



# Design and Evaluation of a Comprehensive e-Learning System using the Tools on Web 2.0

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## ABSTRACT

e-Learning on web 2.0 encourages the users to collaborate and build the knowledge rather than being a mere consumer of the knowledge. Web 2.0 provides various tools to perform collaborative learning, that is to interact, have individual accountability, team work and personalized guidance. This research article presents an assessment of 23 e-learning systems, a survey to have the look and feel of 81 tools and sites in web 2.0 which will augment e-learning 2.0, features of an experimental web solution, data collection on the user preferences on it and the analysis of those attributes.

## Keywords

e-Learning 2.0, Web 2.0, Learning Styles, Social Networking, Cloud Computing

## I. INTRODUCTION

An individual's way of processing information is said to be cognitive styles (CS) [1]. Humans have the cognitive ability to acquire and recognize information, map them to representations and then to knowledge and then use them. Some of the CS are Cognitive Trait Model and Inductive Reasoning Ability [2]. Learning Styles are the different ways in which learners perceive and process information [3]. Several learning styles have been in [4] towards designing e-learning materials based on multi-learner style [5]. Felder-Silverman's synthesis of these theories is designed to easily translate them into strategies for a higher education sector (Table I) [6]. Mostly the authors classify the learners into groups and propose corresponding inventories and methods. One such model is Sarasin [7]. According to him, the learners are classified into three groups based on their learning styles namely visual learners, auditory learners and kinesthetic learners. Visual learners gain knowledge through visual inputs, auditory learners learn through listening and kinesthetic learners learn through experiments and



exploration [8]. This paper is structured as follows. Section II describes about e-Learning and lists some of the popular e-learning systems used around the world and provides a comparison table of these systems with Felder-Silverman model. Section III identifies various ways of utilizing web 2.0 to augment e-Learning. Section IV and Section V lists the various tools that are available in web 2.0 and tabulates them. Section V shows the proposed comprehensive e-LMS and discusses its features. Section VI presents the analysis of the attributes on the user preferences on the designed system. Finally a brief conclusion is described in Section VII.

## II. E-LEARNING

Teaching and learning process has undergone a vast change after the advent of Internet. As Internet and World Wide Web expanded rapidly e-Learning has become a major form of education where time and geographical constraints have been overcome. As pointed out in [9] e-Learning is a learning that involves acquisition, generation and transfer of knowledge using ICT. This enables universal learning, overcoming the barriers of time and distance. E-learning is based on learning objects [10] like audio, video, presentations, documents, etc., which are stored in a learning repository from where they are accessed and processed by the learner. The learning management systems like Black Board, WebCT, MOODLE etc., support various kinds of teaching learning activities but, they do not suit all kinds of learners who have different levels of intelligence and maintains “one size fits all” approach. Hence, the adaptive and intelligent web based educational systems [11], which cater to different types of styles of learning according to the requirements of the learner and their situations. NetCoach and SIETTE are comparable with modern day LMS. Most of the e-Learning systems, adaptive or non adaptive, do not relate or collaborate with external systems and mostly they are stand alone. A search was made for some of the popular e-learning management systems along with their URL (Table II).

TABLE I. LEARNING STYLES

| Author                       | Characteristic's |            |            |              |
|------------------------------|------------------|------------|------------|--------------|
| David Kolb's                 | Accommodating    | Diverging  | Converging | Assimilating |
| Peter Honey and Alan Mumford | Activists        | Reflectors | Theorists  | Pragmatists  |



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|                  |                     |                 |              |                     |                     |
|------------------|---------------------|-----------------|--------------|---------------------|---------------------|
| Dunn and Dunn    | Environmental       | Emotional       | Sociological | Physiological       | Psychological       |
| Felder-Silverman | Active / Reflective | Visual / Verbal |              | Sensing / Intuitive | Sequential / Global |
| Sarasin VAK      | Visual              | Auditory        |              |                     | Kinesthetic         |

This motivated the researchers to make a comparison between the popular e-LMS's and the Felder-Silverman model. So, a comparative study was done on the systems mentioned in Table II for the various characteristics of the selected model to know how far they exhibit them. Table III provides these statistics. The serial number in Table III corresponds to the LMS listed in Table II.

### III.E-LEARNING IN WEB 2.0

Web 2.0 is a collection of inter operable web applications that facilitate user interaction and collaboration with each other as creators of content rather than passive viewers as in web 1.0. Examples of Web 2.0 are social networking sites, blog, wikis, mashups, etc. [12]. These tools can be used by the learning community to interact, share knowledge and augment problem based learning. This has started a culture of contribution and not mere consumer of knowledge among the learning community. Web 1.0 was useful for connecting people to the contents thus useful for finding information and performing basic transactions. The meeting point of users and resources are called a course [13]. E-learning is primarily focused on groups. A group is a collection of individuals who are engaged in a joint work. One such place is a social networking site, which are very popular among people to stay connected. "Social" is often referred to as communication, construction and collaboration [13]. Currently 300 million people use social software [14] and it is still growing. In social networking, each individual has a page and profile that one develops and shares with others in the network. These social networking sites act as pedagogical agent for problem based learning since it is a combination of personalization and socialization. These social software provide platform to enable users to build applications for e-learning and enables them to learn from each others' work [14]. To broaden and generalize the data transfer between different social networking sites, Google brought out an open social development platform in 2007. This platform defines common API, which can be used to develop sites to provide services to multiple sites and easily exchange data between different social sites. MySpace, Friendster, LinkedIn uses open social API. Using REST API, personalized



materials and queries can be provided to users. The dimensions of a high quality education experience are structure, content, service and delivery [15]. Structure is the foundation of quality content, service and delivery. Content should be comprehensive, authentic and researched. Services are resources, administration and technical support for the action done. Delivery is the usability, interactivity levels of the action performed [16]. All these desirable dimensions could be easily achieved through web 2.0. It is also very easy to monitor the students' learning process and levels through social media since they are open and transparent and allow the learners to construct their own learning. The critical challenge of web 2.0 is identifying the right co learners, content, service, and user interfaces to facilitate interaction, communication and collaboration. Scaling is another problem and expensive to implement. Here, Cloud computing comes to the rescue by providing storage and other services, freeing the users to focus on applications [17]. Applications like Google docs, presentation, etc., provide teachers and learners with free and low cost alternative. Browser based applications are easily accessible even on mobile platforms making learning possible where Internet is accessible.

#### IV. TOOLS OTHER THAN SOCIAL NETWORKING

Web 2.0 offers a wide variety of tools that can be used for e-learning. Social networking sites can be used for e-learning. According to Felder-Silverman Learning Style Model, the learning style can be sensory, intuitive, visual, verbal, inductive, deductive, active, reflective, sequential and global. There are a number of tools in web 2.0, which according to the researchers, could be mapped to Felder Silverman learning styles. Tools such as WebCasting and PodCasting can be used to broadcast audio/video/slide/recordings, which can complement classroom environment. Similarly, Wikis for group assignments; wikiversity.org to collaborate and create contents freely; SuTree.com and Slide.net offers a variety of resources to learners and teachers; eduSlide allows teachers to group their content and present them to the learners; Footnote allows the users to access documents and other resources and prepare online reports;

TABLE II. LIST OF POPULAR E-LEARNING SYSTEMS

| S.No | Title         | URL                                                                      |
|------|---------------|--------------------------------------------------------------------------|
| 1    | Apex Learning | <a href="http://www.apexlearning.com/">www.apexlearning.com/</a>         |
| 2    | ATutor        | <a href="http://www.atutor.ca/credits.php">www.atutor.ca/credits.php</a> |
| 3    | Blackboard    | <a href="http://www.blackboard.com/">www.blackboard.com/</a>             |
| 4    | Brainshark    | <a href="http://www.brainshark.com/">www.brainshark.com/</a>             |
| 5    | Chamilo       | <a href="http://www.chamilo.org/">www.chamilo.org/</a>                   |



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|----|------------------------------|--------------------------------------------------------------------------|
| 6  | Claroline                    | <a href="http://www.claroline.net/">www.claroline.net/</a>               |
| 7  | CERTPOINT                    | <a href="http://www.certpointsystems.com/">www.certpointsystems.com/</a> |
| 8  | Desire2Learn                 | <a href="http://www.desire2learn.com/">www.desire2learn.com/</a>         |
| 9  | DoceboLMS                    | <a href="http://www.docebo.com/">www.docebo.com/</a>                     |
| 10 | Dokeos                       | <a href="http://www.dokeos.com/">www.dokeos.com/</a>                     |
| 11 | .LRN                         | <a href="http://www.dotlrn.org">www.dotlrn.org</a>                       |
| 12 | Latitude learning            | <a href="http://www.latitudelearning.com/">www.latitudelearning.com/</a> |
| 13 | EFront                       | <a href="http://www.efrontlearning.net/">www.efrontlearning.net/</a>     |
| 14 | HotChalk                     | <a href="http://www.hotchalk.com/">www.hotchalk.com/</a>                 |
| 15 | ILIAS                        | <a href="http://www.ilias.de/docu/">www.ilias.de/docu/</a>               |
| 16 | Interactyx                   | <a href="http://www.interactyx.com/">www.interactyx.com/</a>             |
| 17 | Moodle                       | <a href="http://www.moodle.org/">www.moodle.org/</a>                     |
| 18 | Metacoon                     | <a href="http://www.metacoon.net/">www.metacoon.net/</a>                 |
| 19 | Meridian Knowledge Solutions | <a href="http://www.meridianksi.com/">www.meridianksi.com/</a>           |
| 20 | RCampus                      | <a href="http://www.rcampus.com/">www.rcampus.com/</a>                   |
| 21 | Saba Software                | <a href="http://www.saba.com/">www.saba.com/</a>                         |
| 22 | Sakai                        | <a href="http://www.sakaiproject.org/">www.sakaiproject.org/</a>         |
| 23 | Studywiz                     | <a href="http://www.studywiz.com/">www.studywiz.com/</a>                 |

VoiceThread.com allows tutors to create lessons and add audio narrative along with it; Visual Thesaurus.com provides all the synonyms in graphical format; and wePapers.com allows sharing of academic/research papers, tutorials, lectures and test. LMS are learning management systems, which provide the learner with the learning contents. Personal Learning Environments (PLE) are tools, used by the learners to gather information, reflect and work on them. Since these tools are not exclusively meant for LMS, they could lead one to error. So, it becomes necessary to provide a system with the combination of LMS and PLE under controlled environment and this process can be done using web 2.0 tools. For example, SHARek – uses social bookmarking and consists of PLE within LMS.



TABLE III. FELDER-SILVERMAN MODEL vs E-LEARNING SYSTEMS

| LMS | Active | Reflective | Visual | Verbal | Sensing | Intuitive | Sequential | Global |
|-----|--------|------------|--------|--------|---------|-----------|------------|--------|
| 1   | N      | Y          | P      | N      | Y       | P         | Y          | Y      |
| 2   | Y      | Y          | P      | Y      | Y       | P         | Y          | Y      |
| 3   | P      | Y          | P      | P      | Y       | P         | Y          | Y      |
| 4   | N      | Y          | Y      | N      | Y       | P         | P          | Y      |
| 5   | Y      | Y          | P      | Y      | Y       | Y         | Y          | Y      |
| 6   | Y      | P          | P      | P      | Y       | Y         | Y          | Y      |
| 7   | P      | Y          | Y      | P      | Y       | Y         | Y          | Y      |
| 8   | N      | Y          | Y      | N      | Y       | Y         | P          | Y      |
| 9   | Y      | Y          | Y      | P      | Y       | Y         | P          | Y      |
| 10  | Y      | Y          | P      | Y      | Y       | Y         | Y          | Y      |
| 11  | Y      | Y          | P      | P      | Y       | Y         | Y          | Y      |
| 12  | Y      | Y          | Y      | Y      | Y       | Y         | Y          | Y      |
| 13  | Y      | Y          | P      | Y      | Y       | Y         | Y          | Y      |
| 14  | Y      | Y          | Y      | Y      | Y       | Y         | Y          | Y      |
| 15  | Y      | Y          | Y      | Y      | Y       | Y         | Y          | Y      |
| 16  | Y      | Y          | P      | P      | Y       | Y         | Y          | Y      |
| 17  | Y      | Y          | Y      | Y      | Y       | Y         | Y          | Y      |
| 18  | Y      | Y          | P      | P      | Y       | Y         | Y          | Y      |
| 19  | N      | Y          | P      | P      | Y       | Y         | Y          | Y      |
| 20  | Y      | Y          | Y      | P      | Y       | Y         | Y          | Y      |
| 21  | N      | Y          | P      | P      | Y       | Y         | Y          | Y      |
| 22  | Y      | Y          | Y      | Y      | Y       | Y         | Y          | Y      |
| 23  | N      | Y          | P      | P      | Y       | Y         | Y          | Y      |

Y – Yes, Fully Available, P – Partially Available, N – No, Not Available



## V. TOOLS IN WEB 2.0

A survey was made to look for e-Learning components such as repository to hold different items like learning objects, student profile, etc., multimedia, simulations, gaming, quizzing, searching, socializing, assessment, etc., as mentioned in Felder-Silverman style of learning. Some of the popular sites/tools which can be used for e-Learning are tabulated in Table IV.

TABLE IV. SITES SURVEYED

| S.N | Websites / Tools                                                          |
|-----|---------------------------------------------------------------------------|
| 1   | <a href="https://voicethread.com/">https://voicethread.com/</a>           |
| 2   | <a href="http://www.facebook.com">www.facebook.com</a>                    |
| 3   | <a href="http://www.myspace.com">www.myspace.com</a>                      |
| 4   | <a href="http://www.twitter.com">www.twitter.com</a>                      |
| 5   | <a href="http://www.wayfaring.com/">http://www.wayfaring.com/</a>         |
| 6   | <a href="http://www.wepapers.com/">http://www.wepapers.com/</a>           |
| 7   | <a href="http://www.wordpress.com/">http://www.wordpress.com/</a>         |
| 8   | <a href="http://www.bebo.com/">http://www.bebo.com/</a>                   |
| 9   | <a href="http://www.ning.com/">http://www.ning.com/</a>                   |
| 10  | <a href="http://www.friendster.com/">http://www.friendster.com/</a>       |
| 11  | <a href="http://www.linkedin.com/">http://www.linkedin.com/</a>           |
| 12  | <a href="http://www.stumbleupon.com/">http://www.stumbleupon.com/</a>     |
| 13  | <a href="http://www.coolpreviews.com">www.coolpreviews.com</a>            |
| 14  | <a href="http://www.wikiversity.org">www.wikiversity.org</a>              |
| 15  | <a href="http://www.visualthesaurus.com">www.visualthesaurus.com</a>      |
| 16  | <a href="http://translate.google.co.in">http://translate.google.co.in</a> |
| 17  | <a href="http://maps.google.co.in/">http://maps.google.co.in/</a>         |
| 18  | <a href="http://www.classmarker.com">www.classmarker.com</a>              |
| 19  | <a href="http://www.quizgalaxy.com">www.quizgalaxy.com</a>                |
| 20  | <a href="http://www.tcyonline.com">www.tcyonline.com</a>                  |
| 21  | <a href="http://www.surveymonkey.com">www.surveymonkey.com</a>            |
| 22  | <a href="http://www.zoomerang.com">www.zoomerang.com</a>                  |
| 23  | <a href="http://www.smg2000.org/">http://www.smg2000.org/</a>             |



|    |                                                                                                                                                                 |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24 | <a href="http://www.marketwatch.com/">www.marketwatch.com/</a>                                                                                                  |
| 25 | <a href="http://www.cut-the-knot.org/">www.cut-the-knot.org/</a>                                                                                                |
| 26 | <a href="http://lstat.kuleuven.be/java/">http://lstat.kuleuven.be/java/</a>                                                                                     |
| 27 | <a href="http://www.thiswaytocpa.com/career-tools/interview-simulation/">http://www.thiswaytocpa.com/career-tools/interview-simulation/</a>                     |
| 28 | <a href="http://en.wikipedia.org/wiki/Webcast">http://en.wikipedia.org/wiki/Webcast</a>                                                                         |
| 29 | <a href="http://www.librivox.org/">http://www.librivox.org/</a>                                                                                                 |
| 30 | <a href="http://www.slideshare.com">www.slideshare.com</a>                                                                                                      |
| 31 | <a href="http://www.scribd.com">www.scribd.com</a>                                                                                                              |
| 32 | <a href="http://www.docs.google.com">www.docs.google.com</a>                                                                                                    |
| 33 | <a href="http://www.youtube.com">www.youtube.com</a>                                                                                                            |
| 34 | <a href="http://www.google.co.in/blogsearch?hl=en&amp;tab=wb">http://www.google.co.in/blogsearch?hl=en&amp;tab=wb</a>                                           |
| 35 | <a href="http://pipes.yahoo.com/pipes/">http://pipes.yahoo.com/pipes/</a>                                                                                       |
| 36 | <a href="http://www.programmableweb.com/">http://www.programmableweb.com/</a>                                                                                   |
| 37 | <a href="http://www.google.com/talk/">http://www.google.com/talk/</a>                                                                                           |
| 38 | <a href="https://www.google.com/calendar/">https://www.google.com/calendar/</a>                                                                                 |
| 39 | <a href="http://translate.google.com/">http://translate.google.com/</a>                                                                                         |
| 40 | <a href="https://sites.google.com/">https://sites.google.com/</a>                                                                                               |
| 41 | <a href="http://www.google.co.in/ig">http://www.google.co.in/ig</a>                                                                                             |
| 42 | <a href="http://www.rapidshare.com">www.rapidshare.com</a>                                                                                                      |
| 43 | <a href="http://www.mediafire.com">www.mediafire.com</a>                                                                                                        |
| 44 | <a href="http://www.hotfile.com">www.hotfile.com</a>                                                                                                            |
| 45 | <a href="http://www.4shared.com">www.4shared.com</a>                                                                                                            |
| 46 | <a href="http://depositfiles.com/">http://depositfiles.com/</a>                                                                                                 |
| 47 | <a href="http://zshare.net/">http://zshare.net/</a>                                                                                                             |
| 48 | <a href="http://uploading.com/">http://uploading.com/</a>                                                                                                       |
| 49 | <a href="http://www.csse.monash.edu.au/~dwa/Animations/index.html">http://www.csse.monash.edu.au/~dwa/Animations/index.html</a>                                 |
| 50 | <a href="http://www.cosc.canterbury.ac.nz/mukundan/dsal/appldsal.html">http://www.cosc.canterbury.ac.nz/mukundan/dsal/appldsal.html</a>                         |
| 51 | <a href="http://www.cs.jhu.edu/~goodrich/dsa/trees/index.html">http://www.cs.jhu.edu/~goodrich/dsa/trees/index.html</a>                                         |
| 52 | <a href="http://downloads.ziddu.com/downloadfile/12314754/Data_Structures_Thr">http://downloads.ziddu.com/downloadfile/12314754/Data_Structures_Thr</a>         |
| 53 | <a href="http://www.dzone.com/links/animated_tutorials_for_data_structure_algorit">http://www.dzone.com/links/animated_tutorials_for_data_structure_algorit</a> |
| 54 | <a href="http://www.edsim51.com/">http://www.edsim51.com/</a>                                                                                                   |
| 55 | <a href="http://www.homesoft.gen.tr/products/Sim8085.html">http://www.homesoft.gen.tr/products/Sim8085.html</a>                                                 |





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|----|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 56 | <a href="http://sourceforge.net/projects/picmicrosim/">http://sourceforge.net/projects/picmicrosim/</a>                                                    |
| 57 | <a href="http://www.angelfire.com/electronic2/8085simulator/">http://www.angelfire.com/electronic2/8085simulator/</a>                                      |
| 58 | <a href="http://www.samphire.demon.co.uk/">http://www.samphire.demon.co.uk/</a>                                                                            |
| 59 | <a href="http://www.ontko.com/moss/">http://www.ontko.com/moss/</a>                                                                                        |
| 60 | <a href="http://vip.cs.utsa.edu/simulators/">http://vip.cs.utsa.edu/simulators/</a>                                                                        |
| 61 | <a href="http://www.cs.kent.ac.uk/people/staff/frmb/moss/">http://www.cs.kent.ac.uk/people/staff/frmb/moss/</a>                                            |
| 62 | <a href="http://www.cs.unm.edu/~crowley/osbook/sos.html">http://www.cs.unm.edu/~crowley/osbook/sos.html</a>                                                |
| 63 | <a href="http://www.freevbcode.com/ShowCode.asp?ID=4079">http://www.freevbcode.com/ShowCode.asp?ID=4079</a>                                                |
| 64 | <a href="http://samate.nist.gov/index.php/Tool_Survey.html">http://samate.nist.gov/index.php/Tool_Survey.html</a>                                          |
| 65 | <a href="http://pmd.sourceforge.net/">http://pmd.sourceforge.net/</a>                                                                                      |
| 66 | <a href="http://www.stachliu.com/resources/tools/google-hacking-diggity-">http://www.stachliu.com/resources/tools/google-hacking-diggity-</a>              |
| 67 | <a href="http://findbugs.sourceforge.net/">http://findbugs.sourceforge.net/</a>                                                                            |
| 68 | <a href="https://www.fortify.com/ssa-elements/threat-intelligence/rats.html">https://www.fortify.com/ssa-elements/threat-intelligence/rats.html</a>        |
| 69 | <a href="http://www.modelsphere.org/open_modelsphere.html">http://www.modelsphere.org/open_modelsphere.html</a>                                            |
| 70 | <a href="http://www.sqlpower.ca/page/architect">http://www.sqlpower.ca/page/architect</a>                                                                  |
| 71 | <a href="http://www.dbvis.com/">http://www.dbvis.com/</a>                                                                                                  |
| 72 | <a href="http://www.sqlmanager.net/tools/free">http://www.sqlmanager.net/tools/free</a>                                                                    |
| 73 | <a href="http://www.elphsoft.com/">http://www.elphsoft.com/</a>                                                                                            |
| 74 | <a href="http://www.isi.edu/nsnam/ns/">http://www.isi.edu/nsnam/ns/</a>                                                                                    |
| 75 | <a href="http://www.cc.gatech.edu/computing/compass/pdns/index.html">http://www.cc.gatech.edu/computing/compass/pdns/index.html</a>                        |
| 76 | <a href="http://www.ssfnet.org/homePage.html">http://www.ssfnet.org/homePage.html</a>                                                                      |
| 77 | <a href="http://www.cisco.com/web/learning/netacad/course_catalog/PacketTracer">http://www.cisco.com/web/learning/netacad/course_catalog/PacketTracer.</a> |
| 78 | <a href="http://www.filebuzz.com/findsoftware/Free_Network_Simulation_Exe/1.h">http://www.filebuzz.com/findsoftware/Free_Network_Simulation_Exe/1.h</a>    |
| 79 | <a href="http://www.questionwriter.org">www.questionwriter.org</a>                                                                                         |
| 80 | <a href="http://www.compilr.com">www.compilr.com</a>                                                                                                       |
| 81 | <a href="http://www.spicynodes.com">www.spicynodes.com</a>                                                                                                 |

The websites surveyed exhibit the following features, which corresponds to Felder-Silverman learning styles. These are collaboration; sharing materials; creating groups / communities; uploading, managing and downloading materials / files; creating web pages / blogs; chatting/broadcast – audio, video, text, search and discover; perform analytics; play games; perform testing and evaluation of the learner; track his learning pattern; allow the user to experiment / simulate different scenarios; conduct a survey and gain insight; translate to different



languages; make use of open and free educational resources; and provide free storage and more.

## VI. COMPREHENSIVE E-LMS

Using the knowledge acquired from the survey listed in Table V, a web based e-learning system specific for learning Object Oriented Programming Using C++ was developed. It is a minimal working prototype which gives the look and feel of all the learning components [17] that utilizes various social tools, interactive environments of Web 2.0, various web based services and cloud. The proposed system is available at [18]. Some of the key features of the system are as follows:

1. Cloud is used as a repository for learning objects like presentations, documents, etc. The cloud service used for this purpose is [19]. The service provider provides 500 GB of free storage, freeing the server from the respective overload and enables the researchers to focus on the application.
2. All the video lessons are uploaded to YouTube.com and played here. This is implemented using the open APIs provided by YouTube.com.
3. Google Gadgets, like Google Calendar are used to publish the Schedule / Course plan.
4. Links to different sites for non human resources like animations, references, books, journals, articles and other forms of media are incorporated. Online quizzes produce the result of the quiz and mail it to the stakeholders about the learners' performance. This was done using Question writer [20]. A dictionary of all the key words in the C++ language, a custom built software is also provided.
5. REST API and other API provided by FaceBook are used to build discussion forum and chat room features for those attending the course.
6. The learners can also test their programs using [21], which provides a platform for program compilation and execution facility for many programming languages.
7. A question bank is a repository of questions to support the learning process. This web solution also holds a sample question bank for learning C++.
8. Using [22] mind map is generated to represent and structure ideas and concepts of C++ graphically.



Some of the other features included in the system are deriving class diagrams from source code [23], learning by playing cross word puzzle [24], analyzing the code's efficiency using static analyzer [25] and sample C++ programs [26].

## VII. ANALYSIS OF THE ATTRIBUTES

Attributes identify the way user preferences in the using the tools available in web 2.0. The comprehensive e-learning system developed was allowed to be used by students for around six months and their learning behavior was captured and analyzed. A total of 1397 students explored and used the system, out which only 1074 had the complete profile and 323 students' data could not be used because of incomplete profile. The frequency statistics are tabulated from Table V to Table XII.

TABLE V. GENDER OF THE RESPONDENTS

|        | Frequency | Percent |
|--------|-----------|---------|
| Male   | 750       | 69.8    |
| Female | 324       | 30.2    |
| Total  | 1074      | 100     |

TABLE VI. EDUCATIONAL QUALIFICATION OF THE RESPONDENTS

| Qualification | Frequency | Percent |
|---------------|-----------|---------|
| MCA           | 252       | 23.5    |
| MBA           | 222       | 20.7    |
| M.Sc. CS      | 120       | 11.2    |
| B.Sc CS       | 174       | 16.2    |
| BBA           | 180       | 16.8    |
| BCA           | 99        | 9.2     |
| Ph.D          | 27        | 2.5     |
| Total         | 1074      | 100     |

TABLE VII. DOMICILE TYPE OF THE RESPONDENTS

| Domicile | Frequency | Percent |
|----------|-----------|---------|
| Urban    | 865       | 80.5    |
| Rural    | 209       | 19.5    |
| Total    | 1074      | 100     |



TABLE VIII. USAGE OF THE WEB SITE

| Learning Objects                               | Frequency | Percent |
|------------------------------------------------|-----------|---------|
| Lecture Presentation                           | 97        | 9       |
| Video Lessons                                  | 213       | 19.8    |
| Tutorial                                       | 74        | 6.9     |
| Online Compilation                             | 76        | 7.1     |
| Animation                                      | 71        | 6.6     |
| Simulation                                     | 62        | 5.8     |
| Question Banks                                 | 82        | 7.6     |
| E-Materials                                    | 26        | 2.4     |
| Discussion Forms                               | 24        | 2.2     |
| Mind Map                                       | 91        | 8.5     |
| Online Quiz                                    | 74        | 6.9     |
| Custom Built Lexicon                           | 12        | 1.1     |
| Others (Web Search, Google Translator, etc...) | 172       | 16      |
| Total                                          | 1074      | 100     |

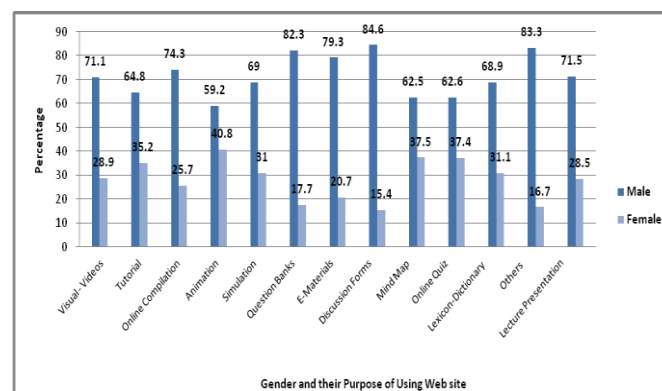


FIGURE 1. USAGE OF WEB SITE \* GENDER OF THE RESPONDENTS

TABLE IX. CHI-SQUARE TEST

|                              | Value               | Df | Asymp. Sig. (2-sided) |
|------------------------------|---------------------|----|-----------------------|
| Pearson Chi-Square           | 22.305 <sup>a</sup> | 12 | 0.034                 |
| Likelihood Ratio             | 23.155              | 12 | 0.026                 |
| Linear-by-Linear Association | 0.716               | 1  | 0.398                 |



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|                  |      |  |  |
|------------------|------|--|--|
| N of Valid Cases | 1074 |  |  |
|------------------|------|--|--|

H0: There is no association between gender and usage of website.

H1: There is an association between gender and usage of website.

Since the level of significance value is less than the 0.05, H0 can be rejected and it could be conclude that there is relationship between usage of web site and the gender of the respondents.

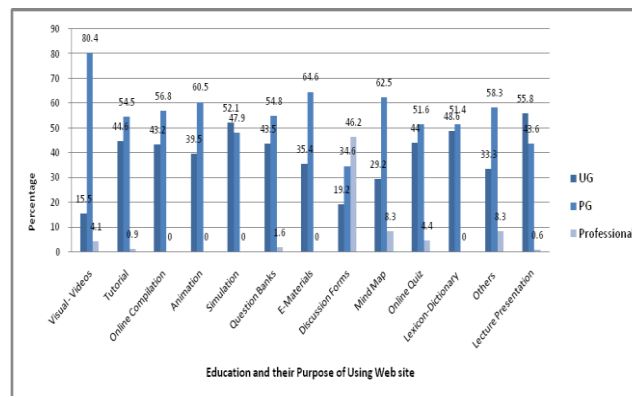


FIGURE 2. USAGE OF WEB SITE \* EDUCATIONAL QUALIFICATION

TABLE X. CHI-SQUARE TEST

|                              | Value                | Df | Asymp. Sig. (2-sided) |
|------------------------------|----------------------|----|-----------------------|
| Pearson Chi-Square           | 432.344 <sup>a</sup> | 72 | 0                     |
| Likelihood Ratio             | 311.952              | 72 | 0                     |
| Linear-by-Linear Association | 10.783               | 1  | 0.001                 |
| N of Valid Cases             | 1074                 |    |                       |

H0: There is no association between qualification and usage of website.

H1: There is an association between qualification and usage of website.

Since the level of significance value is less than the 0.05, H0 can be rejected and it could be conclude that there is relationship between usage of web site and the qualification of the respondents.



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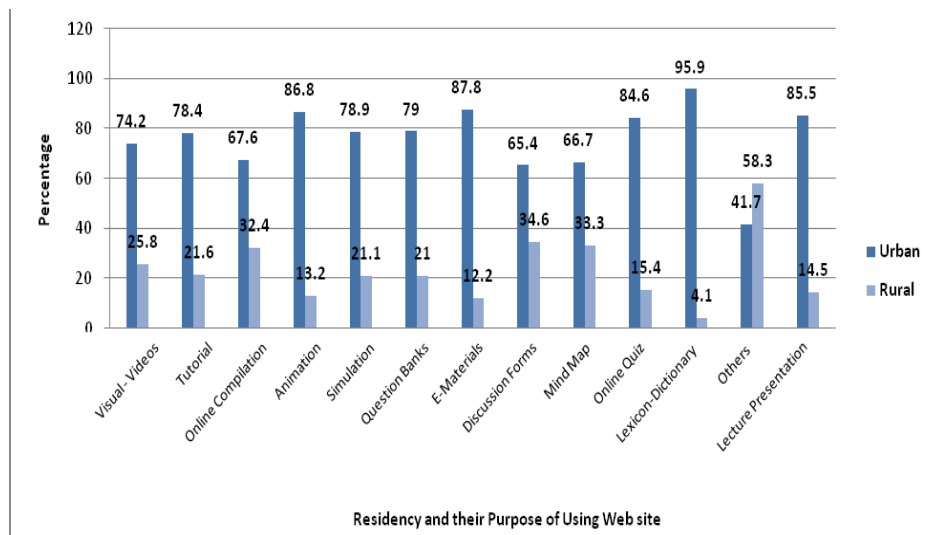


FIGURE 3. USAGES OF WEB SITE \* DOMICILE TYPE

TABLE XI. CHI-SQUARE TEST

|                              | Value               | Df | Asymp. Sig. (2-sided) |
|------------------------------|---------------------|----|-----------------------|
| Pearson Chi-Square           | 49.095 <sup>a</sup> | 12 | 0                     |
| Likelihood Ratio             | 49.217              | 12 | 0                     |
| Linear-by-Linear Association | 8.518               | 1  | 0.004                 |
| N of Valid Cases             | 1074                |    |                       |

H0: There is no association between domicile type and usage of website.

H1: There is an association between domicile type and usage of website.

Since the level of significance value is less than the 0.05, H0 can be rejected and it could be conclude that there is relationship between usage of web site and the domicile type of the respondents.

## VIII. CONCLUSION

This study aims to identify e-learning possibilities using social and other tools available in web 2.0. This will enhance the e-learning framework by using the freely available tools to be mashuped together to provide a better e-learning framework according to the need of the stakeholders. Every requirement can have different frameworks. Thus, the above research and the experiment, is bound to motivate and enlighten the stakeholders to go for customized e-learning platforms according to their requirements.



The findings from the analysis of the attributes are as follows,

1. From Table VIII, the top five usage of the system are video lessons, search other related components on web, lecture presentations, mind map and question bank respectively.
2. From Figure 1 which provides the statistics on gender wise usage of the system, the top three usage by male respondents are simulation, lexicon and e-materials. The top three usage by female respondents are discussion forum, mind map and video lessons.
3. From Figure 2 which provides the statistics on the usage based on the educational qualifications of the respondents is that, post graduate students top three usages are discussion forum, lexicon and lecture presentations. The top three usages by under graduate students are online quiz, simulation and animations.

From Figure 3 which provides the statistics on the usage based on the location of residency is that, urban respondents top three usages are online quiz, online compilation and question bank. The top three usages of the rural respondents are e-materials, discussion forum and tutorials.

These interpretations will be useful to the e-learning system designer to design and make the system adaptive based on the behavior pattern and the requirements of the learning community. This could be the future scope of this system. This can be implemented using the tools available in web 3.0. Another e-LMS for learning Java Programming is also being designed and is available at [29].

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