

Open Source Software for Virtual Learning Environment: Comparative Study

Shalini R Lihitkar

Dipti Arora

Abstract

Virtual learning environment (VLE) provides students a common platform where they can get the subject-wise tutorial online (and anytime), i.e. they are not limited to only class room teaching. Apart from making learning and teaching virtually real, VLEs are equipped with other features like syllabus/curriculum for the course; administrative information like location of sessions, details of prerequisites and co-requisites, credit information, notice board for up-to-date course information and how to get help, etc. Present paper is an effort to evaluate and compare the most widely used open source VLE software tools. It compares the features, pre-requisites, and other parameters based on the predetermined parameters. Ranks to all the four open source VLEs are given on the basis of comparative study.

Keywords: Virtual Learning Environment, Atutor, Claroline, Dokeos, eFront, Open Source Software

1. Introduction

Information and communication technology (ICT) and Internet has changed the scenario and life style of the people a lot. Today whole life revolves around Internet in and out, rather almost everywhere. Starting from accessing scholarly content to buying electronic equipment to even buying cloths and lots more, everything is dependent on Internet somewhere. Education and knowledge sector is also one area which has also been widely developed. Keeping in view the requirements and also with focus on providing need based information, Internet and ICT helped lot. Overcoming the constraints imposed by traditional learning and teaching, the new way of learning has given wide opportunities. This new way of learning environment that emerged today and is growing invisibly rather virtually is called Virtual learning environment (VLE).

Virtual learning environment provides students a common platform where they can get the subject-wise tutorial online (or anytime), i.e. they are not limited to only class room teaching. Besides all these, VLE also provides syllabus for the course; Administrative information like location of sessions, details of prerequisites and co-requisites, credit information, and how to get help, notice board for up-to-date course information; Student registration and tracking facilities; Basic teaching materials, and lots more. They may be the complete content of the course, if they are being used in a distance learning context, or copies of visual aids used in lectures or other classes where it is being used to support a campus-based course. VLE enables students to have Self-assessment quizzes which can be scored automatically; Formal assessment procedures; Electronic communication support including e-mail, threaded discussions and a chat room, with or without a moderator, Differential access rights for instructors and students; Production of documentation and statistics on the course in the format required for institutional administration and quality control.

Virtual learning environment are such a user friendly that even a non-technical user can make changes to a website with little training. A VLE typically requires a systems administrator and/or a web developer to set up and add features, but it is primarily a website maintenance tool for non-technical staff. A VLE can control a dynamic collection of web material, including HTML documents, images, and other forms of media. http://en.wikipedia.org/wiki/Web_content_management_system - cite_note-3 A VLE facilitates document control, auditing, editing, and timeline management. A VLE typically has the features like automated template; access control; scalable expansion; Easy editable content; Scalable feature sets; Web standards upgrades; Workflow management; collaboration platform; Document management; Content virtualization; Content syndication; Multiple languages support, etc. There are two types of virtual learning courseware available—open source type and closed system type. Open source type courseware are the one that facilitate the users to customized them at their end and come with sourcecode open. But closed system is the proprietary kind of virtual learning environment. Most open source VLE have the capability to support add-ons, which provide extended capabilities including forums, blog, wiki, web stores, photo galleries, contact management, etc. These are often called modules, nodes, widgets, add-ons, or extensions. Add-ons may be based on an open-source or paid license model. While hybrid systems, combine the offline and online approaches. Some systems write out executable code (e.g., JSP, ASP, PHP, ColdFusion, or Perl pages) rather than just static HTML, so that the CMS itself does not need to be deployed on every web server. Other hybrids operate in either an online or offline mode.

2. Literature Review

Some studies have been done for virtual learning environment and content management system in the past. A comparative study done by Iglesias¹ compared three open source VLE software. It says that learning content management systems (LCMSs) have become increasingly popular in the educational field over the past few years. However, problems in system design can create difficulties in the interactions between LCMSs and an important sector of the user population. The assessment and monitoring of LCMS accessibility are vital for the guarantee of universal accessibility in education. Results of the study indicate that barriers to accessibility are present in each of the three systems evaluated. A primary aim of the study is to help detect and correct these barriers such that the goal of universal access in educational environments may one day be achieved. But the study is limited to only three VLE software i.e., Moodle, ATutor, and Sakai. Also it has not measured their feasibility, availability, and usability on any criteria.

Another study done by Sunny² evaluated open source content management system. He said, content management systems (CMS) evolved as an alternative to web-authoring tools like Dreamweaver, Frontpage, etc. According to him, a content management system offers a way to manage large amounts of web-based information that escapes the burden of coding all of the information into each page in HTML by hand. Although the rapid proliferation of commercially available content management systems makes it easier to find a vendor that might have right solution, the cost to purchase a commercial CMS application is very high. As an alternative to commercial CMS, open source solutions are a tantalizing option. Though, there

are a huge number of open source CMS available in public domain, it is difficult to decide what solution will work best for a particular organization (or library). The author only tried to explain the functional requirements, for novice users, but did not evaluate any open source VLE. A study done by Benevolo³ tried to make a theoretical comparison between the functionalities of CMS and those of the systems they are often confused with. Then they show the results of an empirical research on 22 products offered by international vendors. Their results consists of performing definitions for CMS and the other systems for managing information. They tried to analyze various content management products and also compared and evaluated by using a special table created to point out the actual functionalities of the products offered on the market, despite vendors' declarations. Moreover the highlights are displayed in a matrix to evaluate the level of personalisation-flexibility of the different products. The paper conclusions show how, on the demand side, companies' needs are growing in a confused framework; at the same time the supply side keeps on feeding this confusion, reducing company satisfaction in regard to knowledge and information management. The study is based on a survey (though it is too old, carried out in the year 2005) to recognize definitions to delimit the areas of competence of the different products offered in content management market. The study bears no relation with the open source type VLE available or their use. One more study done by Clements⁴ compared only three (Moodle, Claroline, ATutor) VLE based on criteria like cost and features. The study is limited to only three software and also criteria for choosing any of the open source software has not been provided. Above all the study is also very old.

3. Objectives of the Study

Present study is an effort to compare the most usable and open available type of E-learning software available. It also carries the major objectives like finding out the current status of open source virtual learning environment system which is being mostly used by LIS departments/universities/institutions for providing e-learning at national and international level. It compares four open source software for creating E-learning environment for LIS education based on the predetermined parameters. It finds out and rank the more user friendly open source software based on the comparative study. It also offers suggestions or guidelines for creating virtual learning environment for LIS education.

4. Methodology

It seems no fresh work has been done on the virtual learning environment in the recent time. Present study was carried out with the stated objectives. For this four open source virtual learning environment software were downloaded. All the software were compared and evaluated based on the same criteria. The criteria revolve around the students, their requirements, functionalities, pre-requisite, user-friendliness and all were tested on a common evaluated standards and a rank is given to each of the VLE software.

5. Scope and Limitations of the Study

The study took only open source software, no closed type VLEs has been considered. There are many open source software available, the study evaluated and compared four most widely used open source type

VLEs. The result and evaluation totally surrounds on individual way of handling any VLE and also how easy to customize and avail the flexibility of the software. Each VLE software was evaluated on a common criterion, and a common procedure was followed to rank it. For the present study only open source software which are used to create e-learning environment by LIS departments/ institutions/ organizations were considered. The open source e-learning software studied were Atutor, Claroline, Dokeos, and eFront.

6. Selected Features

For testing the variable features stated and for comparing the selected features, all the four software were downloaded. The basic requirements as an administrator like creation of course, addition of materials, chapters, creation of users' account, managing users' (students, professors) accounts were tried and checked for all the software.

6.1 ATutor

ATutor⁵ is a promising software took little more technical handiness to be downloaded and installed, but its good documentation and step-wise provided installation manual helped lot while installation. ATutor is strong on standards and written in modular format. It also conforms to SCORM (Sharable Content Object Reference Model) and IMS (Integrated Management System) interoperability standards. The two friendliness, i.e., user friendly and install friendly makes 'A' in ATutor validated. As 'A' in ATutor stands for adaptive and accessible as stated in its manual. ATutor as such is available in four modules as 'ATutor' for Course Management; 'AContent' for Content Management; 'ATutor Social' for Networking; and 'AChecker' for Accessibility. ATutor was created with accessibility as a priority to ensure that all users can access the system regard-less of the technology they use for online learning or teaching. Users with a disability, possibly using assistive technologies, or those who use an older browser, a slow Internet connection, a Personal Data Assistant (PDA) or a cellular phone, can all expect to access ATutor and participate fully in teaching and learning activities⁶. Figure 1 shows the home screen after ATutor is logged in. One can use the setup wizard to make their own preferences like choosing alternatives and access.



Figure 1. Home page and preference customization



Figure 2. Creating a new course

Figure 2 shows the creation of course and its sub-categories in ATutor. Whenever any new information is uploaded on ATutor, it asks for its accessibility, i.e., public, private or protected like to whom it will be viewed

and also whether log-in will be required to view it or not. One more feature that is available in ATutor is ‘Photo gallery’ option. One can create its own albums with their captions, preferences, and also can make them clustered to appear in the gallery (Fig. 3).

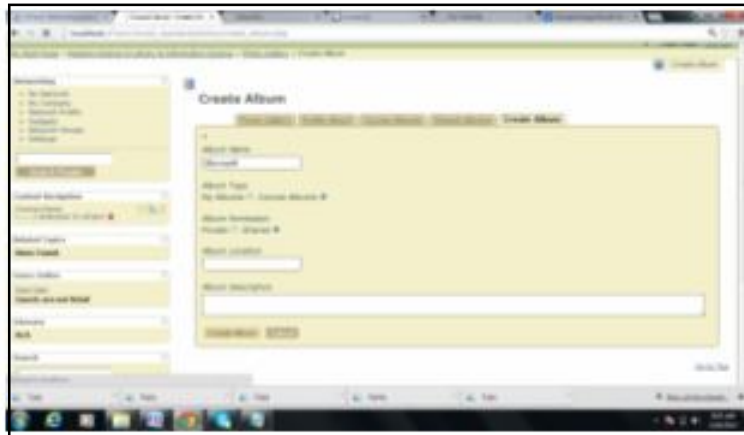


Figure 3: Creating photo albums in the photo gallery

6.2 Claroline

Claroline⁷ software was initially started by the University of Louvain (Belgium) and released under Open Source licence (GPL). Since then, a community of developers around the world contributes to its development. Claroline is a simple and easy to use, open source software with few navigations but compromised with all the basic requirements. Earlier version were limited with some features, but its latest versions are full of latest features, more languages translations, attractive and adhere to standards. It also provides group management, forums, document repositories, calendar, chat, assignment areas, links, user profile administration on a single and highly integrated package. Some of the features that are provided by claroline are:

- ◆ Learning Path—Allow course manager to easily organize course resources for student in a framed learning path.
- ◆ WYSIWYG Editor—To create and edit content on the fly and store it into documents, posts, announcements, messages, and quizzes.
- ◆ SCORM & IMS—Compatible with IMS 1.1.2, SCORM 1.2 (minimal conformance level + optionnal Data Model Element) and SCORM 2004 (basic conformance), i.e. It can import content package & allow exchange between various learning management systems.
- ◆ LDAP and External Authentication—Able to connect itself simultaneously to several external authentication systems, to retrieve user settings from the outside.
- ◆ Languages—Some of the languages that are added are Arabic, Brazilian, Danish, Dutch, English, French, German, Greek, Indonesian, Italian, Japanese, Malay, Russian, Spanish, Swedish, Thai, Turkce, etc.

- ◆ Security Improvement—More security options are provided for its accessibility.
- ◆ “Course Home Page—New layout left most of the display area to course manager, allowing him to fill it with his own content.
- ◆ Course Banner—Navigation improvement

Figure 4 shows the Claroline Homepage as an administrator login. Figure 5 shows the creation of new course. One can also provide the course code and also can limit its accessibility options.

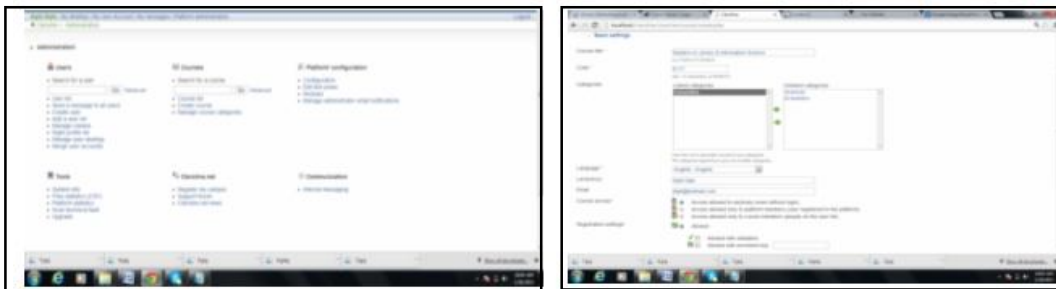


Figure 4. Claroline platform administration page **Figure 5. Creation of new course**

6.3 Dokeos

Dokeos⁸ was first created by Thomas De Praetere but grew out of experience with inflexible commercial tools. It was always compared with its existing softwares like WebCT, Blackboard (proprietary VLE software) and was always a better alternative. Dokeos was experienced as more flexible, more open in ideas, more open in source, more open in standards like real SCORM/IMS, and with more flexibility. It uses stylesheets so administrator can customise the web page and can change the appearance as per his choice and requirements. Technically, Dokeos is an AMP software, i.e., it should work on any platform running Apache + MySQL + PHP. Dokeos includes a LDAP module that allows admin to deactivate MySQL authentication and replace it by connection to a LDAP directory. Upgrade from a previous version is also very simple but developers recommends to take full backup of the previous Dokeos directories and databases. It is also suggested not delete the previous Dokeos installation directory before installing the new one. When the update is successfully finished, one can remove the old path. Some of the other features that are also provided in the Dokeos are LDAP support, rapid learning, powerpoint conversion, audio-recorder, videoconferencing, mathematics formula option, Multisite. Figure 6 shows the customized home page for the Dokeos. Figure 7 shows the creation of new course in the Dokeos software and also its categorization and accessibility options. Dokeos administration page is available in the four sections that makes it more user-friendly and easily customized (Figure 8).



Figure 6. Customized home page for the Dokeos.



Figure 7. Creation of new course.



Figure 8: Dokeos Administration Page

6.4 eFront

eFront⁹ is an easy to use, visually attractive, SCORM compatible, eLearning and human capital management platform. Its natural interface, self-explanatory options makes it more visually attractive rather more beautiful VLE tool. It is also technologically advanced like Ajax enabled, Unicode, LDAP and SCORM supporting, multilingual eLearning, etc. Its integrated sound pedagogical concepts also guide users and keep them motivated. Although it is distributed as free software, still it is being supported by a professional team of highly skilled developers. eFront includes a wide variety of components that helps to create lesson structure, add content, build online-tests, communicate with others, track users history and progress, conduct surveys, assign projects, and to create certifications. Some of the features provided by eFront¹⁰ are: User and files; Curriculum, courses, lessons and categories management; Exam and assignments builders; Communication tools like forum, chat, calendar, glossary; Progress tracking, authentication methods and Certifications; Enrollment methods, reports generators; Extensibility via module; Social tools like lesson & system history, user wall, user status, Facebook interconnection; Customizable notification system through email; Skinning via themes. Figure 9 shows the logged in home page as an administrator. Figure 10 shows the logged in page when logged in as users (professors and students).



Figure 9. Logged-in homepage (As a professor) Figure 10. Logged in pages (As a user)

7. Analysis and Interpretations

There are various open source software available but for the current study only four software were selected. The features of software were studied by applying some criteria like ease of downloading, ease of installation, ease of customization, features provided to users (students, professors) searching facilities, platform to run software, associated software, languages included in software, searching parameters and above all user friendliness and after analysing grading of software have been done based on the assigned points for each parameters. Table 1 shows the URL, developer and the contact information for the open source software considered.

Table 1. Selected Open Source Software

Software	URL	Free down-loadable	Developed by	Contact information mailing lists
ATutor	http://www.atutor.ca	Yes	Adaptive Technology Resource Centre (ATRC), Toronto	info@atutor.ca
Claroline	http://www.claroline.net/	Yes	Catholic University of Louvain, Belgium	info@claroline.net
Dokeos	http://www.dokeos.com/	Yes	UCL, Belgium	support@dokeos.com
eFront	http://www.efrontlearning.net	Yes	Epignosis Ltd, Greece	http://www.efrontlearning.net/

Table 2 shows the latest version of software that are readily available for the use and also gives the information about the year in which new version first version released it also specifies, the site address from which the user can download the particular software and also its size in MBs.

Table 2. License, new version, downloaded site and size of the selected OSS

Name of software	License	Version used	Year (latest version)	Downloaded from	Size (MB)
ATutor	GNU General Public License	2.1	2012	http://atutor.ca/atutor/download.php	6.6 MB
Claroline	GNU General Public License	1.11.4	2012	http://www.claroline.net/downloads/?lang=en	6.4MB- Windows 5.5MB for Unix, Linux, Mac OS X
Dokeos	GNU General Public License	2.1	2011	www.dokeos.com/extensions/index.php	53.5 MB
eFront	Common Public Attribution License	3.6	2010	http://www.efrontlearning.net/download	23.4 MB

Table 3 shows the pre-requisite requirements for each of the four OSS. It is being observed that Apache is the most widely tested and accepted web server recommended. But eFront can work with Apache 1.x, IIS server also well. MySQL database support is provided by all the stated software, but Claroline recommend MySQL database server 4.23 or later. For browser support, any browser can be used but ATutor works well even on latest browsers like FireFox 2+, Opera 8+, Internet Explore 7+, and Google Chrome. Some difficulty was felt for opening Dokeos files on Mozilla FireFox. The latest versions for all the four software are compatible with Windows 7, however Dokeos recommends use of Linux server for optimal flexibility, remote control and scalability. The eFront support MySQL server 4+ but it strongly recommends MySQL 5 and made it mandatory for eFront Enterprise installations.

Table 3. Pre-requisite/associated software for installation of selected open source software

Software	Written in	Recomm-ened server	Database support	Recommended browser	Platform support	Tested on
ATutor	PHP	http/Apache	MySQL Postgres SQL	Current versions of FireFox 2+, Opera 8+, and Microsoft Internet Explorer 7+, and Google Chrome	Windows/ Linux / Mac OS/ BSD/ Solaris	Windows XP/Windows 7/ Linux
Claroline	PHP	Apache	MySQL databases server 4.23 or later	Any web browser	Linux/ BSD / Unix (*) Windows (9x, Me, NT4, 2000, 2003, XP) Mac OS X	Fedora, Mandrake, Red Hat Enterprise Server, Ubuntu, Debian Windows XP, Windows2000 Mac OS X 10.3
Dokeos	PHP	Apache	MySQL	Any web browser	Cross-platform	Windows, Linux, Mac OS X and UNIX servers
eFront	PHP	Apache 2+	Mysql Server 4+	Any web browser	Windows, Linux	Windows, Linux

Table 4 shows the number of languages supported by the stated software and are readily available for use. Maximum number that is more than 40 languages are supported by eFront. As per the user requirement, the user can choose and change the language according to his convenience for handling the software.

Table 4. Total Number of languages included in the software

S.No	Software	Languages supported	Points assigned
1.	ATutor	30	3
2.	Claroline	35	3
3.	Dokeos	34	3
4.	eFront	40	4

Table 5 shows the comparisons of basic required features provided by the selected VLE software tool. Table 6 shows the number of facilities provided by each of the VLE. Though it was little bit cumbersome to validate, still a comparative check was followed and a number is assigned to each of the VLE tool. Table 7 shows the number of searching parameters. ATutor and eFront provide the open search, so maximum 10 points have been assigned to each of them. Table 8 shows the ranking for each of the assigned point for all the four VLE tools.

Table 5. Facilities provided by selected open source software

Name of software	Searching/browsing	Multilingual support	Web 2.0 support	Course tool management	Text editor	Standards conformance	Customised homepage	Themes	Export/Import	Tracking , statistics & report	Points gained
ATutor	√	√	√	√	√	√	×	√	√	√	9
Claroline	√	√	√	√	×	√	×	×	×	√	6
Dokeos	√	√	√	×	×	√	√	×	×	√	6
eFront	√	√	√	√	×	√	×	√	√	√	8

Table 6. Total number of facilities provided by open source software

Software	Announcements	Back-up & restore	Photogallery	Forum	Automatic e-mails	Glossary	Blogs	Adding external tools.	Plugins	Points Gained
ATutor	√	√	√	√	×	√	√	√	×	7
Claroline	√	×	×	√	√	×	×	×	×	3
Dokeos	√	√	×	√	√	×	√	×	√	6
eFront	√	√	×	√	×	√	√	√	×	6

Table 7: Total number of searching parameters in the software

Sr.No.	Software	No. of searching parameters	Points assigned
1.	ATutor	Open	10
2.	Claroline	2	2
3.	Dokeos	2	2
4.	eFront	Open	10

Table 8: Ranking of Selected OSS

Parameters	Points Assigned	Open Source Software			
		ATutor	Claroline	Dokeos	eFront
Operating system					
Windows	4	√	√	√	√
UNIX	2	-	√	√	-
LINUX	2	√	√	√	√
Other	1	√	-	√	-
Total		7	7	7	6
Languages					
English & other		3	3	3	4
Learning tools					
Forums		√	√	√	√
Backup & restore		√	-	√	√
Glossary		√	-	-	√
Exercises, assignments, grading		√	√	-	√
Export/Import		√	-	-	√
Student tracking		√	√	-	-
Total		6	3	2	5
Usability					
Total		16	13	12	15

Table 9 shows the analysis of grading of selected open source software. Grading is based on the parameters as

- 1) 40-50: Excellent
- 2) 30-40: Very Good
- 3) 20-30: Good
- 4) 10-20: Average
- 5) Below 10: Poor

Table:9. Analysis of grading of selected open source software

S. N.	Software	Points gained	Excellent	Very Good	Good	Average	Poor
1.	ATutor	45	√	-	-	-	-
2.	Claroline	27	-	-	√	-	-
3.	Dokeos	29	-	-	√	-	-
4.	eFront	43	√	-	-	-	-

7. Findings And Conclusions

The study of OSS restricted within the study of the features of the software. They represent rather different perspectives, and have different and in many ways complementary, goals and strengths. One goal they share is that they are flexible, and can be customised and modified at many different levels – including the programming level, since they are open source systems. This gives the ultimate flexibility and yields significant advantages over closed-source systems.

- a) All the OSS are freely available and some are under the GNU (General Public License) license except eFront which is available in CPAL i.e. Common Public Attribution License.
- b) It is also observed that to run this software they need pre-requisite software. This software can be used to make sophisticated computational techniques accessible to everyone.
- c) Though not much expertise are required for installation and customization, still little difficulty was felt for customizing ATutor as compared to others.
- d) All the four selected OSS support course material management, students tracking and reports management, still the grading system of ATutor was more user friendly.
- e) ATutor and eFront share most of the features that are common, also they support Themes that users can change the colour and fonts of their screens accordingly.
- f) As observed from Table 4 maximum number that is more than 40 languages are supported by eFront. As per the user requirement, the user can choose and change the language according to his convenience for handling the software. It was interesting to note that eFront and ATutor even translate even in Hindi language.
- g) The home page of eFront was found more user-friendly and gridded. As options were available on the very first page, so it was easy to look for all options. For rest of all the three VLE tools, one can has to navigate and search to look for other options.
- h) Though Dokeos provided customized home screen, still it was felt very few options were available. Though the documentation and the Demo feature for this was felt extremely commendable.
- i) It was felt difficult to navigate & search for various available features for all except the ATutor which provide glossary and all the site map type features in the ‘Manage’ tab in the course menu.

- j) Studying of course material and learning experience for eFront was more clear, and also it constantly shows the progress of all the lessons which are covered. Scheduling for studying the material option is also provided in the eFront.
- k) Claroline and Dokeos also provide the automatic e-mails features. Internal meessaging is the feature provided only by the Claroline.
- l) Fully customize the homepage for the Dokeos was felt unique and also one can add the slogans, overview, and others like team responsibilities and all.

8. Conclusion

Open source virtual learning environment software tools certainly made the e-learning experience unique and 24X7 available. Virtual learning environment provides students not only a common platform where they can get the subject-wise tutorial online (or anytime), also they are not limited to only class room teaching. The slated features, unique characteristics and also availability of basic on-time needs like syllabus for the course; Administrative information, location of sessions, details of prerequisites and co-requisites, credit information, registration and tracking facilities are tremendously useful. Above the campus-based learning, VLE enabled students to have self-assessment quizzes which can be scored automatically; formal assessment procedures; threaded discussions, chat room, with or without a moderator, etc., and above all a visually attractive screen that made them widely used everywhere. Most of the open source VLEs is already in used by most of the small and medium size institutes. Though Blackboard and Vista (commercially available VLE tools) provided many other secured and unique features still open source available i.e. freely available VLE tools serve the purpose well and also deserve to be the best component for any distant learning. Besides providing the e-learning, and making teacher-student discussion forum, VLE have provided 'face-to-face learning' that as always missing in the distance education mode of studying. Open source VLEs are not only accessible, flexible, customizable, but above all they are economical.

References

1. Iglesias, A., *et al.* (2011). Evaluating the accessibility of three open-source learning content management systems: A comparative study. Computer Applications in Engineering Education, Wiley Periodicals, Inc
2. Sunny, Sanjeev K. (2008). Evaluation of Open Source Content Management System: A Comparative Study, 6th International CALIBER -2008, February 28-29 & March 1, 200, INFLIBNET Centre, Ahmedabad
3. Benevolo, Clara & Negri, Serena. (2010). Evaluation of Content Management Systems (CMS): a Supply Analysis. DiTEA, University of Genoa, Italy, ejise-volume10-issue1-article 754
4. Virtual learning environment comparison, prepared by Lain Clements.

Available at http://atutor.ca/atutor/files/VLE_comparison.pdf (Accessed on 03 January 2013)

5. ATutor Virtual learning environment available at <http://www.atutor.ca> (accessed on 05 January 2013)
6. ATutor brochure available at http://atutor.ca/atutor/docs/ATutor_brochure.pdf (accessed on 05 January 2013)
7. Claroline. <http://www.claroline.net/> (Accessed on 06 January 2013)
8. Dokeos. <http://www.dokeos.com/> (Accessed on 06 January 2013)
9. eFront learning. <http://www.efrontlearning.net> (accessed on 08 January 2013) [http://en.wikipedia.org/wiki/EFront_\(eLearning_software\)](http://en.wikipedia.org/wiki/EFront_(eLearning_software)) (accessed on 11 January 2013)
10. [http://en.wikipedia.org/wiki/EFront_\(eLearning_software\)](http://en.wikipedia.org/wiki/EFront_(eLearning_software)) (accessed on 11 January 2013)

About Authors

Dr. Shalini R Lihitkar, Assistant Professor (Sr. Grade) and Head, DLISc, Rastrasant Tukadoji Maharaj Nagpur University, Nagpur.

Mrs. Dipti Arora, Presently she is working in Defence Scientific Information & Documentation Centre.
E-mail: dipti30arora@gmail.com