

E-Catalyst Learning System

by

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B.Eng., Delhi College of Engineering, Delhi University, 2010

A Project Submitted in Partial Fulfillment
of the Requirements for the Degree of
MASTER OF SCIENCE
in the Department of Computer Science

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Abstract

The e-catalyst Learning system is a user-friendly system, designed especially for the instructors to provide them an environment where they can teach and helps students to learn efficiently. The e-Catalyst learning system, built on top of the Salesforce platform, provides the foundation for the instructors, students, and institutions to connect to each other in new ways. In this learning system instructors can browse through their own courses, monitor the performance of the students, make direct call to the students through Skype, chat with the students, create tasks and events for the students, answers to the student's queries on the discussion board, check the schedule on calendar, add and delete courses, which are some of the features which available in e-Catalyst System. As the system is deployed in the cloud, it will be available online and accessible from anywhere in the world.

This system is developed in Canada, and it will be available as an open source system which will be later delivered over to a non-profit organization. This report gives the detailed overview of the e-Catalyst system. We will discuss the architecture of the system, model of the system, user interface overview, features of the system in detail, benefits and future work.

Table of Contents

Abstract	ii
Acknowledgements	v
1. Introduction	1
1.1 Problem Statement	2
1.2 e-Catalyst System Approaches and Characteristics	2
1.3 Benefits of e-Catalyst System	2
1.4 Report Outline	3
2. Cloud Computing Platform	4
3. E-Catalyst System Overview	5
4. System Modelling and Analysis	6
4.1 Design Analysis	6
4.2 Verification	7
<i>Figure 2 Verification of e-Catalyst system</i>	8
4.3 Entity–relationship model diagram	8
5. Implementation of E-catalyst system	10
5.1 Technologies and Tools	10
<i>Table 1 Technologies and Tools</i>	10
5.2 Framework	10
5.3 System architecture	11
5.4 Features of e-Catalyst System	11
<i>Figure 4 Home page</i>	12
<i>Figure 5 Instructor Personal Details Edit Mode</i>	12
<i>Figure 6 Calendar on Home Page</i>	13
<i>Figure 7 Calendar with Day View</i>	14
<i>Figure 8 Calendar with Week View</i>	14
<i>Figure 9 Calendar with Month View</i>	15
<i>Figure 10 Activities on Home Page</i>	15
<i>Figure 11 Assign Task</i>	16
<i>Figure 12 Assign Event</i>	17
<i>Figure 13 Students Enrolled</i>	17
<i>Figure 14 Skype Integration</i>	18
<i>Figure 15 Calling Student through Skype</i>	18
<i>Figure 16 Discussion Board</i>	19
<i>Figure 17 Survey posted on discussion board</i>	20
<i>Figure 18 Student Performance Dashboard</i>	21
<i>Figure 19 Course Inline Editing</i>	22
<i>Figure 20 Course Saved After Inline Editing</i>	22
<i>Figure 21 Add New Courses</i>	23

<i>Figure 22 New Course Saved</i>	23
<i>Figure 23 Delete Course</i>	24
<i>Figure 24 System throws Error Message when try to delete active course</i>	24
<i>Figure 25 Affiliated Institutions representation on google map</i>	25
6. E-Catalyst System Management	25
<i>Table 2 Detailed e-Catalyst System Management</i>	26
7. Conclusion and Future work	26
References	27

Acknowledgements

I would like to thank **Dr. Issa Traore** for his continuous support and mentoring throughout the project and my supervisor **Daniel M German** for his valuable feedback and suggestions.

Also, I would like to thank my friends and family who encouraged me during this project.

1. Introduction

Today's technology is changing and proliferating. With the growing of the internet and the World Wide Web, it becomes much easier to reach people around the world. Education is an essential part of human development; it gives us knowledge of the world around us, and the skills needed to succeed in the job market which has become so competitive. Standing out in the crowd is vital to be successful. Online education plays a significant role in the current market [1]. Nowadays education has become so expensive that people prefer to be more inclined to learn online compared to traditional methods like attending in-person universities or schools. Several institutions are now offering online education programmes [2]. Those institutions are competing for an increasingly sophisticated pool of students. To achieve success in the market, the online education platform should be reliable, trustworthy, efficient, and easy to use [3].

The objective of the project presented in this report is to develop a platform which attempts to address some of the aforementioned expectations. By keeping everything in mind we have built an e-learning platform called e-Catalyst system, which provides extensive functionalities for the instructors and students.

The e-catalyst system is an e-commerce software developed and deployed in the cloud where instructors and students from different universities collaborate with each other in an innovative way. It offers free online courses to the students wherein students can learn courses from renowned reputed instructors. e-Catalyst believes in collaborative work and sharing knowledge with each other, one of the ways to achieve this is Skype integration and a discussion board where students and instructors can share knowledge with each other. This system emphasizes user-friendliness. Instructors can log in, and view their teaching schedule on the calendar by day, weekly and monthly basis. Instructors can adjust their schedule and once the schedule changes a notification will be sent to the registered students. Instructors can add courses and change courses as per the course module. The instructor can view the number of students enrolled in each course and measure the performance of each student on the dashboard. They can assign tasks and events to a particular student or group of students as well. The instructor can call students directly using the skype feature.

While the students and system managements modules are important functionalities of the system, this report will focus principally on the instructor module, and its related features.

1.1 Problem Statement

Education plays a meaningful role in the life and getting a good quality education nowadays has become hard because everything is expensive. There are many online education providers who offer online courses, but only a few providers are successful. Successful online education requires reliable, flexible and user-friendly learning system. The e-Catalyst system is easy to use and has out of the box functionalities. If the system is too complicated, hard to understand and to use then the instructor will lose interest, which could lead to the failure of the system. So, it is essential to make the learning system reliable, efficient and user friendly, by understanding and addressing the basic needs of the users. The e-catalyst system was developed by keeping all these things in mind.

1.2 e-Catalyst System Approaches and Characteristics

The design of e-Catalyst software architecture rely on two guiding principles as follows:

- 1) Instructor-led and facilitated learning: this method believes in collaborative work, where instructors can get connected directly to the learners and assist them directly if they need any help.
- 2) Self-paced learning: In self- paced Learning learners can learn from the course materials and the videos which are provided by the instructors. The materials are available all the time and accessible from anywhere.

1.3 Benefits of e-Catalyst System

Thee-Catalyst system provides several benefits including the following:

1. Commuting: the e-Catalyst system can be accessed from anywhere. Instructors don't need to commute, and this saves money and time.
2. Collaborative learning: the e-Catalyst system allows instructors to teach innovatively. The e-Catalyst system provides a common platform where instructors, students can share knowledge

and help each other. Chats, discussions forum, Skype are some of the standard features which are provided by the system.

3. Cost-effectiveness: As the e-Catalyst system is free, Instructors don't need to pay anything to use the system.

4. Student-Performance measurement: In e-Catalyst system instructors can measure the performance of each registered students into their courses. By monitoring performance, instructors can identify and help students who need more assistance and prepare unique materials for them.

5. Flexibility: As the system is in the cloud, the instructors can teach the students from anywhere at their convenience.

1.4 Report Outline

Section 2 describes the usage of cloud computing platform. The Salesforce force.com platform features which make it ideal for the -e-Catalyst system. Section 3 gives the overview of the e-catalyst system and defines all its features. In Section 4 we discuss the architecture of the e-Catalyst system, where we present design analysis using Tapaal, and Petri net formal model and check the system for deadlock and starvation. Verification of the system is performed to test whether the system is working as per the requirement or not. We have also provided the model diagram of the system to show the relationship between objects involved, it's attributes and how they are connected to each other. In section 5, we are discussing the implementation of the e-Catalyst system, by giving an outline of the technologies used, the architecture of the e-Catalyst system. Section 6 discusses the management of the e-Catalyst system, like the total cost involved, how much workforce will be needed to maintain the e-Catalyst system, how we are planning to continue the operation in future, maintenance cost, security, release, and storage information. Section 7 summarizes the outcome of the project, makes concluding remarks and discuss future work.

2. Cloud Computing Platform

The e-catalyst system is purely implemented on Salesforce Force.com cloud platform. Salesforce is a CRM (Customer Relationship Management) platform [6]. This cloud platform is available online and accessible from anywhere. As the system is deployed on the Cloud, end-users don't need to install anything on their system [10].

We have used Force.com platform for the following reasons:

- **Multitenant architecture:** Salesforce Force.com supports multitenant architecture [5], where all the users share the same infrastructure and follow the same version of Force.com platform. The multitenant architectures do the upgrades automatically for all the users, so no one has to worry about the version upgrade of the e-Catalyst system.
- **Cost Savings:** Force.com platform eliminates the capital expenses of buying hardware and software. We don't need to buy any software and install in the system; the platform itself is available online.
- **Security:** One of the primary concern nowadays is providing security to the system. Salesforce Force.com cloud platform provides security to all the applications which are built into their system. So, we don't have to worry about e-Catalyst system security as the Salesforce is taking care of them.
- **Flexibility:** Salesforce Force.com is an on-demand technology, so we can manage the bandwidth as per the usage of the system. If the number of users in the system is growing it is easy to scale up the cloud capacity as per the need for the system and it is also easy to scale down the cloud capacity anytime from anywhere. It makes the Force.com cloud system very user-friendly and business-centric platform.
- **Accessibility:** The cloud platform is a same single base platform where all the documents, files, and data are stored in one place in the cloud. Since everything is present in one place, all the data, documents and files are easily available and accessible.
- **Disaster Recovery:** Salesforce Force.com platform backs up all organization data. It helps from all kinds of an emergency scenario like natural disasters or human errors.

3. E-Catalyst System Overview

In the current market, there are many organizations which provide online education like Coursera, edX, etc [4]. e-Catalyst system provides out of the box functionalities especially for the instructors, which makes the system attractive. Online teaching is unique and different as compared to classroom instructing [2]. To make the system successful into the market, e-Catalyst provides the following features:

- **Manager timetable:** e-Catalyst offers an option to the instructors to manage their schedule, which shows when the instructors are available for teaching (i.e., number of days availability in a week, monthly, or daily basis). Once the schedule is fixed, a notification will be sent to the corresponding registered students.
- **Manage Courses:** Instructors can add new courses and can delete their existing courses as well provided the course is not ongoing. Any action in the course module by the instructor triggers a notification to the registered students.
- **Discussion Board:** Instructors can post questions or reply to the questions asked by the students on a discussion board. It makes the learners feel connected to each other.
- **Communication:** the e-Catalyst system provides different types of communication methods between the instructors and students.
 - **Chat:** Instructors can chat directly with the learners if they are online.
 - **Email:** Students can send email to the instructors where a case is generated inside the e-Catalyst system, and a notification sent to the instructor.
 - **Skype:** e-Catalyst provides an innovative feature in which instructors can call or video or chat directly to the students from within the e-Catalyst system.
 - **Discussion board:** Another way to communicate is the use of discussion board. The discussion board is used as a public forum, any questions asked will be visible to all users.
- **Inappropriate behavior:** If any learner misbehaves on the discussion board, instructors can send a private message to the learner as a reminder of him/her of the class policies.

- **Event/Task:** Instructors can create a task and assign work to the students; also, instructors can create events like for a meeting or exam schedules and send notifications to all the students.
- **Students Performance:** Instructors can view the performance of each registered students in their course on dashboards. It helps instructors to define the strategy like how to improve the performance of the students.
- **All affiliated institutions view:** Instructors can view all the affiliated institutions and can see all the details in a single place.

4. System Modelling and Analysis

In this section, we are performing the detailed analysis of the e-Catalyst system. In the system, there will be three actors, namely, instructors, students and Admin. Each actor will play a different type of roles in the system. In this report, we are focusing on instructor's modules.

4.1 Design Analysis

To implement the e-Catalyst system, first, we have designed the system and checked the system behavior whether the system is working without any deadlock and starvation or not. To do this, we have used Tapaal tool and Petri net mathematical [9] model (see Figure 1), and observed the whole system and checked how accurately the system would work in real time scenario.

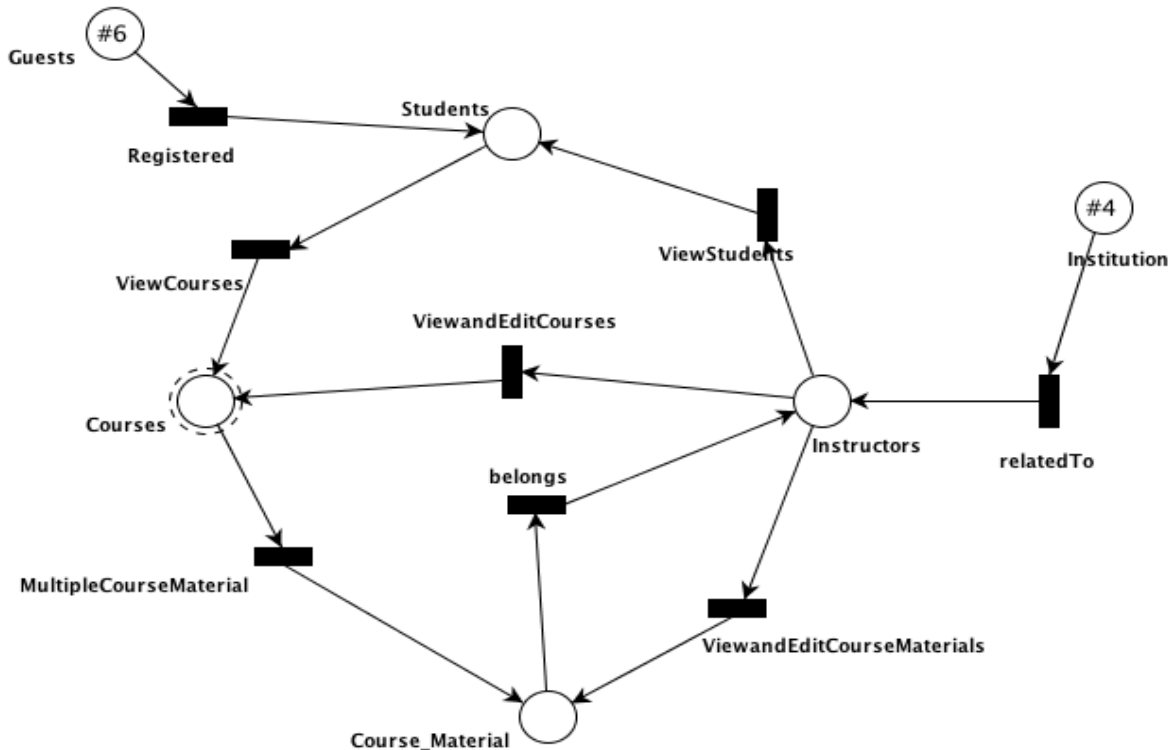
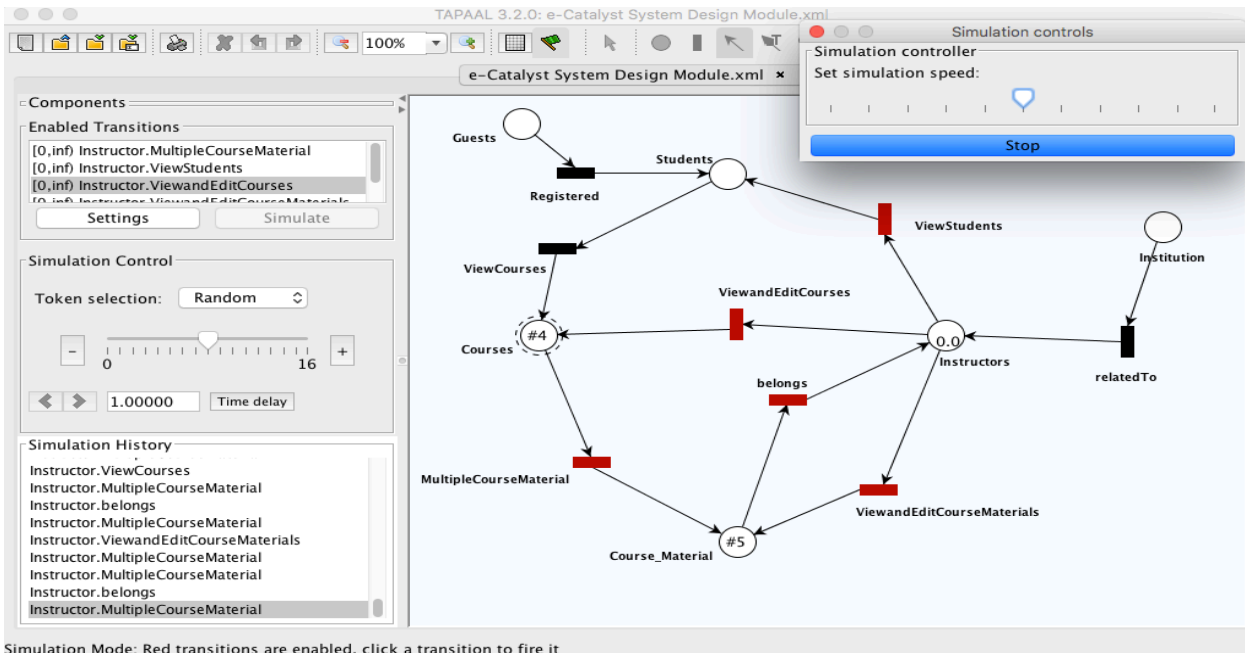


Figure 1 e-Catalyst System Design

As shown in Figure 1, Guest first registers to the e-Catalyst system, and after that, they become students to the system. Now Students can view all the courses and its respective course materials. Institution represents the university where instructors belong too. Instructors can see and make changes to the course materials. Instructors can also view the number of students present in the e-Catalyst system.

4.2 Verification

The e-catalyst system is verified by observing the simulation history results of the e-Catalyst Design depicted by Figure 2. Simulation history represents the outcomes of the e-Catalyst system, where the outcomes are validated with the real-time requirement and checked whether the system is behaving correctly or not and whether the system is working without deadlock or starvation or not.



Simulation Mode: Red transitions are enabled, click a transition to fire it

Figure 2 Verification of e-Catalyst system

4.3 Entity–relationship model diagram

An Entity relationship model diagram has been designed which indicates the relationship between each object of the e-Catalyst System as depicted in Figure 3. Each object performs some role which is associated with the functionality of an e-Catalyst system. The Entity-Relationship diagram represents the following:

- **Instructor Object:** Holds all the information of the instructors.
- **Course Object:** Hold information about the courses. One instructor can teach many courses.
- **User Object:** Holding information about the users.
- **Institution Object:** Holds information about institutions, which represents instructors from a different institution.
- **Course Material Object:** All course materials related to the courses are stored in this object, and the information about the users who have access to these course materials are also being stored.
- **InstructorsAndCourses Object:** Information about the instructors and courses they are teaching.

- **StudentsAndCourse Object:** Information about the registered students and the courses they are learning. Many students can take many courses

The relationships between each object are represented by a color line which indicates the following:

- — Lookup Relationship
- — Master-Detail Relationship
- | Required Field

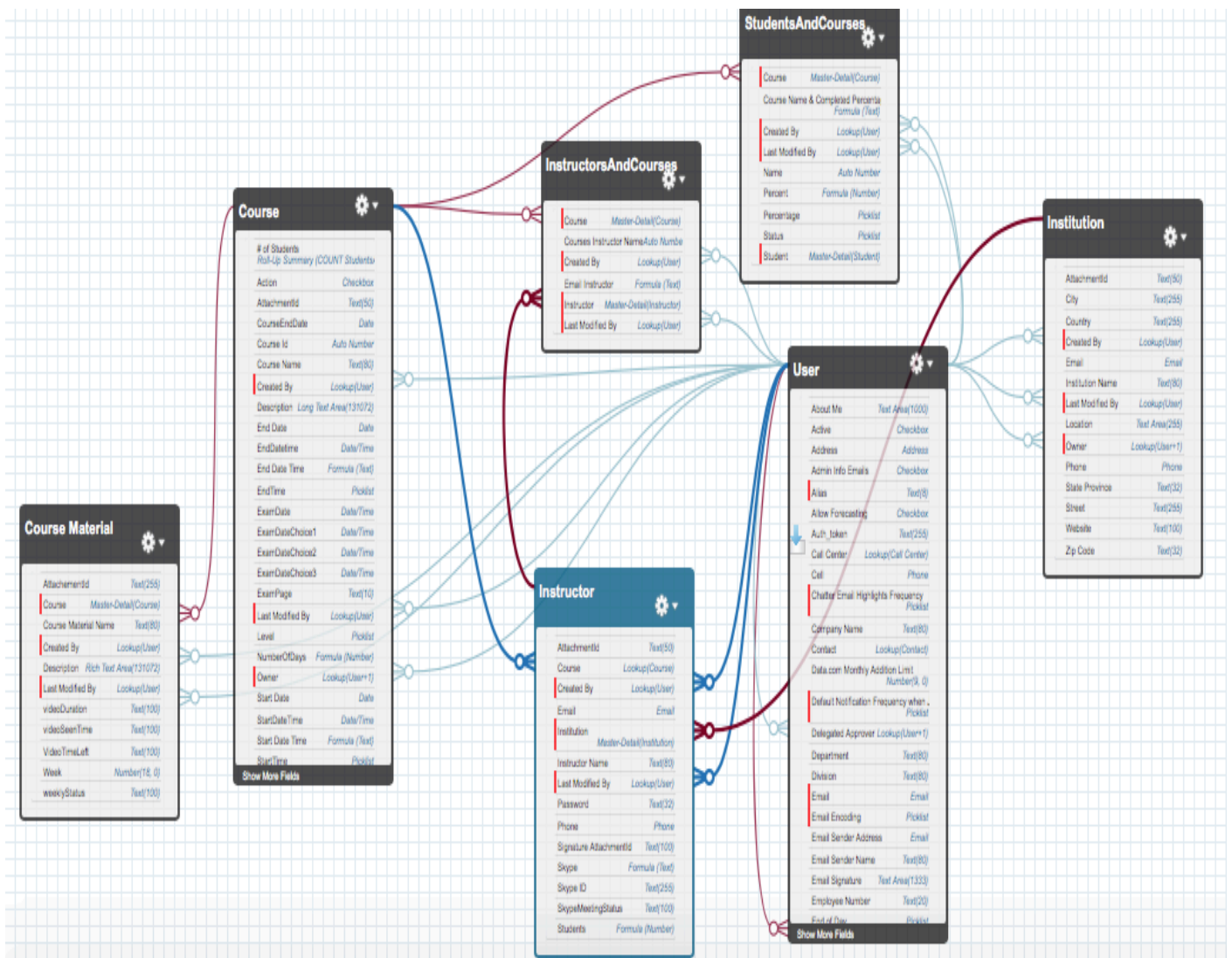


Figure 3 Entity–relationship model diagram

5. Implementation of E-catalyst system

In this section, we present the implementation of e-Catalyst by discussing the technologies and tools involved and the implementation outcome.

5.1 Technologies and Tools

To design the e-Catalyst system efficiently, we used various technologies as described in table 1. First, we did design analysis and verification of the system and checked whether the system is working without deadlock or not. For that, we have used Tapaal Tool and Petri net mathematical model [9]. After completing the design and verification, we built the system on the Salesforce Force.com cloud platform. Cloud platform eliminated the installation of hardware and software in the system and helped us mainly focused on building the e-Catalyst system.

Technology	Description
Tapaal & Petri Net	Used to design the e-Catalyst system for verification and testing purposes.
Multitenant Architecture	All users are using the same platform where the resources are shared among the users by Salesforce.
Apex	A programming language which is used to perform business logic in the Salesforce Force.com Cloud platform.
Visualforce	A programming language which is used to design the user interface of the e-Catalyst system.
HTML, CSS, JavaScript, JQuery	Used primarily to enhance the user interface in the e-Catalyst system.

Table 1 Technologies and Tools

5.2 Framework

Salesforce Force.com cloud platform follows Model View Controller (MVC) Framework. This framework is the most popular design pattern in 3-tiered applications. MVC pattern contains three modules:

- **Model:** represent the data model of the system. The model includes all the objects which are provided by Salesforce. Controller access to this model to execute business logic in the system.
- **View:** representation of the schema and data. The view is used to show the data in a systematic way to the users. Any changes in the data model reflect in the view model [8].
- **Controller:** Represents the business logic of the system like what kind of functionalities need to be performed by the system. It is used to manipulate the data model of the system [7].

5.3 System architecture

e-Catalyst system deployment leverages the characteristics of the Salesforce multi-tenant architecture [5]. Salesforce follows multi-tenant architecture where all the users share the same infrastructure and the same version of the Force.com Platform. Multi-tenant architecture release upgrades automatically and concurrently for all the users. In this type of architecture, users don't have to worry about the operating system, virtualizations, server, storage and networking; everything is handled by Salesforce. This type of architecture enables lowering application cost, quick deployment, and greater flexibility and extensibility.

5.4 Features of e-Catalyst System

This section gives detailed overview of the features of the e-Catalyst system.


- **Home Page**

We have developed an interactive homepage where instructors can see their details (as shown in Figure 4).

Hello, Rajiv Roy

Edit Save

Instructor Detail



Choose File | no file selected
Save

Instructor Name: Rajiv Roy
Phone:
Email: rajivvic@gmail.com
Institution:

Edit Save

Calendar

All Activities | Edit | Delete | Create New View

Action	Subject	Name	Related To	Due Date	Status	Priority	Assigned Alias	Last Modified Date	Last Modified By
Edit Del	Call			10/23/2017	Not Started	Normal	RRoy	10/5/2017 2:29 PM	RRoy
Edit Del	Call				Not Started	Normal	RRoy	10/22/2017 1:47 AM	RRoy

Figure 4 Home page

The instructor is allowed to make changes (as shown in Figure 5) in their details by clicking on edit button. Once the new value is entered, instructors can save the new value by clicking Save button.

Edit Save

Instructor Detail

Instructor Name:

Phone:

Email: rajivvic@gmail.com
Institution:

Edit Save

Calendar

All Activities | Edit | Delete | Create New View

Action	Subject	Name	Related To	Due Date	Status	Priority	Assigned Alias	Last Modified Date	Last Modified By
Edit Del	Call	Rajiv		10/22/2017 4:00 PM			RRoy	10/22/2017 3:31 PM	RRoy
Edit Del	Email				Completed	Normal	RRoy	12/3/2017 2:12 AM	RRoy
Edit Del	Java Programming		Rajiv	12/5/2017 2:00 PM			RRoy	12/3/2017 2:11 AM	RRoy
Edit Del	Java theoretical con...		Rajiv	3/25/2017 10:00 AM			RRoy	9/11/2017 12:21 PM	RRoy
Edit Del	Outbound - 177867...	Rajiv		9/28/2017	Completed	Normal	RRoy	9/28/2017 5:01 PM	RRoy
Edit Del	Outbound - 177867...	Rajiv		9/28/2017	Completed	Normal	RRoy	9/28/2017 5:14 PM	RRoy
Edit Del	Skype Meeting			9/28/2017 8:00 PM			RRoy	9/28/2017 7:13 PM	RRoy

Figure 5 Instructor Personal Details Edit Mode

From the home page, Instructors can navigate to MyCourses, students enrolled, discussion board, student performance, and institution tabs. A calendar section is also visible on the home page as Shown in figure 5, wherein they can view their schedule by daily, weekly and on a monthly basis. Instructors can also view the tasks and events which are assigned to him/her and prioritize their work accordingly.

- **Calendar**

Instructors can view their schedule on a calendar from the home page itself. They can view the schedule on the calendar on daily, weekly, and monthly basis. As shown in the Figure 6, a tab named as “1”, “7” and “31” represents a day, week and month respectively. If the instructors click on one of the tabs then by mode of the selection a Calendar view will get opened.

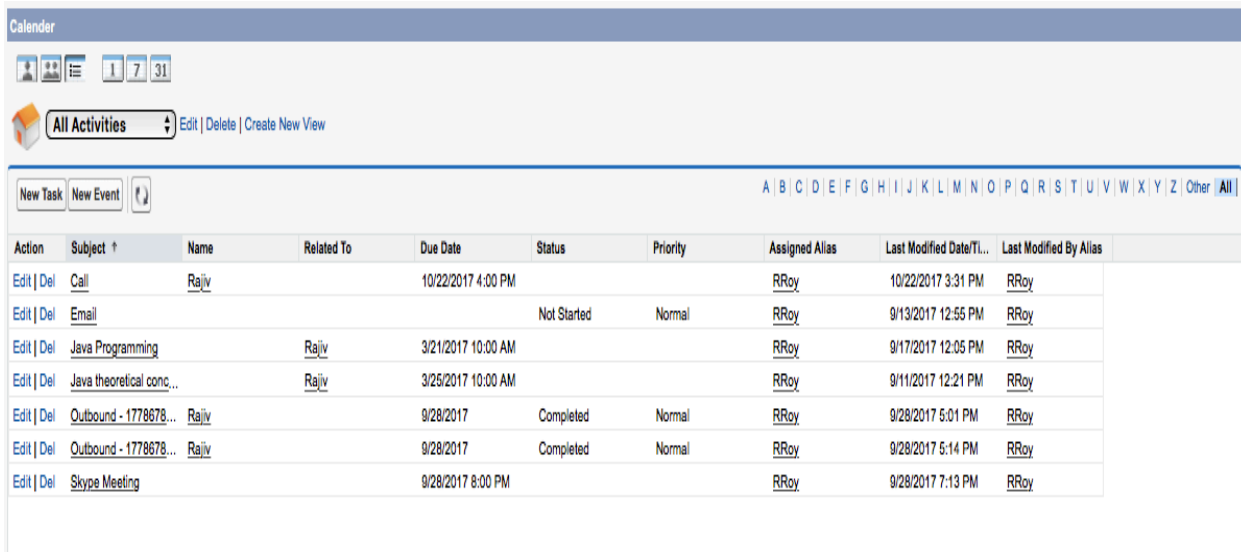


Figure 6 Calendar on Home Page

e-Catalyst provides **different types of Calendar view**:

1) When an Instructor clicks on tab 1 then a calendar with day view will get opened.

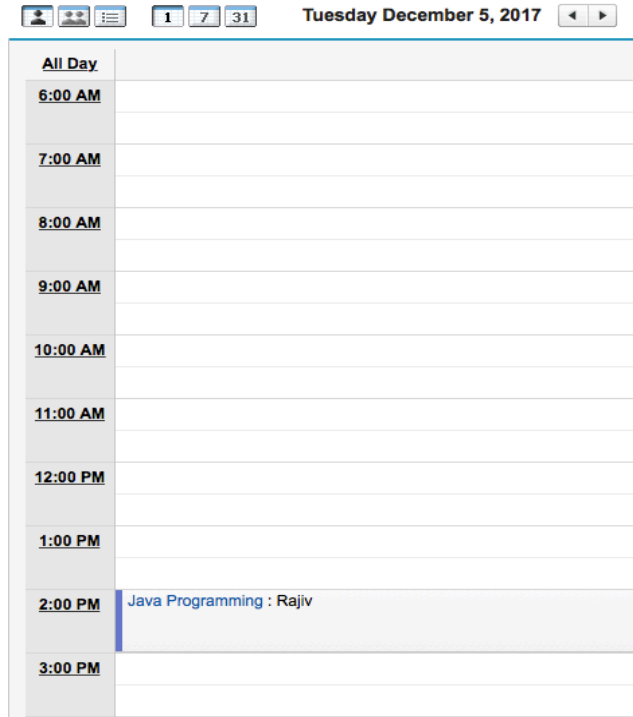


Figure 7 Calendar with Day View

The Figure 7 shows that the instructor is busy from 2 to 3 pm on Thursday.

2) When the Instructor clicks on tab 7 then a weekly view of the calendar will get opened.

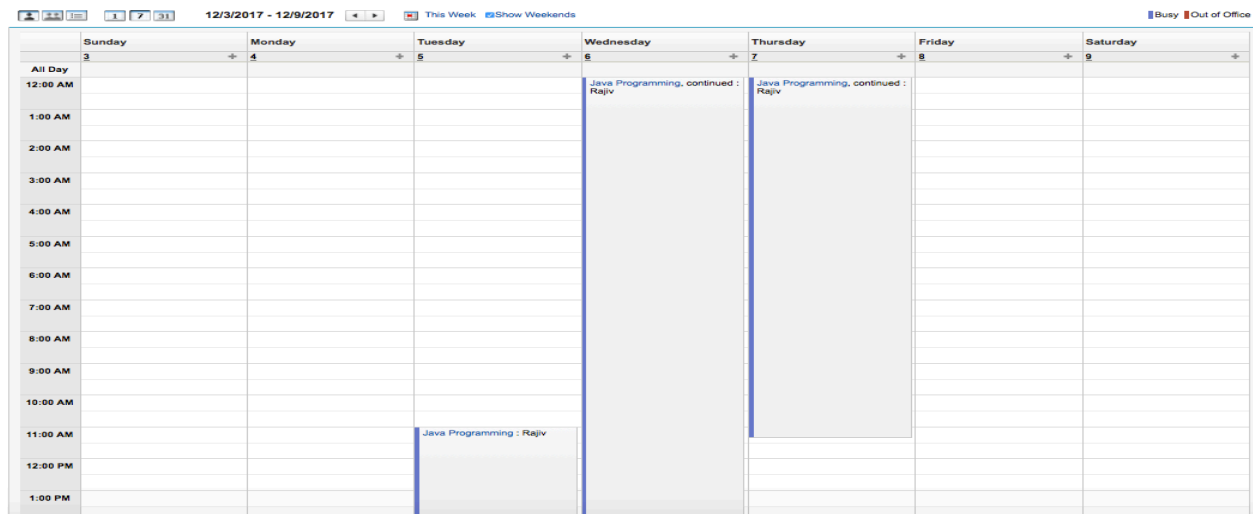


Figure 8 Calendar with Week View

By viewing Figure 8, we can see the instructor is busy on Tuesday, Wednesday, and Thursday and free on other days.

3) When the Instructor clicks on tab 31 then a monthly view will get opened. As you can see in Figure 9 the instructor is busy on Tuesday from 2:00 pm to 3:00 pm.

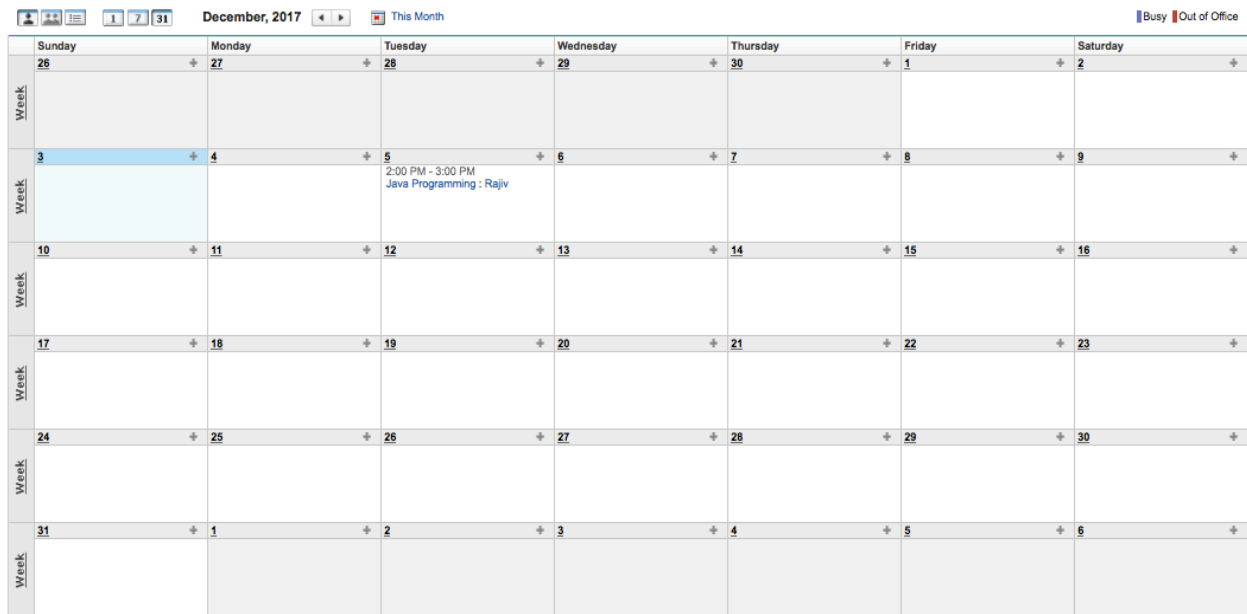


Figure 9 Calendar with Month View

Hence Calendar functionality helps the instructors to manage their schedule.

Activities are also visible on the home page. Instructors can assign a task and create events for the students. In Figure 10 we can see in e-Catalyst system on the home page there is a button called as New Task and New Event.

Action	Subject +	Name	Related To	Due Date	Status	Priority	Assigned Alias	Last Modified Date/Time	Last Modified By Alias
Edit Del	Call	Rajiv		10/22/2017 4:00 PM			RRoy	10/22/2017 3:31 PM	RRoy
Edit Del	Email				Completed	Normal	RRoy	12/3/2017 2:12 AM	RRoy
Edit Del	Java Programming		Rajiv	12/5/2017 2:00 PM			RRoy	12/3/2017 2:11 AM	RRoy
Edit Del	Java theoretical concepts		Rajiv	3/25/2017 10:00 AM			RRoy	9/11/2017 12:21 PM	RRoy
Edit Del	Outbound - 17786783542	Rajiv		9/28/2017	Completed	Normal	RRoy	9/28/2017 5:01 PM	RRoy
Edit Del	Outbound - 17786783542	Rajiv		9/28/2017	Completed	Normal	RRoy	9/28/2017 5:14 PM	RRoy
Edit Del	Skype Meeting			9/28/2017 8:00 PM			RRoy	9/28/2017 7:13 PM	RRoy

Figure 10 Activities on Home Page

- **Add Task**

Once we click on New Task button, an edit page gets opened as show in Figure 11, and then the instructor can assign a task to any registered student. Once the instructor clicks on save button, a task will be assigned to the assigned student.

Task Edit Save Save & New Task Save & New Event Cancel Help for this Page ?

Task Information ! = Required Information

Assigned To ! User ! Rajiv Roy !

Subject !

Due Date ! [12/3/2017]

Phone

Priority ! Normal !

Status ! Not Started !

Name ! Contact !

Related To ! Opportunity !

Email

Description Information

Comments

Recurrence

Create Recurring Series of Tasks

Reminder

Reminder 12/3/2017 8:00 AM !

Figure 11 Assign Task

- **Add Event**

Same with Event, once the instructor clicks on new event button as shown in Figure 12, an event page in edit mode gets opened where he/she can create an event and assign it to the student.

Event Edit

Calendar Details = Required Information

<p>Assigned To User Rajiv Roy <input type="button" value="🔍"/></p> <p>Subject <input type="button" value="🔍"/></p> <p>Name Contact <input type="button" value="🔍"/> [Add to Invitees]</p> <p>Phone <input type="button" value="🔍"/></p> <p>Email <input type="button" value="🔍"/></p> <p>Related To Student <input type="button" value="🔍"/></p>	<p>Location <input type="button" value="🔍"/></p> <p>Start 12/3/2017 3:00 AM [2:25 AM]</p> <p>End 12/3/2017 4:00 AM [2:25 AM]</p> <p>GoToMeeting Organiser <input type="button" value="🔍"/></p> <p>GoToMeeting Status Scheduled <input type="button" value="⌵"/></p>
--	---

Description Information

Description

Notes


Notes

Recurrence

Figure 12 Assign Event

- **Students Enrolled and Skype integration**

Instructors can view the number of students enrolled in their courses, as shown in Figure 13. Wherein they can see all the essential information related to the students like student Name, Email, and Skype Id.


Logout

Home
My Courses
Student Enrolled
Discussion Board
Students Performance
Institutions

Hello, Rajiv Roy

Students Enrolled			
Students Name	Email	Skype ID	Skype
John	abc@gmail.com	abc@123	Chat Call Video Call
Robin		rizwana.rahman1	Chat Call Video Call

Figure 13 Students Enrolled

The instructor can interact directly with a student through skype either by chat, call or Video call. Suppose the instructor clicks on Call link, a message will be popped up as shown in Figure 14.

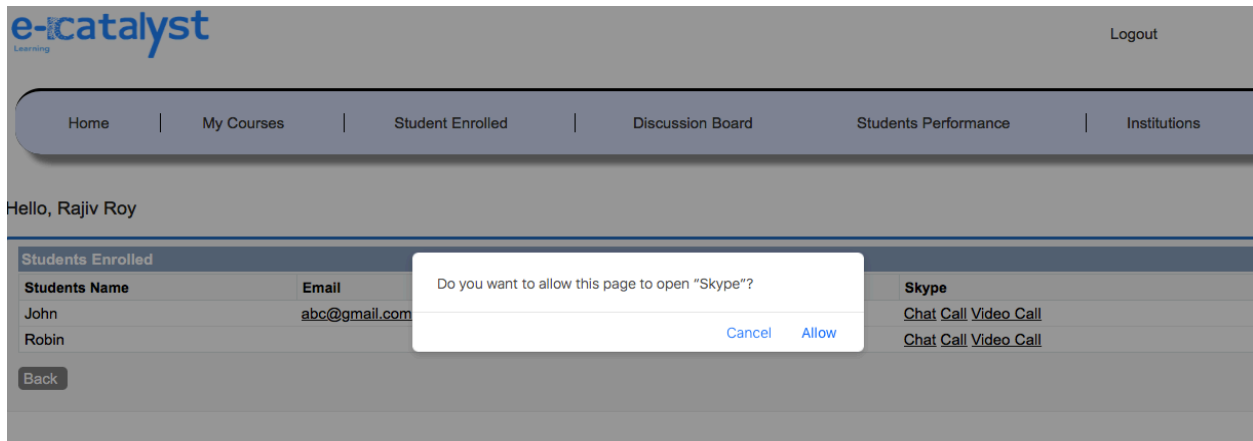


Figure 14 Skype Integration

Once the instructor presses “allows”, a skype panel will open automatically and start calling the student instantly as shown in Figure 15.

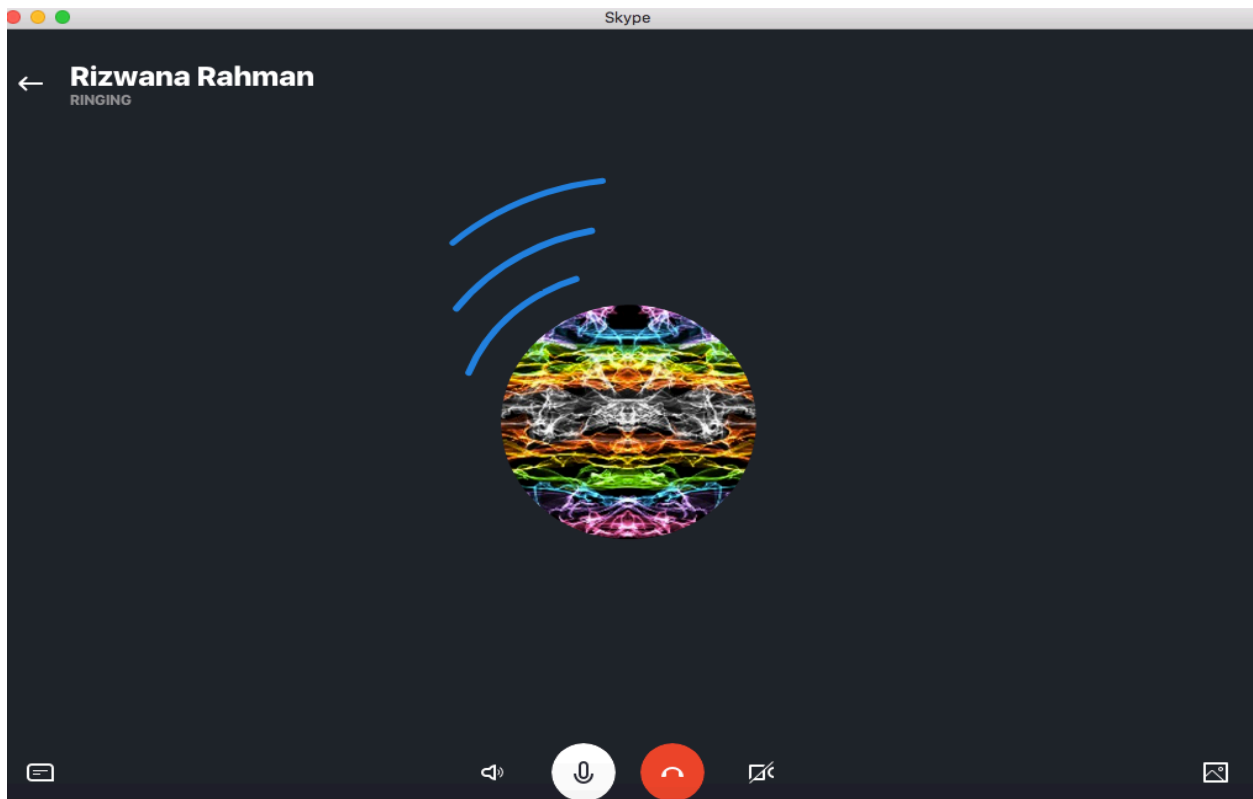


Figure 15 Calling Student through Skype

This functionality is specially built for the instructors and students so that they can interact directly with each other. This helps instructors to understand the student better, provide performance feedback to them and students can ask questions related to the course.

- **Discussion Board**

The design of e-Catalyst system stresses the importance of collaborative work. That is supported by the discussion board feature, depicted in Figure 16. Such feature is specially built for all the users present in an e-Catalyst system, and helps instructors and students to interact with each other and works together. This board is available openly in the confine of the course, where users can exchange information with each other. With the help of the discussion board, Instructors can make important announcements to the students or reply to the questions asked by the students. Important lectures notes, or videos can also be shared with the users.

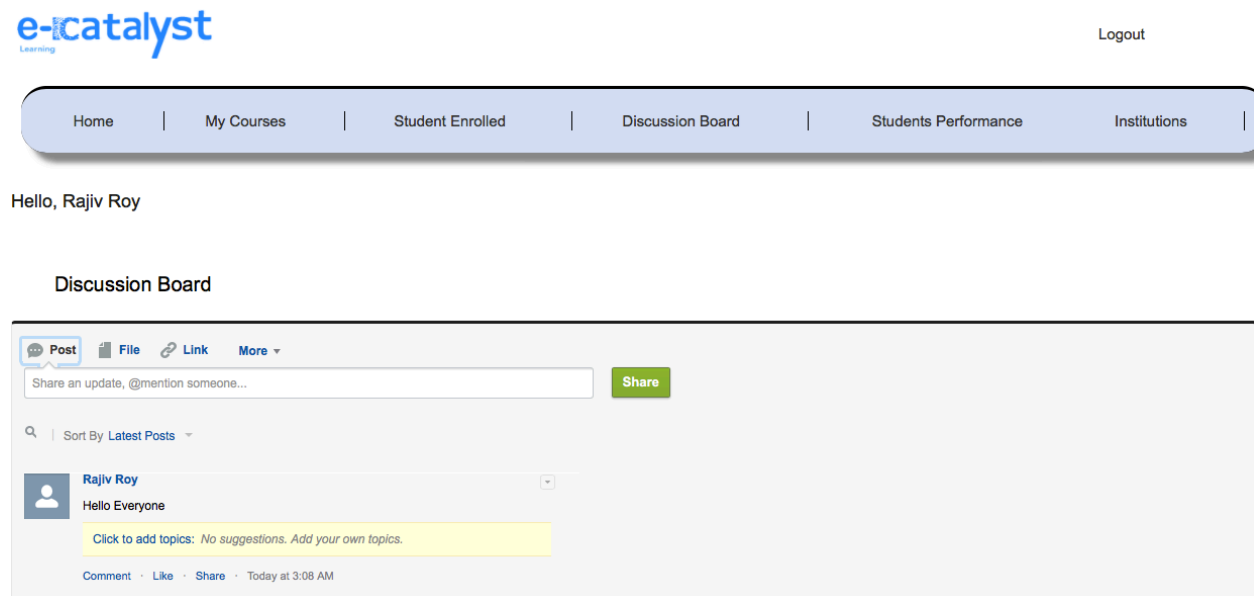


Figure 16 Discussion Board

- **Survey**

Instructors can create surveys and posts on the discussion board; students who are registered in their courses can fill the surveys. The feedback obtained from the students help instructors to improve the performance of their courses. For example, to improve the course content, instructors can create a survey and ask students questions and see the students' responses

received, as shown by Figure 17. On the basis of the responses, instructors can decide what next steps they should take to make the course better.

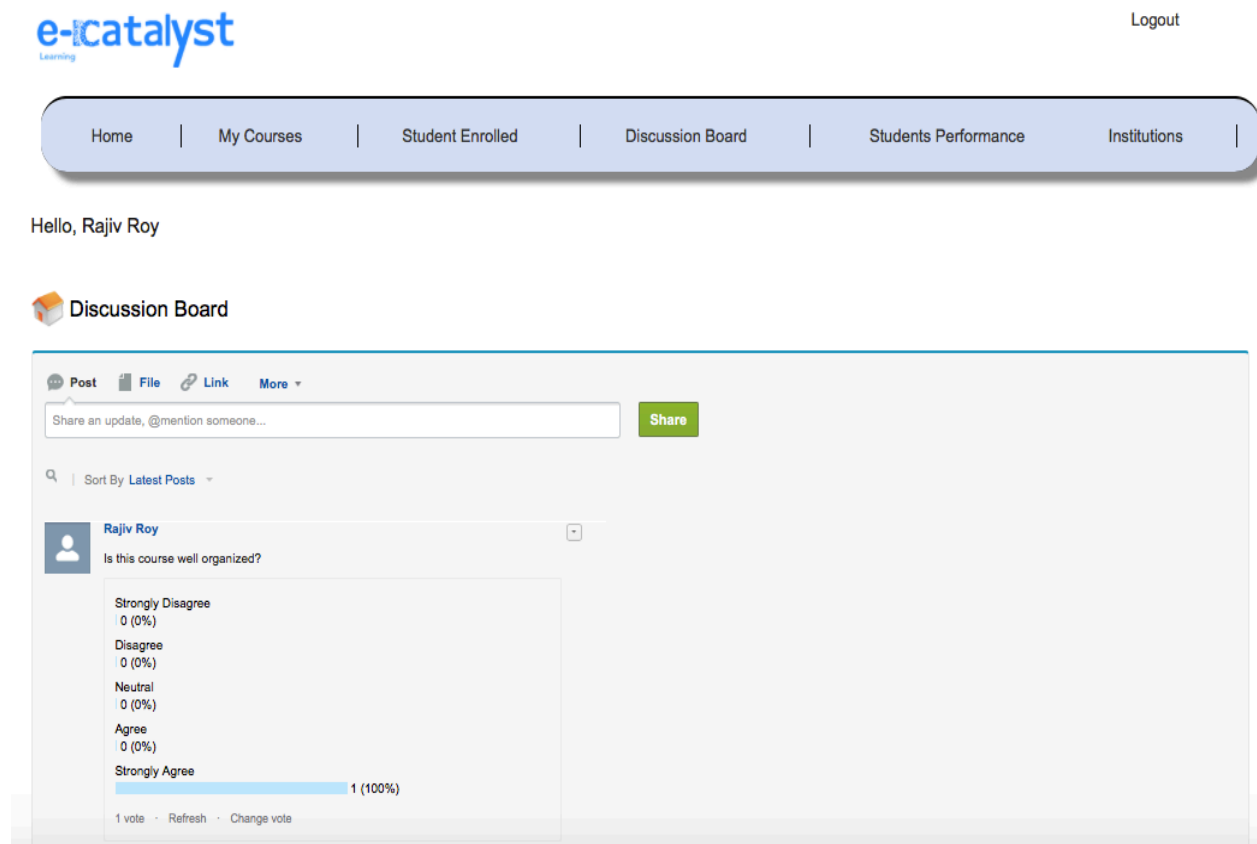


Figure 17 Survey posted on discussion board

- **Student Performance Dashboards**

e-Catalyst system design stresses the importance of interactive learning environment. So it is essential to know how much time students are spending on the e-Catalyst system and how active they are in studying the course material. To make better the learning environment and achieve successful learning outcome, instructors should know how well students are doing in their courses. That's why a Student performance dashboard, as shown in Figure 18, has been introduced. This helps the instructors to know how much students have progressed in the course material and shows students' progress and remaining percentage of coursework left to finish the course material. It helps the instructors to analyze each student progress and plan best practice strategies to assist students learning, define the timeline for next session, set the level of the course contents, and also determine the popularity of the course.

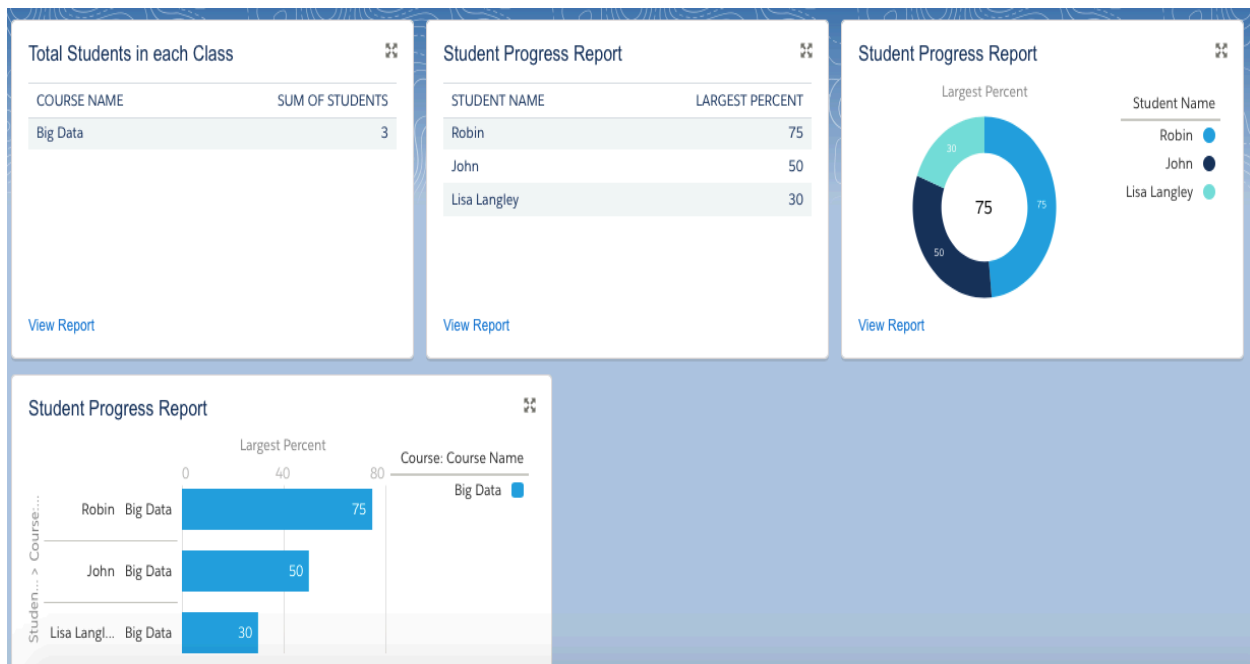


Figure 18 Student Performance Dashboard

Student performance dashboard figure encompasses the following features:

- 1) Total students registered in each course: E.g. in figure 18, In Big Data course, three students are registered.
- 2) Student progress table view: E.g. for the course Big data, percentage completed by each student, is showed in a tabular format.
- 3) Student progress chat view: E.g. Percentage completed by each student for the course big Data showed in a chat format.
- 4) Student Progress Bar chat view: E.g. Percentage completed by each student for the course big Data showed in Bar chat format.

- **Manage My Courses**

Inline editing

e-Catalyst allows Instructors to see all the courses they are teaching. All the necessary information like Course Name, Start Date, End Date, and course Description is visible to the instructor. If they would like to change any information about the course instructor, they just

need to double click on the field value. For instance, in Figure 19, if the instructor would like to change the start date of Big Data course, then he/she just need to double click on start date field, and the start date field will become editable; once it becomes editable, the instructor can enter a new value as shown in the Figure 19.

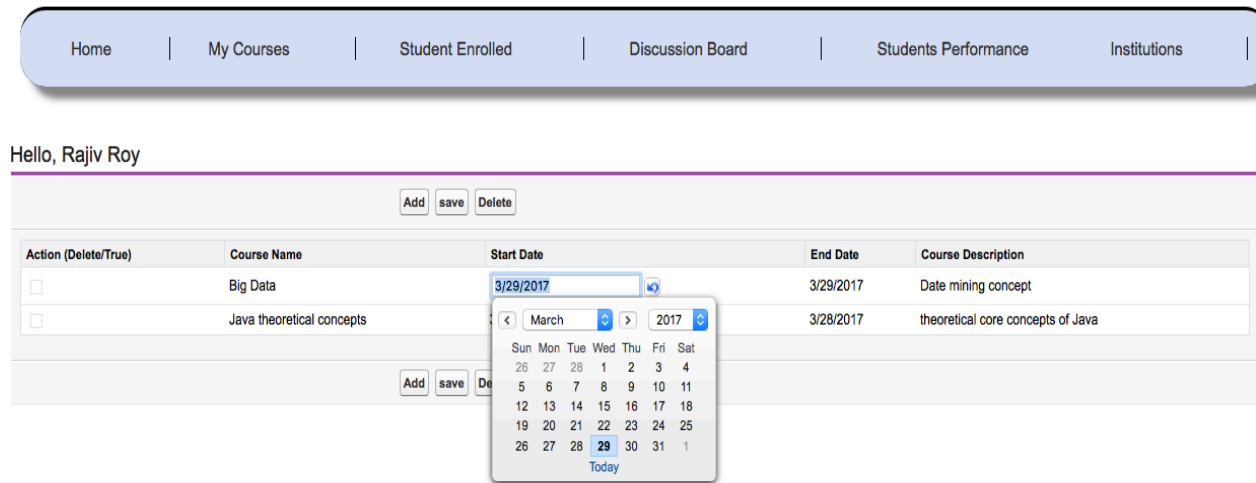


Figure 19 Course Inline Editing

Once the value is entered the instructor can click on Save button, and the record will be saved Figure 20.

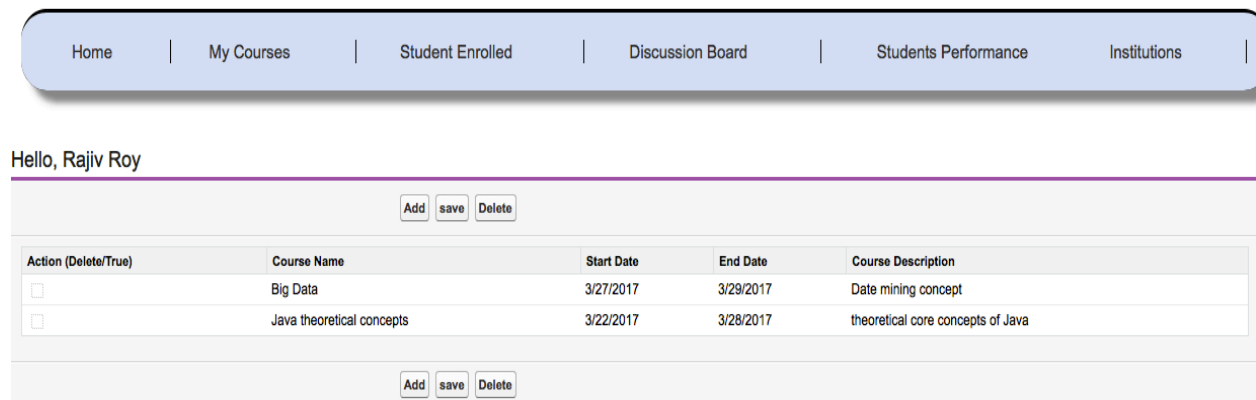


Figure 20 Course Saved After Inline Editing

e-Catalyst also provides the rights (i.e. privileges) to the instructors to manage their courses; they can either add or delete the courses.

Add Course

Instructors can add new courses by clicking on Add Button as shown in Figure 21. Once the button is clicked, a new page will get opened which allows instructors to enter all the required information related to the course.

Course Name	Start Date	End Date	Course Description
Data Structure	12/4/2017 [12/3/2017]	12/19/2017 [12/3/2017]	Linked list, Class, array etc
<input type="text"/>	<input type="text"/> [12/3/2017]	<input type="text"/> [12/3/2017]	<input type="text"/>

Figure 21 Add New Courses

Once the information is entered, the user can press the hit button, and the new course will be added to the database as shown in Figure 22.

Action (Delete/True)	Course Name	Start Date	End Date	Course Description
<input type="checkbox"/>	Big Data	11/28/2017	12/5/2017	Date mining concept
<input type="checkbox"/>	Java theoretical concepts	3/22/2017	3/28/2017	theoretical core concepts of Java
<input type="checkbox"/>	Data Structure	12/4/2017	12/19/2017	Linked list, Class, array etc

Figure 22 New Course Saved

Delete Course

To delete a particular course, the instructor needs to select the action corresponding to the course and then press the delete button as shown in Figure 23.

Home | My Courses | Student Enrolled | Discussion Board | Students Performance | Institutions |

Hello, Rajiv Roy

Add save Delete

Action (Delete/True)	Course Name	Start Date	End Date	Course Description
<input checked="" type="checkbox"/>	Big Data	11/28/2017	12/5/2017	Date mining concept
<input type="checkbox"/>	Java theoretical concepts	3/22/2017	3/28/2017	theoretical core concepts of Java

Add save Delete

Figure 23 Delete Course

Suppose if the instructor wants to delete Big Data course, in that case it will throw an error message, as shown in Figure 24. As this course is an active course, the system will not allow the instructor to delete this course. Only courses which are in planned phase and not started yet can be deleted.

Warning:
This course is already in progress. Sorry, this course is not allowed to delete.

Home | My Courses | Student Enrolled | Discussion Board | Students Performance | Institutions |

Hello, Rajiv Roy

Add save Delete

Action (Delete/True)	Course Name	Start Date	End Date	Course Description
<input type="checkbox"/>	Big Data	11/28/2017	12/5/2017	Date mining concept
<input type="checkbox"/>	Java theoretical concepts	3/22/2017	3/28/2017	theoretical core concepts of Java

Add save Delete

Figure 24 System throws Error Message when try to delete active course

- **Institutions Representation**

The e-catalyst system basic purpose is to provide students world-class instructors around the globe and help them to grow further in their career. Instructors are allowed to view all the details of the affiliated institutions on the Google map, as depicted by Figure 25. The instructors can use this information and connect directly to these institutions. The e-catalyst system not only brings students and instructors together, it also can be used to solve the big challenges facing today's generation in education by connecting the people around the globe.

Hello, Rajiv Roy

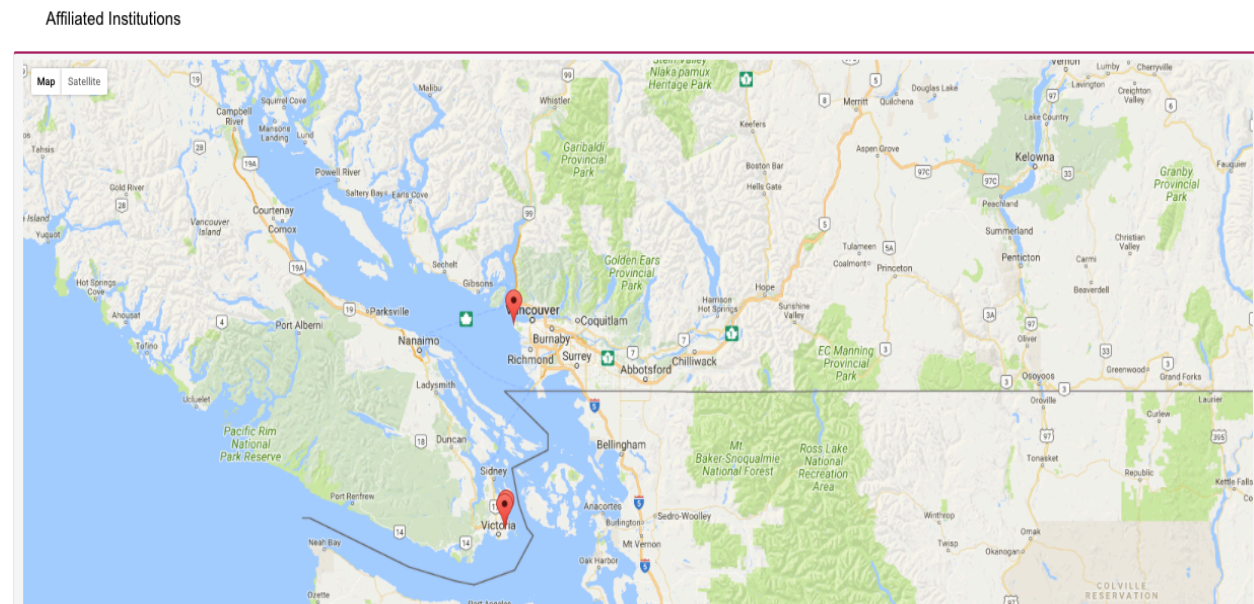


Figure 25 Affiliated Institutions representation on google map

6. E-Catalyst System Management

The e-Catalyst system provides out of the box functionalities to the instructors and students and to deliver positive outcome to the society, it is very important to maintain the system consistently. In order to achieve and maintain the system with all its functionalities, proper management of the system is needed. We have decided that the e-Catalyst system will be handed over to a non-profit educational organisation. The Non-profit organisation will not only maintain this system but also help students to learn from this system. Many instructors from reputed universities, software developer from big companies work for non-profit organisations without any pay for good cause. It will be easier for non-profit organisations to find good instructors and

software developers who are willing to teach and maintain the system pro bono or with limited fees. The detailed e-Catalyst system management and costs incurred are described in Table 2

Cost Items	e-Catalyst system
License Fee	No cost
Number of free License	100 beyond 100 each license will cost \$25
Source Code	Open, already developed
Development Team	Graduate students from Computer Science department at Uvic
Ownership	Handed over to non-Profit Organisation
Client support/maintenance services	Relies on developer forum, online documentation, development community
Support/maintenance cost	No Cost as maintained by the members of Non-Profit organisation
Verification of Product	Already done
Risk of product discontinuation	No
Ease of customization	Assured, performed by an engineer of non-profit organisation according to the specific needs
Security	Maintained by Salesforce
Version control	Automatically Update by Salesforce
Release process	Very easy
Storage	Initially free up to 1 GB More than 1 GB will cost per GB \$10

Table 2 Detailed e-Catalyst System Management

7. Conclusion and Future work

In this project, the “e-Catalyst Learning software system” is designed, verified, implemented and tested. The primary purpose of the system is to understand the basic needs of users who will use

the system and make the system more user-friendly. The system has introduced new functionalities which are easy to use and are beneficial for the instructors and students. Instructors can now schedule their calendar as per their convenience, can make Skype calls directly to the students, manage their courses, can check the student performance and give feedback to their students. Instructors can discuss topics and answers to the posts made by students on discussion board. Instructors can also see the institutions wherein they can contact the organizations and conduct seminars or group meetings with the instructors who work in those organizations to discuss the issues related to the education or to improve the performance of students. Thus, the features of the e-Catalyst system will not only help instructors to perform effectively their work but these will also make the system reliable, easy to use and user-friendly. There are still some features to be implemented in the future, including the following:

- Mobile application for e-Catalyst system
- Video Camera integration so that instructors can watch who is giving the exam
- Use of Artificial intelligence so that the instructors get best recommendations automatically like the performance of students, Other instructors interested areas, etc.

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