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Critical Appraisal of Web-Based Learning Systems

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ABSTRACT

The face-to-face to web-based teaching has taken a systematic swing, which has become evident, since the introduction of web-based courses by higher education institutions. The Internet & the *World Wide Web (WWW)* in particular provide a distinctive platform to link learners with educational resources. Fetching the knowledge of demanded level in possibly the shortest period is a crucial problem in any *Web-Based Learning (WBL)* system. In other words the problems of an optimum teaching process management are imperative. But, in the existing scenario, the teaching process can be best managed from the learning arrangement that is adequate to the end-user's knowledge. The fanaticism in *WBL* systems results in net earnings to the institutions & is principally motivated by cost savings. People are captivating the total advantage of distance learning since the introduction of the Internet & during the last few years massive research efforts have been dedicated to the development of distance learning systems. In this paper an attempt is put forth to recapitulate the aspects for upgrading the *WBL* system considering the proposed *End-user Counseling System (ECS)* as an example. And based on the aspects identified, the *End-user Representation (ER)* is structured that enables a clear & natural representation of constraints & solutions for different *WBL* system (as well as related) problems, such that it facilitates in supervising the end-user's progress in any of the *WBL* systems. Finally, based on the *ER* proposed, it designs a *Simple Representative Policy (SRP)* that is effective, scalable & interoperable specifically adequate to develop any *WBL* system.

Categories & Subject Descriptors

K.3.1 **[Computer & Education]:** Computer Uses in Education – *distance learning.*

General Terms

Algorithms, Management, Measurement, Performance, Design, Reliability, Experimentation, Security, Verification.

Keywords

Web-Based Learning, e-learning, End-user, Keep-count, Counseling, Knowledgebase, Genetic Algorithms, Decision Support System, End-user Representation, Fixed Record Set, Variable Record Set, Representative Policy.

1 INTRODUCTION

The educational institutions are using *WWW* extensively worldwide to deliver the courses electronically. At the same time, they are trying to boost & progress the end-users (students) learning experiences by using a wide range of media & web technologies. The wide acceptance of *WBL* environments in all stages of human education has led scientific research in the field of adaptive & intelligent *WBL* systems in order to provide higher quality services towards the end-users. Personalization is yet another aspect in the evolution of web-based learning systems.

In spite of the global enthusiasm in web-based education, it is not apparent that all end-users can be benefited by distance learning, since the end-user may feel uneasy with the instructor's (teacher) new role of facilitating, guiding, & mentoring as against the conventional instructing mode. In fact, the end-users are motivated to use the system because of the ease they will experience & this may lead them to their enhanced performance. The effectiveness & usefulness of a *WBL* system is different with distinct end-users since learning is a cognitive activity that differs from learner to learner [20]. The individual aspects of an end-user are not considered by most of the *WBL* systems, ignoring the unusual needs that are definite to existing cognitive profiles. The end-users need not only feel contented, but also realize the lively atmosphere of online scenery. They must understand how learning takes place in terms of communications, associations, & awareness in the middle of students-to-teachers (traditional) & students-to-electronic (*WBL*) content. It is widely recognized that the most competent products are personalized to meet the needs of the end-users. Hence, that is the core rationale for the massive scientific effort in all market sectors to introduce features in products or services that convince the need for personalization. The same applies to the innovative & rising area of *WBL*.

Many studies have shown that the profit experienced by both end-users & instructors exp& further to add up several merits such as asynchronous environment of *WBL*, flexibility in scheduling the daily life activities & personalized opinion [5], though it is apparent that the web-based setting for learning is not suitable for everyone. Currently, many studies have also revealed that the *WWW* makes possible the delivery of tests & maintain distance learning. But, it reflects that the web-based setting is beleaguered to a meticulous group of end-users with a precise set of talents, temperaments, & mind-sets. Many studies also showed that many absolute & certified degree programs are now offered over the Internet have calculated & report on consequences indicating that *WBL* has made this shift & *WWW* as a teaching tool is no less than as effectual as that in the traditional classroom

[17,18,19]. In order to meet the market trends & user requirements, *WBL* systems require setting up of convinced aspects in terms of functionalities. These aspects comprise the key aspects for triumph in all *WBL* environments.

However, we can still come across intricacies in view of the method adopted for teaching in *WBL* systems: if too much reading off the screen is essential, then online courses may be likely to be time consuming; the feeling of remoteness may creep in if communication with the instructor is not in person; the impending complexity of time negligence by inexperienced & unmanageable end-users & the thought of being an autonomous character may not be appropriate for all end-users. In view of the scenery of *WBL*, it is apparent to impart end-users with guidance about their willingness to participate in the *WWW* environment.

Considering the issues coined in the discussion as described in the first part of this section, the work proposed in this paper begins with identifying the key aspects of any *ECS* (a part of *WBL* system) & then it presents a clear & natural *ER* that is crucial in *WBL* system so that it can be best utilized to personalize any *WBL* system. Finally, adhered to the aspects identified in *ECS* & *ER*, it presents *SRP*, a comprehensive design for any *WBL* system.

The paper proposed is organized into six chapters. Chapter 1 introduces & briefly discusses the current issues in *WBL* system. Chapter 2 includes an introduction to *ECS* in any *WBL* system. Chapter 3 introduces *ER* for personalizing any *WBL* system. Chapter 4 introduces *SRP*, which is scalable, effective & interoperable design suitable for any *WBL* system in general. Chapter 5 discusses the related work in the field of developing the effective *WBL* system. Finally, chapter 6 summarizes the conclusions & suggests future applications & extensions of the work proposed.

1.1 End-user Counseling System (ECS)

This chapter introduces a simple *ECS* that achieves the subsequent objectives: weighs up the end-user potential & limitations persuading association in the *WBL* environment, obtain suggestions to improve end-user weaknesses, & identify the aspects characterizing end-users who are well-suited to benefit from the *WBL* environment.

WBL learning environments are influenced by the preliminary set of aspects that are vital to categorize. But, ascertaining an entire set of aspects is of chief importance to accurately categorize end-users. The categorization is done based on the response of the subsequent questions: who are attuned to profit from this virtual environment? Who have the eccentricity to deal with the intricacies coupled with *WBL*? & who have the talents to use virtual environments capably. The system developed comprises of all the components of a classic Decision Support System (DSS) that encompass Database, Knowledgebase, Data Management & User Interface (see fig.1)

The system depicted works using a simple *keep-count* approach. Each end-user obtains a count that is associated with an appropriate explanation from the answers to the questions as explained in the previous paragraph. Specific recommendations are provided based on the end-user's answers. Each answer has a weight for the ultimate count. This weight describes the comparative significance of each aspect to the entire objective of the system result. Equal weights are assigned for all variables during the study stage of this work. Corresponding to the knowledgebase of DSS, the aspects of *ECS* are identified. They are as described: end-user personality, computer-internet proficiency, learning methods, confidence & nervousness, cultural aspects, & instance provision. These aspects are in line with the variables reported by other researchers in *WBL* studies [17,18,19].

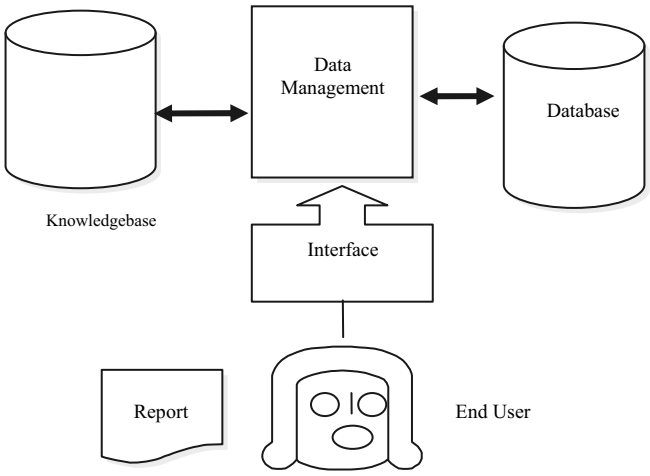

Figure 1: Illustrative representation of the components of a Decision Support System.

This is a beginning stride for the design of this system. In future, inference techniques such as neural networks or genetic algorithms can be used to train the system & find the optimal weight for each aspect.

End-user Personality: To ensure the end-user's motivation & interest in the course, the end-user personality (character, traits, behavior, qualities) would play a constructive role & does not fail to keep up with a web-based course workload. It is evident that the ultimate end-user for web-based course is one that is inherently inspired, responsible towards target & submission dates, & well organized. Supervision, monitoring & motivation by self, appear to be even more necessary for accomplishment in a web-based course than in traditional teaching.

Computer-Internet Proficiency: The people with more computer experience would have better gain in choosing web-based course over those with little experience. Many studies identify the importance of previous experience in computer & internet proficiency in the successful completion of a web-based course [4]. Consequently, web-based courses are using aspects of course management tools, such as discussion boards, chat rooms, & the use of such web-based communications technologies can be pretty taxing for novice internet users.

Learning Methods: There are diverse set of end-user proficiency requirements for any web-based course in a *WBL* environment. The proficiency requirements that are significant for the face-to-face learning environment may not essentially be sufficient for learning via the *WWW*. Furthermore, the chances of success are augmented if end-user involves keenly & have a strong compliance to learn in an improved *WBL* environment. Therefore, the learning methods of an end-user describe the methods by which an end-user believes that he/she can learn unsurpassed.

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Confidence & Nervousness: The end-user's confidence is also crucial for end-user accomplishment in a *WBL* environment. The security & the confidence the end-user has in his/her internet connection aspects the overall accomplishment of independently learning in a *WBL* environment.

Computer nervousness is yet another aspect that is defined as the fright about those consequences while a person is set to use a computer. On the other hand, nervousness declines as the end-user become more accustomed with the interface & functionality of the *WBL* environment. Earlier researches explain that the nervousness level is directly linked with the experience of the end-user. The more experience the end-user has, the lesser his/her nervousness level, & it enhances the chances that he/she will endure more comfort in a *WBL* environment.

Cultural Aspects: In a global scenario every individual is different, but he/she shares many similarities & ideas with others as he/she will establish the relationship with each other. Cultural aspects can reveal a strong influence on the end-user's accomplishment in any of the web-based course. In contrast, some cultural aspects & values may not realize the *WBL* thought & may prefer a more practical approach of learning. Many researchers have been given several definitions describing what exactly a cultural aspect is. The work in [9] explains that the aspect is something that forms behavior or that organizes one's awareness of the world (as in the case of ethics, laws & society).

Table 1: Aspects categorizing the end-user's suitability for an online course.

Aspect & Question	Calculation Objective
End-user Personality: Is the end-user's personality matching with suggested personality traits for taking an online course?	Inspiration / analytical skill/ ability to work.
Computer-Internet Proficiency: Is the end-user's computer proficiency adequate for taking an online course? Is the end-user's internet proficiency adequate for taking an online course?	Access to computer / ease of using a computer / computer fundamental skills. Access to internet / Internet usage proficiency.
Learning Methods: Is the end-user's learning method well-suited with learning in an online environment?	Significance to classroom conversation / reading command / tendency to communicate liberally using different media.
Confidence & Nervousness: Does the end-user have any nervousness or confidence problems that may affect his/her performance in an online course?	Revealing private information / ease of communicating via the internet / confidence in the internet medium / nervousness of virtual environment / awareness of importance of information placed online.
Cultural Aspects: Does the end-user's culture acknowledge online courses as a way for learning?	Traditional learning awareness / private cultural attitude about web-based learning / societal standard in using computer & internet / family unit.
Instance Provision: Does the end-user's everyday life is demanding to take an online course?	Remoteness from university grounds / service schedule / everyday life / individual learning requirements.

Instance Provision: Attending a class on campus proves to be annoying for the end-users when it comes to the subsequent conditions: service schedule, livelihood arrangements, & remoteness from university grounds. Therefore, the instance provision represents the benefit, *WBL* offers to end-users by allowing them the freedom to be inclined to their studies at their own time & tempo.

After identifying the above aspects of an end-user the next step is to measure their characteristics & categorize the end-users by making use of an effective technique.

The Technique

The aspects recognized above can be calculated by a feedback form so as to capture the end-user's characteristics. Table 1 catalogs the six aspects, & describes what each aspect aims to calculate & the number of items used to calculate each aspect. The items for the aspects are adapted from earlier presented instruments [5].

The answers for the questions quoted can be calculated using a five-point Likert-type scale with anchor from "Strongly agree" to "Strongly disagree". Based on the aspects that are used to categorize the end-user, the subsequent chapter presents *ER* that can be best utilized to personalize any of the *WBL* system.

1.2 End-User Representation (ER)

This chapter develops an end-user representation for personalization of *WBL* system. The student model developed from the studies done in several areas like user modeling, authoring systems, adaptive web-based educational systems, adaptive educational hypermedia, adaptive web-based tutoring system, intelligent tutoring systems & semantic web for user modeling is the basis for the *ER*. The end-user admission form, information from the interaction between end-user to system, end-user to instructor & from the perspective of the system supervisor is some of the numerous information resources for developing this *ER* in a systematic approach. The *ER* clearly defines about what information can be extracted from the end- user. The subsequent part of this chapter describes the ER in greater detail.

The ***i. Fixed Record Set*** *(FRS)* & *the* ***ii. Variable Record Set*** *(VRS*) are the two major ingredients of *ER*. The *FRS* comprises of the information that is not modified throughout the communication of end-user & system. & the *VRS* comprises of the information that gets modified in accordance with the end-user's learning progress & the communication with the system.

i. FRS

This set comprises of five different records namely private, academic, personality, preference & cognitive records. Each one is a comprehension of end-user characteristics, which are usually predetermined during a *WBL* session.

The *private* record comprises the personal information about the end-user, & this information can be effortlessly acquired from the course admission form.

The attributes of this record are:

- The end-user name;
- Association;
- The collection of degrees & qualifications obtained;

- Particular accessibility requirements to course resources that the end-user must have;
- End-user's specialized activities;
- The Information about the end-user protection & access testimonials;

The *academic* record defines the characteristics of the end-user that are dealt with the learning activity directly. The information in the academic record includes two firm private attributes & three operational attributes (see table 2). The *personality* record comprises of the information that represent the type of person the end-user is, in consideration of the end-user aspects. These aspects can be learned from personality tests as the Myers-Briggs test [22].

The attributes of this record are:

- The type of the personality the end-user has;
- The focusing talents of the end-user that depend on the normal time spent in the learning stuff;
- The team-work talents of the end-user that are depending on the sharing in team works;
- The relational talents of the end-user that depend on the communication with other end-users & instructors;

Table 2: Attributes of academic record.

Academic Attributes	What are they?
Private: 1.Learning process 2.Learning approach	These are considered to be firmly associated with end-user's private properties.
Operational: 1. Course assessment	This includes the information about whether the end-user is registering for an assessed course or not.
2. Course aims	This includes the collection of notions in the session course that the end-user must learn.
3. Course navigational organization	This includes the information about the type of organization that is to be used in substance routing.

The *preference* record comprises the set of end-user options concerning the system personalization. The majority of the favorites of the end-user are assembled from the end-user except some that are defined by the system supervisor.

The attributes of preference record are:

- The language preferred for content presentation;
- The format preferred for presentation;
- Web-design customization;
- Control customization;
- Private note-pad;
- Sound volume;
- Video speed;

The *cognitive* record involves the features that correspond to the type of cognition the end-user hold. These features can be estimated from cognitive tests as the Ross & Witkin tests [20]. These features even try to fine tune the type of information processing & interpretation the end-user utilize. In fact, these are the properties that are utilized in the user modeling area, so that the contents can be customized to the end-user requirements.

This attributes are:

- The cognitive method the end-user posses;
- The experience level the end-user holds in utilizing the computer;
- The experience level the end-user holds in utilizing the *WBL* system;

ii. VRS

This set involves two sets of records: the performance record, & the end-user awareness record. The *performance* record gathers information about the end-user's current performance in the course sessions. This information refers to the level of inspiration & assurance for learning, capability to formalize & understand course notions, worldwide performance level shown by the end-user in the present course, level of dedication spent by the end-user in the course, & the collection that stores all the consequences gained by the end-user in the current course. The information is always being grouped in order to keep a restructured record. This information is acquired from the end-user's communication with the system.

The *end-user awareness* record details the understanding concepts & capabilities pertinent to the existing course that the end-user holds & ought to hold until the end of the course.

In addition to the information depicted previously in the couple of paragraphs, these set of records assemble information about the end-user's improvement during the course sessions as well. Therefore, the *ER* can be utilized by any of the *WBL* system.

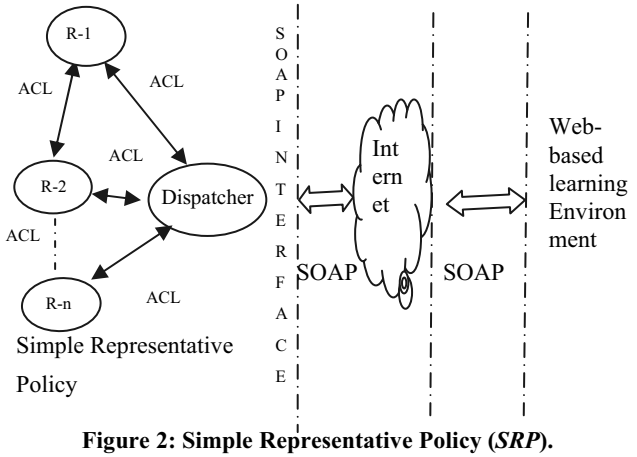

Figure 2: Simple Representative Policy (*SRP*).

1.3 Simple Representative Policy (SRP).

Finally, this chapter introduces *SRP* that is scalable, effective & interoperable for any *WBL* systems in general based on the ideas depicted in the couple of previous sections. The work presented attempts to design the *SRP* for any *WBL* system based on the concept of agent platform. The implementation of the different smart representatives for supporting *WBL* systems can be incorporated by *SRP*.

Since the main effort has been given in the reusability perspective of the specific policy, the *SRP* is structured depending on the open & interoperable standards. With the intention of designing & developing the features (representatives) that will provide the added value to any of the *WBL* systems, the specific design is developed that works on the basis of multi-representative policy. The proposed *SRP* can be developed

utilizing any of the agent development frameworks such as Java Agent Development Framework (JADE) [7], & this can in addition facilitate the global standards in the accomplishment of multi-representative systems.

The central idea is to take the full advantage of the simplicity of the proposed *SRP* & develop representatives that will implement the aspects identified in section II utilizing the *ER* depicted in chapter 3 as per the requirements of the *WBL* system. The fundamental feature of the *SRP* is the fact that it communicates with any of the *WBL* systems through the use of web services & communicates via the Simple Object Access Protocol (*SOAP*) protocol (see fig.2).

Each representative (R-1, R-2,…..R-n) can be designed & developed to implement functionalities that arise from the end-user requirements based on the aspects of the end-user in any *WBL* system (see fig.2). The requests coming from the *WBL* system can then be routed to a particular representative by the *Dispatcher Representative (DR)*. This representative owns the full responsibility for recognizing the requests coming from the *WBL* system & for assigning them to the right representative so as to be processed, & it can also be considered as the front end of the *SRP*.

The Agent Communication Language (*ACL*) [8], the part of Foundation for Intelligent Physical Agents (*FIPA*) template is realized for communication within the *SRP*. It is imperative to highlight that *DR* is the vital constituent of *SRP*. The multiple behavior & usefulness make it to happen in this *SRP*. In addition, it functions as process distributor, process identifier & communication handler. Therefore, it is a significant representative for the right functioning of *SRP*.

The representatives are required to report to the *DR* with the functionalities that they need. Consequently, the *DR* identifies the arriving requests from the *WBL* systems through a *SOAP* interface & transform them to *ACL* [8] messages with the aim of rerouting them to the subsequent representative. The use of the Java Agent DEvelopment framework (*JADE*) sets aside the successful conversation amongst different representatives. It is likely that a particular representative require the execution of functionalities of another representative, then ACL messages can be swapped amongst the participated representatives establishing interoperability aspects between different representatives.

2 RELATED WORK

Identifying the aspects of an end-user is crucial to any WBL system. Therefore, researchers have done numerous studies to come up with significant aspects. In the field of the authoring system abundant research has been done until now. The project BiTE [15] is one of the studies that intend to develop e-learning lessons by categorizing two major types of e-learning namely individual e-learning that focus on the private aspect of learning & group e-learning that deals with joint learning. The MOT system, yet another authoring system explains about how to customize e-learning contents in a personalized way by Power et. al [14]. One more significant authoring system is REDEEM [2] that groups end-users in numerous different classifications. Webster [22] examines the end-user thoughtful capabilities in her/his program & independence in learning & it also narrates about some cognitive styles that relate to learning. Triantafillou [21] explains the cognitive style of a student as the foundation for web-based learning system personalization, & depending on these cognitive styles, he develops a student model. In the field of e-learning, the Personal Reader [13] is also one more apparent that uses the semantic web to customize & improve the contents of e-learning. In the same research line, Dolog [6] argues that the semantic web can be apparent for end-user modeling, because it enables comfortable information about the end-user in e-learning. Kay [10] describes that the student model should be made accessible to the student, so that he/she can be conscious of the learning objectives, & how they can be achieved. Kobsa [11] & Benyon [3] have also shown how an end-user can be modeled along with some user model implementations. Masthoff [12] describes a system that can generate a study plan based on the student & his/her improvement along the learning sessions.

In *WBL* environments, utilization of agents is apparent for providing acumen. Therefore, Buraga [16] presents an agent-oriented extensible framework that deploys mobile agents that can exchange information in a flexible way via XMLbased documents.

The work proposed is based on the XML family for developing a hypermedia e-learning system that is accessible on the world-wide web. Many studies reveal that the intelligent tutoring system comprises of four main components. The information can be stored by XML documents that are to be processed by each component, & most of the components have been realized as intelligent agents. To facilitate the helpful learning material to students, Andronico et al. [1] presented a multi-agent recommendation system that recommends educational resources to students into a mobile learning platform so as to support mobile learning processes.

3 CONCLUSION & FUTURE OUTLOOK

The inference from the ECS is that end-users be presented with tools to help them to be aware of their strengths & weaknesses, by also making a legitimate attempt to assist them to be successful & accomplish outstanding performance. Considering the *ECS* discussed here, the fundamentals of knowledgebase & justification facility are of paramount importance. It is possible to manage the system, since the knowledgebase is structured that is independent from the core program of the system. Genetic algorithms, artificial neural networks, or fuzzy logic can be used to build a simple knowledgebase that enhance the system so as to predict the performance aim of any end-user, this is yet another idea that has been coined in this work. “End-user concern” is the key idea of the ECS.

The inspiration of the ER is based on the two basic ideas, the student as the end-user of the system, & the efforts that were made to model the user in *WBL*. The comprehensive *ER* provides the full knowledge of how a particular end-user can be best handled in a *WBL* environment.

The proposed *SRP* can be used as the simple but powerful integrated approach to achieve the utilization of various representatives in any *WBL* environments. Significantly, this boosts the entire system in terms of flexibility & efficiency. The *SRP* proposed can also support a variety of intelligent agents that provide appraisal services based on computational intelligence techniques such as genetic algorithms.

Future work involves the use of genetic algorithms so as to recognize suitable threshold values to the questions presented in ECS, & a more sophisticated genetic algorithm for updating the procedure of *ER* &, of course, designing representatives in *SRP*

that assist the learning content in the *WBL* system. Future work also involves carrying out tests of this system using any of the platforms with actual courses.

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