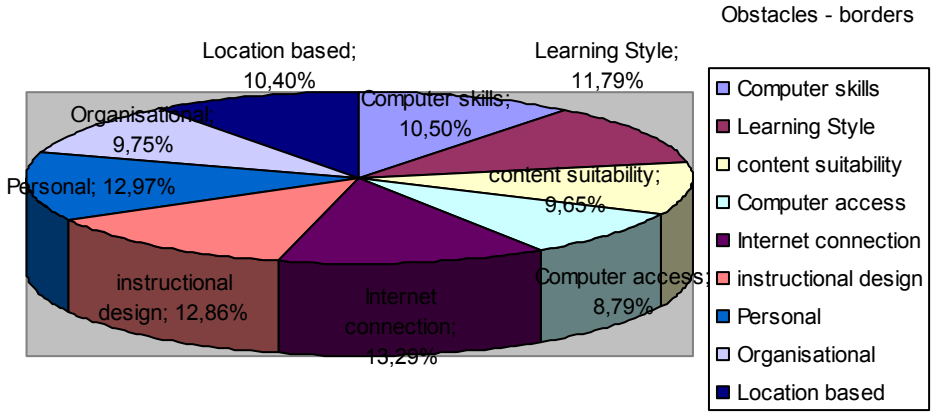

Fig. 13. ANGEL LMS - Findings for indicator

7.4.7.2 MOODLE - Findings for Indicator

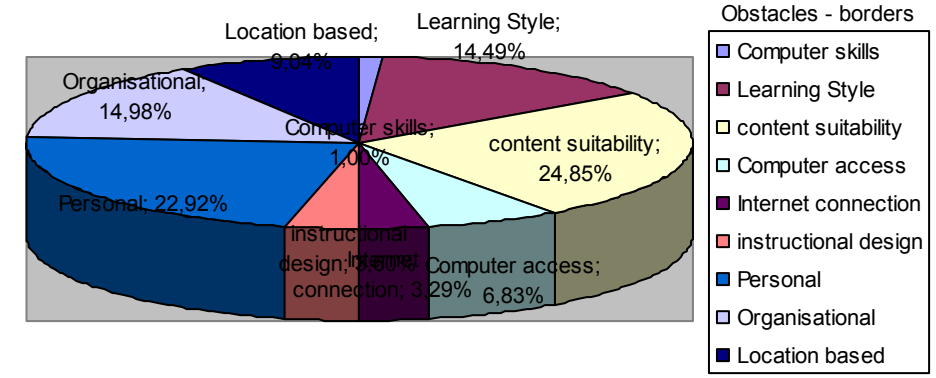

Fig. 14. Moodle LMS - Findings for indicator

7.4.7.3 Discussion of the Findings

The findings indicate that there are a lot of obstacles and barriers to e-learning and they are rated as follows in percentage: Angel: Based on these findings the internet connection and e-content not suited to learners learning style are rated as the biggest obstacles and barriers to enhanced learning. Moodle: Based on the findings content suitability, personal issues and learning style are rated as the biggest obstacles to enhanced learning.