Content Management and Support in 3.0 E-learning Model

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***Abstract*—A number of E-learning models have been proposed in the literature capturing critical success factors of E-learning in an attempt to denote how E-learning can be made effective to achieve the best learning outcomes. In fact, E-learning has redefined the way education is dispensed across the world. It is viewed as a modern, effective and efficient alternative to education for a number of reasons including an alternate means to cater for the increasing demand for higher education and to cater for the increasing expectations to make the learning process more customised to learners' needs to achieved the best learning outcomes. The concept of Web 3.0 is often associated with the Semantic Web, which is a recent effort to make the Web more meaningful to machines. In fact, the Semantic Web is seen as a promising technology to meet E-learning requirement. Consequently, this study represents an attempt to provide a holistic representation of E-learning critical success factors as well as Semantic Web characteristics. The study proposes a combined E-learning and Semantic Web model, E-learning 3.0, derived from the literature review outlining four main characteristics namely Content Management, Teaching and Learning, Support and Technology. It focuses on two of these characteristics namely Content Management and Support, which are further analysed via surveys conducted within the Mauritian higher educational sector from students and lecturers. Results following an exploratory factor analysis on the 2 dimensions surveyed provided a regrouping of their sub characteristics allowing for a more integrated representation of these characteristics within the combined model.**

Keywords-E-learning; Semantic Web; Critical Success Factors; Content Management; Support

I. INTRODUCTION

In the research and development world, there is great stress upon the need to develop educational models that will meet the expectations of the higher-education community where effective learning occurs with the best outcomes. In fact, over recent years, more emphasis is given to the development of education systems that involve intelligent technologies and the World Wide Web [11]. With the need to make the learning process faster with well organised learning materials specific to learners' needs as well as customised online services initiated by user profiles, efforts are now being directed in building 3.0 E-learning systems in line with the Semantic Web [15].

As the name suggests, the Semantic Web aims to add a level of meaning to the Web so that it can be more easily manipulated by computer programs, and thereby used more effectively by humans [23]. In fact, the semantic web is about adapting content to specific users where instead of having to search a long list of web sites for the required information, users have access to a customised file where the content is translated, personalised and adapted to meet specific needs [1]. It encompasses efforts to build a new WWW architecture that enhances content with formal semantics, which enables better possibilities for navigating through the web and accessing its contents [22].

As a matter of fact, the static approach to learning content limits the willingness of many people to use information and communication technologies to learn [29]. Expectations with regards to E-learning lie in having a learning process which is timely and efficient capturing the needs for suitable learning content, as well as a mechanism to organise learning materials based on learner's needs and pace [22]. The concept of Web 3.0 is often associated with the Semantic Web and is seen as having the potential to improve the semantics interoperability for e-learning components and as such provide the best capabilities for learning content composition and access [35]. Central to this is the use of ontologies which is the backbone of the Semantic Web. Ontologies allow for learning domains to be described from different perspectives allowing for a richer description and retrieval of contents [7].

In an effort to remain competitive and maintain their market share, many traditional higher education institutions are offering web-based or web supplemented learning to compete with the growing number of virtual higher education institutions[25]. As such, E-learning is carving its way as an alternate medium of course delivery in many countries including Mauritius which aims to be the centre of excellence in education, attracting international universities and students from all over the region. In fact, in the wake of being a digital island, Mauritius regroups all the necessary ingredients in fostering E-learning as an alternative mode to traditional method of teaching [34]. However, one of the biggest drawbacks of the current

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educational system in the country is the under utilisation of technologies to enhance learning. E-learning platforms in Mauritius are usually used as means of delivery information on the Internet in static ways [34]. With internal university politics, omnipresent technological transformations in education and Government policies to democratise tertiary education, tertiary institutions, particularly public ones, are forced to reconsider the traditional class room delivery model and the roles that educators and learners play in the learning environment [33]. Undeniably, Mauritius is no exception to the growing need for post secondary education. With limited capacity of existing classrooms at academic institutions and the prohibitive cost of building new facilities, E-Learning is an attractive alternative [27]. In line with the aim to become a knowledge based economy, E-learning is seen as part of the solution in converting the island into a knowledge hub, complementing educational infrastructure needs, widening access and eliminating distance barriers and promoting a student centered learning environment [34].

With the numerous benefits that E-learning could bring to countries like Mauritius coupled with Semantic Web technology, which is seen as a promising technology to meet E-learning requirements, this paper aims to look at current literature and provide an overview of E-Learning critical success factors (CSFs) and Semantic Web characteristics in a combined 3.0 E-learning model. The paper will then empirically validate two characteristics outlined from the proposed 3.0 E-learning model namely Content Management and Support through surveys conducted within tertiary institutions in Mauritius. Section II of the paper describes the initial proposed model based on existing literature, Section III outlines the research methodology followed by the survey analysis of the characteristics Content Management and Support in Section IV. The paper ends with the conclusion and directions for future explorations in Section V.

II. INITIAL PROPOSED 3.0 E-LEARNING MODEL

A comprehensive literature search and review clearly revealed that E-learning CSFs which are relevant to the Semantic Web are often omitted or seldom integrated into existing 3.0 E-learning models. In an attempt to provide a holistic representation of a 3.0 E-learning model based on the combined characteristics of the Semantic Web and E-learning CSFs, an initial 3.0 E-learning model is proposed in Fig. 1 as an effort to synthesize existing literature review on E-Learning CSFs and Semantic Web characteristics. It seeks to capture the most prominent set of E-learning CSFs and Semantic Web characteristics derived from the literature review. However, for any E-learning system to be effective, users' perceptions and needs must be taken into consideration. As a result, this review cannot be claimed to be exhaustive. In order to ensure that the new model meets the needs and expectations of higher education E-learning users, namely students and lecturers, the model needs to be evaluated. For this purpose, the proposed 3.0 E-learning model is evaluated within the higher education sector in Mauritius. It consists of four main characteristics which are further broken down into a number of sub characteristics as follows.

A. Content Management consisting of: Content Creation, Content Retrieval, Content Reuse and Knowledge Representation

A systematic approach to managing knowledge is considered to be an essential pre-requisite for knowledge seekers to access relevant learning materials as and when required [16]. In fact, the prevalence of materials and resources to support the learning settings is deemed as critical to the success of online delivery strategies within higher education institutions [32]. As such, content management, which refers to the access, manipulation and maintenance of learning content, is seen as a key characteristic for 3.0 E-learning [31]. Central to this is the creation and retrieval of learning materials based on their degree of difficulty and knowledge levels of students. Furthermore, the Semantic Web is seen as an opportunity to enhance learning content descriptions via the use of ontologies, which provide a formal representation of learning content allowing for better conditions for composing and reusing learning materials [12][30].

B. Teaching and Learning consisting of: Curriculum, Pedagogy, Personalised Learning and Collaboration

According to [17], well-designed courses, curriculums and learning materials are key factors that influence learning performance. He further stated that that the structure and coherence of the curriculum components and of the learning material are major factors for facilitating meaningful learning. Additionally, personalised learning where students are provided with learning content which meet their specific needs and motivations as well as knowledge and skills level based on their particular learning and cognitive styles, is considered key to the success of E-learning environments [11]. Reference [4] further stated that productive learning outcomes are most likely to occur when learners perceive that their actual learning environment matches their preferred learning environment. In fact, according to [10], E-learning is concerned with ensuring learners' learning goals are met, synchronous and asynchronous communications occur, as well as collaboration between learners and instructors. The Semantic web is seen to further support teaching and learning, allowing students to determine their learning agenda and be in control of their learning [8].

C. Support consisting of: Instructional Support, Systems Support, Organisational Support and Government Support

According to [27], the success of E-learning in higher education is a shared responsibility between e-learning stakeholders. Students, lecturers, educational

institutions and the Government have key roles to play in the success of E-learning. In fact, organisational support is identified as a critical success factor for E-learning success in the literature review [14][36][38]. Reference [28] stated that successful implementation of e-learning requires the same management commitment as other mission-critical, university-wide initiatives. This includes the right teaching and learning support to lecturers and students to faciliate online learning acceptance and the necessary technical infrastructure and technical to support the E-learning environment. Students should be provided with the resources to develop and enhance their skills and knowledge of online learning management systems in terms of timely feedback on learning progress, appropriate online learning tools such as FAQs, discussion forums, emails and collaboration among peers [2] [20]. Similarly, lecturers should be provided with the support needed to allow for the shift in mindset and skillset necessary to perform effectively in an online learning environment [32]. It is even argued that the perception of how one is supported within an E-learning environment contributes significantly to its success [20]. In addition, especially in developing countries, such as Mauritius where public tertiary institutions rely a lot on Government's funding, political backing and support from policy makers are essential [3].

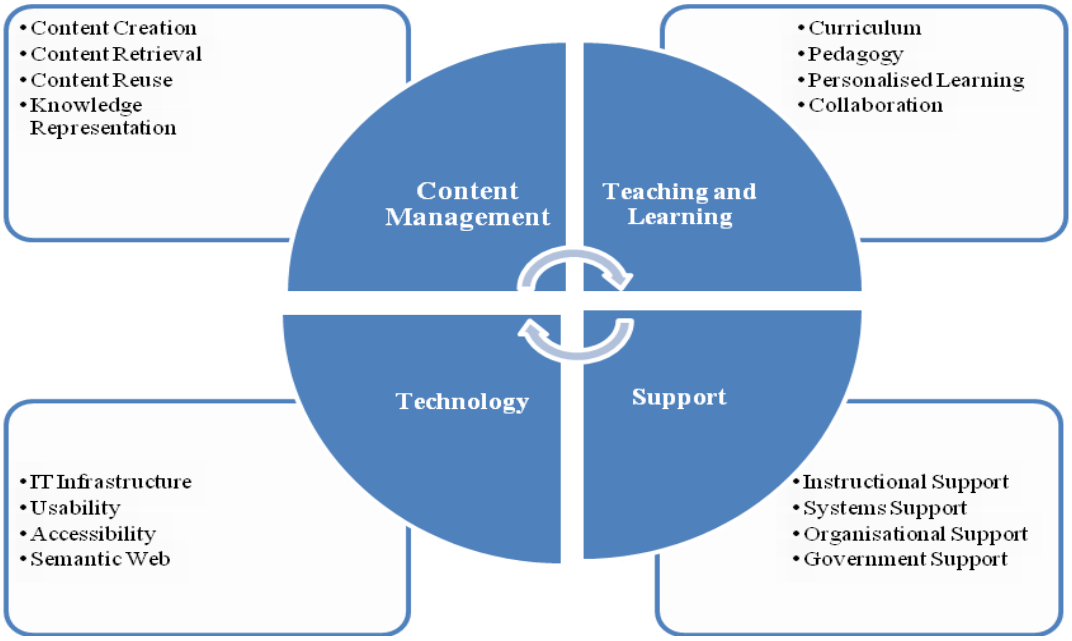

Figure 1. Initial proposed 3.0 E-learning model.

D. *Technology consisting of: IT Infrastructure, Usability and Accessibility and Semantic Web*

The acceptance of E-learning depends a lot on the efficient and effective use of Information Technology [5]. A reliable IT infrastructure capable of supporting online delivery is considered as a critical success factor for E-learning [14]. Systems usability and accessibility are key as systems users, especially students, will not care about didactics as long as as they can find the information they are looking for and their needs are satisfied [16]. The interface design as well as the ease of navigation and consistency in the manner that the online learning environment is presented and organised play vital roles in fostering a friendly and less intimidating learning environment [5]. In addition, the E-learning environment can be further enhanced by Semantic Web technologies where personal profile of students including previous knowledge and experience, preferred learning styles and educational goals can facilitate semantic web retrieval of content to allow for best individuals learning experiences. Semantic Web technologies through the use of ontologies can provide well structured databases to allow better knowledge handling by machines opening the gate to a learner centered learning environment which promotes collaboration, reuse and where learners can manage their own learning content [2].

III. METHODOLOGY

Two web-based surveys were conducted to gather the perceptions of students and lecturers on the initial proposed 3.0 E-learning model. One survey was directed towards students from the Mauritian higher education sector and one

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was directed towards lecturers of the Mauritian higher education sector. Web-based surveys have several advantages including short response time, lower cost to the researcher(s), instant access to the audience irrespective of their geographical location, better design options, speed and accuracy of data collection and immediate access to results in different formats [6] [18] [39]. However, there have been concerns about the reponse rate of web-based surveys which is highly dependent on Internet and email technology as well as participants characteristics [37]. Bearing these in mind and looking at the target participants for this study, namely students and lecturers from Mauritian higher education institutions, web-based surveys were considered as appropriate.

The development of the survey required a thorough understanding and accurate interpretation of E-Learning CSFs and the Semantic Web characteristics from the literature review. The surveys' questions were then based on the characteristics identified in the initial proposed model as per Fig. 1 in order to gather the perceptions of Mauritian students and lecturers on these characteristics.

In order to collect a sample that represents the point of view of Mauritian higher education students and lecturers, a research agency in Mauritius was contacted to distribute the survey. The respective links of the surveys were distributed to students and lecturers from both public and private tertiary institutions via emails. With the response rate of web-based surveys also dependent on the number of contacts made to participants, participation rate was monitored and follow ups emails were sent to participants to ensure as many responses as possible [24][21].The data collection process was anonymous. Participants provided consent before moving to the next part of the survey by reading the Informed Consent form. The fom clearly stated that by completing the survey, they are consenting to participate.

Both surveys were structured in a simple manner and consisted of different types of questions including multiple choice questions, five-point Likert scale questions and free text boxes. Participants were provided with a brief explanation of each section at the beginning of each section.

Section one of both surveys captured general information about participants' demographics. Each of the characteristics in the proposed model had a dedicated section to it with a number of statements using a five point likert scale to determine how strongly participants agree or disagree with the statements. The scale ranged from one to five and consisted of the following values: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree with a '5' representing the participant strongly agree with the statement and a '1' representing the participant strongly disagree with the statement. At the end of each section, participants were given the option to write any comments regarding each section should they wish to do so via a free text box.

IV. SURVEY ANALYSIS

300 students and 105 lecturers from the public and private tertiary institutions participated in the surveys. Table I provides some statistics on the students' and lecturers' surveys participation.

TABLE I. ONLINE SURVEY STATISTICS

	Lecturers' Survey	**Students' Survey**
Number of participants	105	300
Gender		
Male participants	50%	43%
Female participants	50%	57%
Types of Institutions		
Public	51%	48%
Private	49%	52%
Age (Students)		
16-25		97%
26-35		3%
36-45		-
46-50		-
51 and above		-
Age (Lecturers)		
22-35	18%	
36-45	27%	
46-50	41%	
51-55	12%	
56-60	2%	
61 and Above	-	
Fields of Study/Faculty		
Agriculture	-	-
Art & Design	10%	7%
Business, Accounting & Finance	16%	6%
Engineering	1%	6%
Health	1%	3%
Information Technology and Systems	9%	10%
Law and Management	27%	12%
Science	-	6%
Social Studies & Humanities	14%	12%
Tourism	18%	23%
Others	4%	15%
Qualifications		
Foundation	-	3%
Undergraduate Certificate	-	7%
Undergraduate Diploma	-	22%
Undergraduate Degree/Bachelor Degree	5%	62%
Postgraduate Diploma	13%	4%
Postgraduate Degree/Masters	67%	2%
PhD/Research	15%	-
Others	-	-

SPSS software version 22.0 was used to analyse the surveys' results. Exploratory factor analysis was used to "explore the underlying dimensions of a construct" in order to ensure a more consistent interpretation of data from the original groupings in the proposed model [9]. To ensure the appropriateness of factor analysis for this study, the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and the Bartlett's test of sphericity which examines if variables are related were used [13] [26]. KMO recommends a minimum of 0.5 while the Bartlett's test of sphericity is significant when p = .05 or smaller [19]. The KMO for statements

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related to Content Management and Support characteristics are outlined in Table II. The KMO results met the minimum standards required for both groups although Content Management seemed to be a concept more familiar to lecturers as compared to students. The Bartlett's tests were significant for both characterisics and groups. Factor analysis was therefore deemed appropriate for this study.

TABLE II. KMO AND BARTLETT'S TEST

		Content Management		Support	
		Lecturers' Survey	Students' Survey	Lecturers' Survey	Students' Survey
KMO Measure of Sampling Adequacy		.797	0.54	0.699	0.824
Bartlett's Test of Sphericity	Sig.	.000	.000	0.000	.000

With these initial tests and findings, factor extraction was then performed on both characteristics to determine the smallest number of factors that can be used to best represent the interrelationships among the set of variables [19]. Kaiser's criterion where only factors with an eigen value greater than 1.0 was then used to determined the number of factors to be retained [19].

For Content Management for both the lecturer's and the student's survey, there were 2 components with eigenvalues greater than 1; these 2 components accounted for 57 % (lecturer's survey) and 62% (student's survey) of the total variance of the data set. Similarly, for Support, 2 components accounted for 54 % (lecturer's survey) and 57% (student's survey) of the total variance of the data set. To assist further in the analysis of these 2 characterisitcs, Varimax rotation method, a widely used orthogonal method which attempts to minimise the number of variables by keeping the high loadings variables for each factor, was then used to determine which factors loaded on each of the dimensions [9][19].

With respect to Content Management, for the lecturers' survey, the items that cluster on the same components suggest that component 1 represented Content Relevance and Responsibility while component 2 represented Content Representation. As for the students' survey, component 1 was very much related to that of the lecturers' survey and was termed as Content Relevance and Accessibility while component 2 was termed Content Responsibility . Based on these results, Content Management was reviewed to include Content Relevance, Content Accessibility, Content Responsibility and Content Representation as per Table III and Table IV.

TABLE III. CONTENT MANAGEMENT FACTOR LABELS - LECTURERS

Statements from Lecturers' Survey	Component 1	Component 2	Factor Labels
Learning content should match the unit's aims	.764		**Content Relevance and Responsibility**
Learning content should match students' needs	.659		
Students can contribute to learning content creation (e.g. Students' portfolios, presentations etc)	.645		
Only lecturers can create learning materials	.640		
Learning content should be reusable		.908	**Content Representation**

TABLE IV. CONTENT MANAGEMENT FACTOR LABELS - STUDENTS

Statements from Students' Survey	Component 1	Component 2	Factor Labels
Learning content should be quick to search	.795		**Content Relevance and Accessibility**
Learning content should match students' needs	.778		
Only lecturers can create learning materials		.867	**Content Responsibility**
Students can contribute to learning content creation (e.g. Students' portfolios, presentations etc)		-.544	

TABLE V. SUPPORT FACTOR LABELS - LECTURERS

Statements from Lecturers' Survey	Component 1	Component 2	Factor Labels
Training to use the system is important	.875		**Types of Support**
Effective and appropriate technology infrastructure is important	.833		
Ongoing IT Support is important (e.g. help, FAQs, Help desk)	.556	.402	
Students should assist their peers			
Ongoing feedback to students about their learning performances is important		.734	**Stakeholder's Support**
Ongoing feedback from students about their learning experience is important		.724	
Lecturers should support students (e.g. students'; encouragements, provision of study materials, assessment and exams hints, use of different teaching styles)		.681	

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TABLE VI. SUPPORT FACTOR LABELS - STUDENTS

Statements from Students' Survey	Component 1	Component 2	Factor Labels
Ongoing IT Support is important (e.g. help, FAQs, Help desk)	.818		**Types of Support**
Effective and appropriate technology infrastructure is important	.804		
Training to use the system is important	.600		
I should be able to provide feedback about my learning experience	.535	.445	
Lecturers' support is important (e.g. through students' encouragements, provision of study materials, assessment and exams hints, use of different teaching styles)		.713	**Stakeholders' Support**
Peer assistance is important to me		.712	
Ongoing feedback from lecturers about my learning performance is important		.668	

TABLE VII. SUMMARY OF FACTORS FOR CONTENT MANAGEMENT AND SUPPORT

		Results derived after Students' Survey Analysis	Results derived after Lecturers' Survey Analysis	Results derived after Students' and Lecturers' Surveys Analysis
Content Management	Content Relevance			√
	Content Accessibility	√		
	Content Responsibility			√
	Content Representation		√	
Support	Types of Support			√
	Stakeholders' Support			√

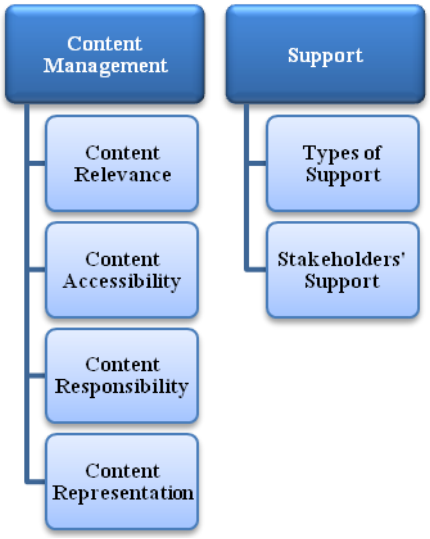

Figure 2. Revised Content Management and Support characteristics.

As for Support, for both surveys, factor loadings after rotation showed clustering on component 1 to represent the types of support expected and therefore renamed as Type of Support. Component 2 for both surveys converged towards the idea of who should be providing the support and was renamed as Stakeholders' Support. Table V and Table VI outline the factors for Support chactacterisitcs.

The revised Content Management and Support Characteristics are shown in Fig 2. For Content Management, the resulting factors Content Relevance and Content Responsibility were derived from both the students' and lecturers' surveys while Content Accessibility and Content Representation were factors derived from the students' and lecturers' surveys respectively. The Support characteristic consists of Types of Support and stakeholders' Support resulting from analysis of both students' and lecturers' survey. Table VII provides a summary of the factors derived , clearly outlining factors common to both surveys' analysis.

To examine the internal reliability of each dimension, Cronbach alpha was calculated on the 2 dimensions resulting in alpha coefficients of 0.737 and 0.778 respectively indicating sufficient level of reliability. Based on these results, it can be concluded that these two dimensions namely Content Management and Support represents different aspects of the 3.0 E-learning model.

V. CONCLUSION AND FUTURE WORK

Higher educational institutions are required to understand the critical success factors affecting E-learning

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to be able to make the best use of the Internet. With Semantic web technologies viewed as a promising technology to meet E-learning requirements, the need for a combined model capturing the CSFs of E-learning as well as the main characteristics of the Semantic Web is deemed necessary.

This study is significant because it proposed a combined model representing the CSFs of E-learning with the Semantic web, namely a 3.0 E-learning model. The study identified four main characteristics within the proposed 3.0 E-learning model and provided empirical evidence and indicative support of the importance of two of these characteristics namely Content Management and Support. This study additionally provided a deeper analysis of Content Management and Support characteristics via exploratory factor analysis further regrouping the sub characteristics of these two dimensions to provide a more holistic view of what they represent within the model.

In terms of future directions, since the results of this study are based on survey outcomes from Mauritian Higher educational sector, they can be further assessed by interviewing experts in E-learning within the Mauritian higher educational sector. Future research should also aim to generalise these results to consider other environments and countries. Additionally, more characteristics and sub characteristics can be added to the E-Learning and Semantic Web Combined Model, as well as new groupings can be made following further analysis.

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