

COURSEBUILDER: Design and Development of an eLearning System

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ABSTRACT

Web-based learning environments have the potential to support collaboration among teachers and students and encourage interaction in the classroom by providing quality Internet resources for learning. By incorporating these environments into the classroom, students can benefit from the support these environments provide in various core subjects within the curriculum. This research is to examine the importance of increasing Internet resources within any discipline by investigating and developing a web-based learning environment that encompasses interactive modules and interactive lessons. We will create tools that support both formal and informal learning to increase the appeal of the learning system for both teachers and students.

With the help of CourseBuilder, one can build an online course and try new technologies with CourseBuilder, an open source online education platform. It has a rich feature set and supports online interaction with your students. Are you thinking about delivering a course with supportive technologies related to education or edX technologies? This product was developed to support the ease of use in the creation of online course materials for formal or informal education.

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CHAPTER 1. INTRODUCTION

Based on the research conducted by Pew Research Center, Mobile devices are very common for the American teens and almost every one of them have access to these devices. Not only teens, everyone even very young children are exposed to these kinds of smart devices. Now it is perfect time to use these devices to educate students. It is a great idea to reach as much people as possible by using these devices. Many of the surveys predicts that about 63% of the world population is exposed to smartphones and the surveys also suggests that these numbers will be keep on increasing exponentially in the coming years.

It is necessary that we take advantage of the technology present now and help young people to gain the required skills to help them excel in their careers. Right now, we can use this technology to deliver more information in a more creative way. This method of education also amplifies the student's ability to learn at their own pace and increases their interaction with the course instructor. It is also advisable that we reach out to students by using these latest technologies rather than only depending on traditional classroom techniques. The internet is being used by all regardless of their backgrounds and all have been exposed to technology for learning. All these things reinforce this concept to build new eLearning platforms.

One of the latest learning methodology is the E-learning approach and most of the America's K-12 schools started using these methodologies. Most of the latest technology trends and smart devices are being used in delivering E-learning. With the help of these technologies distinctive and extensive learning opportunities that aids learning anywhere and anytime. Here the idea is not to replace the traditional classroom approach but to create an

additional learning platform. The motto of the approach is to bolster the teaching techniques to amplify the student's involvement in the learning activity. Students will be benefited by the limits being broken by eLearning as compared to the traditional classroom approach, and can access the learning materials during the time when they are comfortable.

The idea of CourseBuilder is to get the central idea of STEM education to reach the students. CourseBuilder injects the computational thinking to students by making them involve in the various activities which showcases the impact made by the STEM education. The aim is also to captivate students in the most imaginative form. Basic concepts will be gained by students and broaden their skills in finding solutions to the problems. Major achievement of this project is to help teaching in schools, through granting compelling STEM education. This process will play a major role to make students pursue STEM education.

Over the past few years, there has been a growing emphasis on the course content, but not much focus has been placed on the usability of the delivery mechanism. Our focus was to develop an engaging, easy to use platform that can support interactive learning. As a result, we conducted a usability study and developed an interactive website, which mainly focuses on consistency and navigability. An experiment was conducted with approximately 30 students from User Interface Design experience. They were presented with a pre-and post-test surveys. The students explored the website and later were presented with a survey. The survey results were positive and the students found the website user friendly and were willing to use the website.

In the recent days, the focus is more towards the course content rather than how it is being delivered. So, our focus was mostly to give an easy to use engaging platform for

interactive learning. This survey is being conducted and based on an interactive website with the major focus being website navigation and consistency. We conducted this survey with approximately 30 students. Both the pre-and post-surveys being presented. Website was completely traversed by the students and finally they gave their feedbacks. Results were very positive and feedback was mostly on the positive side.

CHAPTER 2. LITERATURE REVIEW

Educational technology usage started back in the 1980s. That is around the time of the birth of the internet and there has been a huge shift in using information and technologies in education. This in turn has given rise to distance education. Distance education can be precisely described as where students are not required to be present physically at school. To make distance education a success different methods and technologies are incorporated to support students learning anytime and anywhere. By using computing devices and technologies in distance education will provide a foundation for E-learning.

By utilizing these latest technologies, educational curriculum can be accessed even outside of classrooms [6]. Since many of the multimedia technologies being used in E-learning, it is one of the recommended methods of education. The reason why E-learning became very popular in a short time is that people could get affordable, fast and at the same time easy access to courses. In the recent past getting faster Internet became easy, so E-learning became more and more popular. At present, all education institutions have access to faster Internet. Internet usage in educational institutions is creating an evolution in learning technologies in the way they operate and use technology for their curriculum. The dream of getting an excellent education became reality with the help of faster internet connection being accessed by almost everyone in the world.

E-learning affects the structure of education in a positive way. Right now, all the educational institutions consider E-learning as one of the important learning methodologies.

Most educational institutions also have an advantage of having some worldwide consumers.

Rapid growth in E-learning provides opportunities for educational institutions to have stronger competition each other by providing better education by using the latest possible technologies available. A major threat for E-learning comes from the traditional education methods. Though E-learning is growing in a rapid fashion, it is ultimately the student's interests, which motivates students to seek more education. Since there are very few interactions between peers/instructors in E-learning, this becomes the motivational factor for the individual. Many students prefer face-to-face session to help get clarity on course materials an activity. The next step is to make sure that the proper infrastructure for the course is in place before getting started. Also, a human relations or company is very helpful and may work with faculties who have a friendly rapport with the students and strong use of technology [1]. This revolution in the education has made the educators to help integrate traditional lessons into learning materials. The internet has created a hug impact in the way people learn and use technologies and integrate them within the curriculum. This has prompted a major shift with opportunities to learn more in fun and innovative ways. All the technologies available should be used to their maximum potential and introduce the various information from all possible sources.

E-learning is used as a supporting tool for the learning process to achieve its full potential. This is the most advanced instructional method available for aiding school systems today.

2.1. E-learning in education

Computing devices with the help of latest technologies are used in the education field to access learning material outside of the classrooms.

2.1.1 E-learning

E-learning has been growing rapidly and is being used by the professionals in the education. These modern technologies enable the students and faculty to access the environment inside as well as outside of the classrooms. All these technological developments enforce the E-learning system to provide a complete learning environment.

There has been exponential growth in the numbers of E-learning system. The number of students taking the online courses also keeps increasing. This rapid growth has influenced researchers to study aspects that make learning environment attractive for students. Students who normally participates in online education are attracted towards the virtual schools because of the advantages they provide. At present, all the traditional classes started to see E-learning as the rightful supplement for them.



Figure 1: Growth of E-learning

2.1.2 Boons of E-learning

E-learning is supported through the help of various electronic devices. Comprehensive, individualized learning is created through the latest technologies, which aids learning from anywhere and anytime. Idea of E-learning is not to replace traditional classroom method, but to provide an additional learning platform, which combines the width of teaching with exploring the full potential of the individual's involvement in the learning mechanism. E-learning is quite cheap because publication costs and other costs are reduced. Since the student has access to the course at any moment, which acts as huge platform and incentive for the student's growth.

Extending the options from where it can be accessed, E-learning provides plenty of options including offices, schools, colleges, home or any other place. E-learning also comes in the various forms. It can be categorized into Synchronous (instructor led) and asynchronous (self-paced) learning. New term called blended learning has been coined which is the unification of the classroom teaching with distance learning. E-learning accommodates the

user to skip the lessons they are already comfortable with and directly head to the concept that they are interested in, and if the user is weak in a concept they can go over that till they get the deep understanding.

E-learning affords additional assistance, which may not be possible or practical in the regular classroom approach and is comparatively cheaper than the traditional approaches.

2.1.3 Difficulties of applying technology in E-learning

Even though there are many advantages of using E-learning, there are also few difficulties of carrying out E-learning. Barriers are said to be around 123 from an empirical study [9]. To give a clear summary of all the difficulties, six categories are formed.

- Absence about clear-cut knowledge
- Educational establishments: Scheduling in schools, arrangement structure in schools etc.
- Evaluation: Absence of regular evaluations of student learning
- Assessment: Lack of assessment for student learning
- Absence of resources, it can range from technical help, time, no proper infrastructure (Computing Devices, Software, Hardware, etc.)
- Technical ability: Regularized activities and probabilities, which is developed specifically

2.2 Importance of STEM

2.2.1 STEM

STEM can be expanded as Science, Technology, Engineering and Mathematics (STEM) and represent the respective academic disciplines. STEM support and development has been very important to our educational and educational policy, with hopes to advance the

effectiveness of science and technology training [10].

2.2.2 Why STEM?

All the latest technological improvements became very important in this modern world. Technology plays a vital role in day to day activities of everyone. Influential technical personalities are not the only ones who are being created by STEM educational initiatives, but also escalates the importance of engineering literacy rate and creates new set of inventors. Invention edges the new products and methods which pushes our economy constantly.

Literacy rate in the engineering mostly focuses towards the solid background in STEM. Obviously in the coming years STEM jobs will easily overtake the non-STEM jobs by at least 8 percent. And it is very certain that all the STEM jobs require the basics of science and mathematics. Out of the 20 fastest growing professions, 15 of them are from STEM related jobs, which indicates the importance of STEM for the current and future generations.

2.2.3 Improving Learning by STEM education

Everyone believed that STEM education is for the individuals who are quite strong in math, and it is being pursued by students to further accelerate their skills. Ultimately, the aim for students is to earn a higher education through their strong foundation in science and math. Various surveys show that by completing courses only is not enough to improve the individual skills; On the other hand, not only completing the course reduces student's opportunities for solving problems and giving a deeper understanding of concepts.

The idea behind more STEM exposure to K-12 students is to give them a greater understanding of STEM regardless of background. Future of education will be protected by

more students improving their foundations in STEM.

“Most high school STEM programs have adopted national standards of curriculum alignment; the common strands have aligned themselves to increase student engagement, motivation, and learning” “As recently as 2006, design courses such as engineering have impacted student achievement, as measured by standardized math tests (Dyer, Reed, & Berry, 2006).”

Learning process is designed to concentrate on analysis, engagement and problem-solving skills. Blending engineering with problem solving skills will provide school children real-world approach to problem solving. Also by these methods, critical thinking of the students will also have been increased through activities provided to support the courses.

Self-learning and self-motivation is necessary for the STEM education as only the path can be given by the instructors and students should have the passion to learn it. This in turn will prepare the students for most of the career opportunities which is available now. And there are also various ways being used to hook students in STEM plus advance the skills required. Learnings based on inquiry and multimedia are the examples for these.

The benefit of pushing STEM education into schools will provide all students to practice and solve problems efficiently. A chance to experience and grasp these skills will boost student understanding and deepen their skills and highlight the latest skills required for the present age jobs. All of these efforts help students in advancing their careers.

Development of interesting e-learning STEM curriculum will aid students to master the reasoning, creative and problem-solving skills. All these combined processes will help the

students to have a better option in their future careers.

2.2.4 STEM Careers

IT jobs are expected to grow with a 45 percentage between now 2010 and 2020. All these jobs require math skills. Fastest growing jobs in the coming years are network engineers, data analyst, biomedical engineers and scientists and the important point over here is these jobs needs a STEM degree [11].

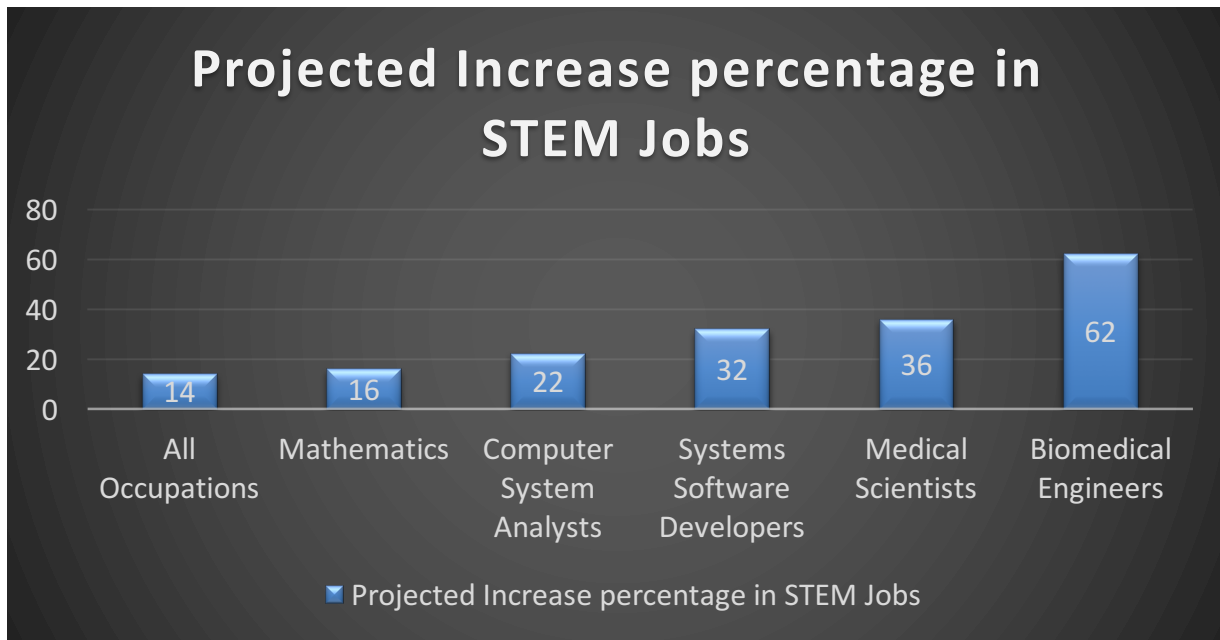


Figure 2: Projected Increase Percentage in STEM Jobs

Individuals with a college degree earn more than 84 percent of the others who has only a high school education. Deep analysis of several majors shows that an individual with STEM majors will earn higher wages. For example, software engineers earn around \$100,000 per annum, as to individuals with English majors who earn around \$30,000 per annum [12]. Also, surveys show that individuals with STEM education earn around 25 percent more money on average than the one who does not have STEM education and further one with the STEM

education are less likely to lose their jobs. Individuals with a STEM degree has a high pay regardless of their type of work or specific job [2].

More than fifty percent of the new openings in the coming years require skills which is being possessed by only twenty percent of the workforce present now. There will be a shortage of at least 3 million skilled workers by 2018. Thirty percent of the jobs might need a minimum requirement of a college degree education. The number of degrees offered in the STEM is low when compared to the other degrees. Overall Asian countries offers more degrees in the STEM education, whereas US ranks 17 for the number of STEM degree it offers.

UNESCO (United Nations Educational, Scientific and Cultural Organization) states that 83 percent of development has taken place in developed countries, but they faced a drop by 7 percent by 2007. 1.4 million researchers are from China, and which is the highest among the developing nations. Half of the US patents were granted to the non-U.S. organizations by 2009 and this was the first time that it ever happened.

2.3 E-learning Applications:

Huge research activity has taken place to investigate IT for making improvements in education and training the students for 20 years, especially in work environment. E-learning has helped everyone ranging from users to the corporates to compete in ever fluctuating global economy. Corporate training uses E-learning to provide necessary skills required for their employees and based on the training they well can perform well in their tasks and achieve their goals (Clark & Mayer, 2003). E-learning is supposed to be the fastest growing platform used in the corporates (Harun, 2002), but the drop rates seems to be higher in E-

learning when compared to the regular approach. It was stated that at least 80% of students have dropped out of E-learning reported by the several corporate trainings (Bonk, 2002; Moshinskie, 2001).

Major reason for this huge chunk dropping out is since there is a lack of motivation or arresting enough courses. Factors such as tech support accessibility, easy to use technology and relevant coursework. The major factor contributing to the attrition rate is poor user interface design.

Every user will have their opinions about the websites they use. An extensive array of emotions can be experienced by the user with just the appearance of the website. These emotion and attitude will be directed towards the product or the organization the website is representing.

Easy to use and quick learnability of a human will determine the usability of the sites. Usability can be defined as the degree to which the software can be used by the users to achieve the efficiency and effectiveness without reducing their satisfaction level [14]. Users can sense aesthetics very quickly. So, user's emotion and perception should be kept in mind while designing the website.

Mind and emotions should be in sync to have a good appreciation for the aesthetics of a system. Design of the systems are based on the business goals, infrastructure capabilities and features required. All features are the important ones, but all these would end up as nothing if we do not have consider the end user. Designing an application should be carried out by User-Centered Design (UCD) approach for which the perspective of the user is considered [16].

Each sense of the user's attitude and behavior should be taken into consideration before even start building the application. By following UCD approach the application will be more efficient, friendly and provides better experience for the users. So, if all these things are kept in mind, the consumer base will be keep on increasing.

Things that dominate the outstanding web is that the user's motivation levels and the product types. Information collected depends on the way the product is being viewed by the user. Content of the website is very important to the user, for example: in case of vehicles, the products specific details matters. We can conclude that a user needs to be motivated and focused. Users need to be very attentive while making these decisions. We think that good aesthetics, ease of use and good functionality will highly motivate users. Since they are not highly motivated, aesthetics seems to be of less importance to them.

CHAPTER 3. Method

3.1. Problem

There has been a decrease in STEM enrollments and this has prompted the government to think innovative ways to attract students to enroll in STEM degrees. Surveys also suggest that there is a huge gap between the jobs available to the students available with the CS degrees. CS is seeing constant decrease in the number of students pursuing its degree and it is said to be around 60 percent [17]. It's been a tough task for the governments to attract students to pursue CS degrees. Based on several reports there are about to be 700 thousand jobs to be created in Information Technology, and by seeing the present scenario there won't be enough skilled candidates and scenario seems to be pathetic as every year passes by. Most important courses of a CS degree are math and science, and for these subject's students should be able to connect with these subjects quickly. Often there is a myth going on that these courses are very difficult and students are discouraged to pursue these degrees.

Maybe by creating different streams inside computer science might interest students so that they can be getting specialized in the things they love, a successful example for that is after starting gaming division inside computer science the enrollment rate seems to be increasing as kids love to play games. But by just adding computer science in the secondary education results are not very encouraging. Normally students who get into CS newly will be finding it difficult to understand the topics as most of the concepts are difficult and abstract. Regular approach like dealing the concepts first and then making the students involve in the projects is not liked by the students nowadays, since the students are feeling that they will be

able to learn by doing. Nowadays visual programming tools are used to increase the programming literacy in schools by taking up various approaches. Other than this there are a lot of activities needs to be completed to make students skilled enough for the jobs available.

3.2. Existing Solutions

Job vacancies were not being able to be fulfilled by the employees who has the right skills with the STEM degrees. Due to lack of motivation in and around them STEM students failed to see their full capabilities in school level or they end up dropping from the STEM degrees from colleges or universities.

The number of students who received undergrad STEM degrees has been reduced by 19.8% in the last 20 years as reported by the Engineering Workforce Commission (EWC) report. Employment rates in the STEM is touted to be on the increasing side and it is said to be of triple time of that of the other occupations. There has been a huge downfall on the number of students being enrolled in computer science degrees of around 50% during the mid 2000's. And the number of students fell by 43% to around 8000 [18] in 2007. According to labor statistics there are touted to be around 850 thousand jobs between 2006 and 2016, and there seems to be a 24% increase in the IT related jobs.

Due to the decline of number of students in STEM education, ten items have been proposed by US National Academies. In these actions top three are [19]

- By making the teachers in STEM education stronger in technical aspects by providing more coaching for them in the math and science.
- Maximize the set of students who prepares for college education and make them pursue

STEM education and graduate in them.

- To change this, changes should be made from the basic structure, so this should be started from K-12 school education where students should be trained with science and math.

Camps during summer and workshops throughout the year will be helping the students in K-12 school level to get attracted towards the STEM education. This is also being helped by giving professional training to the teachers in the K-12 school level. ITEST (Innovative Technology Experiences for Students and Teachers) being created by NSF (National Science Foundation) to assist the STEM education. ITEST program is developed to create awareness and interest among the pre-K-12 students on STEM and IT (Information Technology) careers for the future [20]. Several partnerships have been formed between the Universities and the schools to carry out the ITEST program.

Foundation of math and science is given to the teachers in the K-12 schools to make them stronger by conducting various development programs for them and as well as specialized program to support the students. Course syllabus and curriculum is developed based on the latest textbook approaches such as Alice model. Results are positive by using ITEST program along with inducting Alice programming course which interactive programming sessions [17].

3.3. Research Questions

All the initial process we did by collecting the data about E-learning system and their advantages over classroom approach. School student's constant in need of a E-learning platform which is specifically designed to provide fundamentals of stem courses. The major suggestion was to keep UI simple, attractive and easy to use. Our major research questions are:

1. Can we make a website, which is very simple to use for the school children?

2. Is our website useful for the children who aims for higher studies in STEM?
3. Will this approach be better than the traditional approaches?

3.4 Research Hypotheses

By making the website easy to use for the children without any instructions makes the website simple for the children. The development of CourseBuilder has arisen from the question that whether there can be a site which is specially targeted at people who are interested in STEM education. Usability of the website is derived the empirical study which we conducted. The study we conducted showed that the E-learning system offers more features than the traditional approaches. Results and analysis have been created at the end of the study to make sure where we started and where we reached and whether we were able to meet the research hypotheses.

Hypotheses 1

H1₀: Overall, Students does not find CourseBuilder easy to use.

H1_a: Overall, Students find CourseBuilder easy to use.

Hypotheses 2

H2₀: Students does not find CourseBuilder flexible.

H2_a: Students find CourseBuilder flexible.

Hypotheses 3

H3₀: Students does not find very high User Experience.

H3_a: Students does find very high User Experience.

Hypotheses 4

H4₀: Overall, Students will not recommend CourseBuilder to others.

H4_a: Overall, Students will recommend CourseBuilder to others.

Hypotheses 5

H5₀: Students are not satisfied with using the CourseBuilder to enhance traditional classroom approach.

H5_a: Students are satisfied with using the CourseBuilder to enhance traditional classroom approach.

3.5 Participants

Participants are mostly high school kids and k-12 level school teachers. Some of the participants include normal people from various professions and different sections of the society. Some of the participants had Human Computer Interaction (HCI) or User Interface Design (UID) experience. The usability of the site based on school children feedback as our site is mostly developed for this audience.

Everyone who participates must know to operate computers and use internet. Feedback has been received from the participants by providing them the feedback questions. Based on these questionnaires data has been collected and processed to understand the computer skills, user experience and how often they will be visiting the E-learning sites to learn STEM related skills.

3.6 Instrumentation

By Pre-Questionnaire all the background data is assembled from the users. Feedbacks based on their experience for using the site will be collected with Post-Questionnaires. Many surveying instruments has been researched to make sure that we are able to get the necessary

questions that will support our goals and suitable for our participants. Questionnaires will be both quantitative and qualitative to make sure that all type of important and mandatory questions are incorporated in the surveying instruments which is being used. Basically, instruments can be categorized into participatory and usability based.

3.7 Procedure

All the participants must have access to the computing device and Internet so that they will be able to participate. Some of the devices from which the site can be used are tablets, smart phones and computers. For us there are two set of participants' groups one is the teachers and the one is the students. Both participant groups are used in experiment study. Interface (experiments) and website (benchmark) are evaluated by the participants. Components are evaluated in an unsystematic approach. Participants for the above mentioned are made sure that they are at least amateur users by providing a pre-questionnaire to make the research possible. Computing devices with proper internet connection are being used for the experiment. Same devices are being used for both the benchmark and experiment procedures.

After the experiment has been setup, we will move to the usability tasks. This task is basically web based. The participants for this activity will be given a link about the research to make them comfortable with the procedures. Prior to their participation, they will be given an IRB form which discusses about their privileges. The participants also have a leverage that they can leave their participation at any time without even informing the IRB. There are around 4 sections like signing the agreement between IRB and participants, pre-questionnaire, completing the required tasks and the post-questionnaires. There are around 20 tasks were provided and these tasks will be like that of the benchmark and experiments.

The study involves two phases, they are participatory design which is being conducted to gather the requirements, analyze them and design the interfaces and the next phase is usability testing which is being conducted by making school students as the participants. To the students, the purpose of the will be explained to them clearly by the researchers, and all the necessary tasks and questionnaires will be performed by the students.

Computing devices with the pre-installed interfaces at our Computer Human Interaction Lab (CHIL) at Auburn University is being used for the experiment. This is the place where the students will be participating to take the study. Statistical reporting software's are being used to analyze the date collected. And the study results are presented in a possible manner.

The results which we got from the study were very positive. Feedbacks such as easy to use, simple interface, cool design, pleasing interface were there. And as far as the aim of the study is to get these types of comments from the participants as only these comments will make sure that our aim has been achieved for developing the application.

CHAPTER 4. SYSTEM DESIGN

4.1. Recommended solution: COURSEBUILDER

CourseBuilder site has been developed to be a teaching platform for the STEM subjects. The major motto of the website is to be simple, user friendly, dynamic and easy to use. This web application will be having course materials such as documents, videos and quizzes. CourseBuilder has been designed by carrying out a deep and complete research on all the available E-learning systems to make sure that we are not missing out the important features and provide more than the available features which is being already available in the various E-learning systems. First the users need to sign up and then they can enroll in the courses, which they are interested in and then they will be able to access the respective course videos, reading material, quizzes and will be able to track their progress.

4.2 Use Case Diagrams

The case begins with a student who is interested in learning about a course in the basics of programming. He is being referred by one of his friends to use CourseBuilder as a good platform for the novice users. He visits the CourseBuilder sit and signs up. He then looks out for the basics of programming in the courses list and enrolls in it. Then he starts learning the course at his own time by going through the reading materials and seeing the videos. Then he prepares himself for the quizzes by recapping the resources. Once he is confident about the course material he starts taking the quiz and once after completing it he analyzes his progress. And he can even study the things again if he did not do well in a concept.

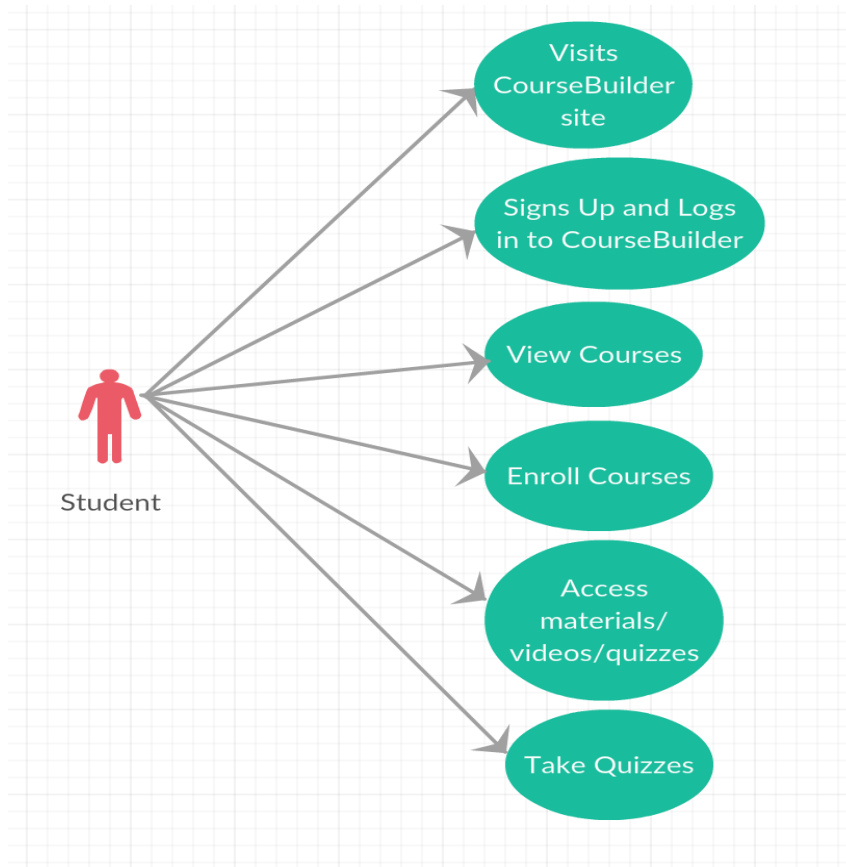


Figure 3: Student's Use Case

Now we will see how the system will behave for an instructor. We are considering a science teacher. Some of his friend's praises CourseBuilder, he visits CourseBuilder web app. Since the UI impressed him very much, he started creating science course. He creates the course from the scratch by adding the necessary materials, posts his videos and formalize his quizzes. He makes sure that all the course content is from his understanding and easy for the students who pursue it. So, whoever interested and curious to learn more about science can enroll in the course.

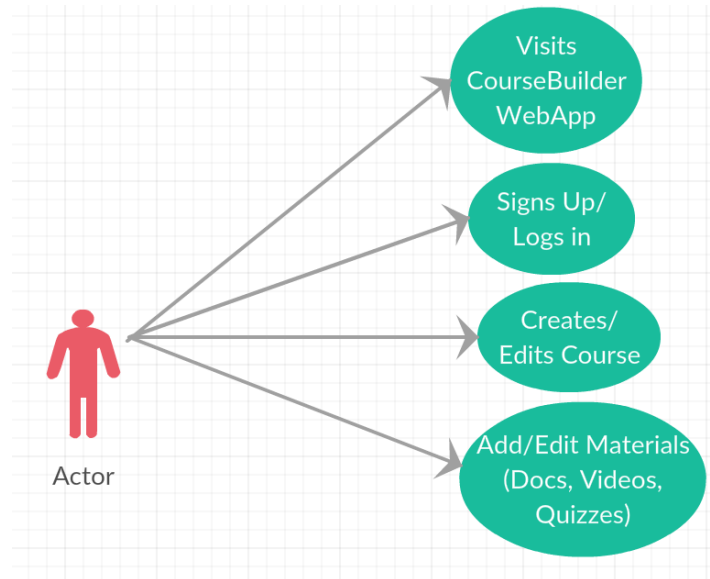


Figure 4: Instructor's Use Case

4.3 Sequence Diagrams

Sequence diagram which is below represents our web application during user's login and start using the CourseBuilder for the courses which is being offered by it.

Sequence Diagram which is at the top represents user's login to the application and his/her course selection process. When the user logs in to the site, he can start learning the course by going through the material, videos and complete activities like quizzes.

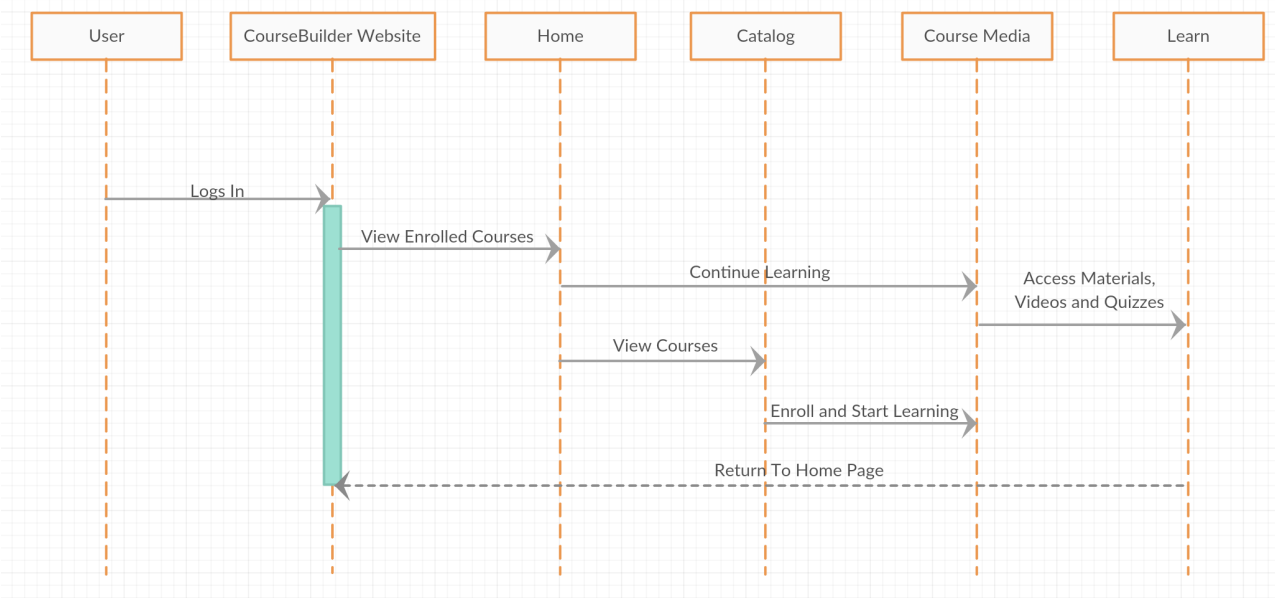


Figure 5: User's Sequence Diagram

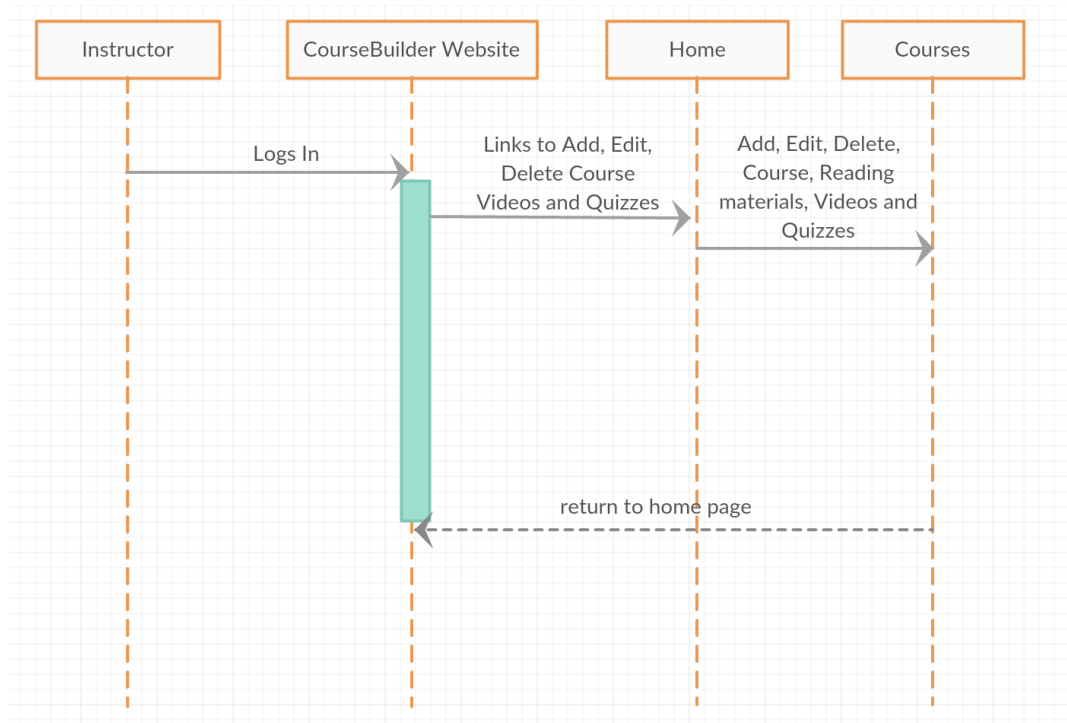


Figure 6: Instructor's Sequence Diagram

Instructor's login process and their method of course management is being depicted by the above diagram. In the home page, instructor will have all the course management options and it will be easy for them to use.

The project was evolved in the consecutive stages

- Assembling the required information's and designing the wireframes
- Coding the Front End based on design (Presentation Layer)
- Coding the Back End based on design (Data Access Layer)

4.4. Requirements and Wireframes

The basic requirement was to provide proper materials for the available courses in CourseBuilder. Every course in the CourseBuilder site should have the below sections

- Course Overview
- Course Materials
- Course Videos
- Quizzes for checking the progress

4.4.1 Functional Requirements

CourseBuilder will be acting as a search environment in the E-learning system. The major functional requirements are as follows:

- Users can make an account by providing basic details, and can login to the site
- The necessary course materials with the videos and section should be there for all courses
- Users can enroll the course of their favor by searching through our site

- Users can access all the materials related to the course
- Account setup and login process is the same for the instructor's also
- Instructor's will be having the additional privileges of creating and editing the courses

4.4.2 Design Requirements

CourseBuilder should be designed in such a manner that it should be very simple and easy to use for everyone. The site must be stable and consistent for all the features it offers. User experience should be in a manner that none of the information present in the website are required to be remembered by the users. Website has been designed in such a manner that all the details will be conveyed in a single page. All the necessary sections of the site will be accessed through the menu bar, some of the features are account settings, home page etc., the consistent factor is also maintained throughout the menu's available. Granted that the available pages are recognizable, user experience is improved there.

The recognizable feature of the site makes user to understand what they know and what they do not. The user base will be loyal if the satisfaction level goes up. Loyalty factor is directly proportional to the satisfaction level of the user [21]. If the site is recognized as widely familiar, percentage of user's learning and developing the skills will also be improved.

The absorbing skill of the user will be improved based on the user experience being provided. And obviously, it makes learning very easy for the students. User experience provided is based on the nature of the user's. If users can recognize the design or else maintaining standards might lead to familiarity factor [22].

Home page will display the courses, which is being enrolled by the user. If the users

haven't enrolled in any of the courses, catalog menu of list of the courses will be provide in the form of a link.

Few of the clear-cut conditions are:

- Categories of users are either student or teacher
- First step is to create an account, then only user will be able to surf through the courses being offered.
- Required materials for all the courses will be accessed by the users without any restrictions on the duration.
- Users will only be able to access the course material only after enrolled in the course.
- Instructor's also will be able to create or edit content once after they log in.

4.4.3 Wireframe

Entire structure of how the website will be designed must be based on the wireframe, wireframe is the schematic representation of the website [23]. Design process will be smoother if there's a wireframe in place. <https://wireframe.cc> is utilized as wireframe creation platform.

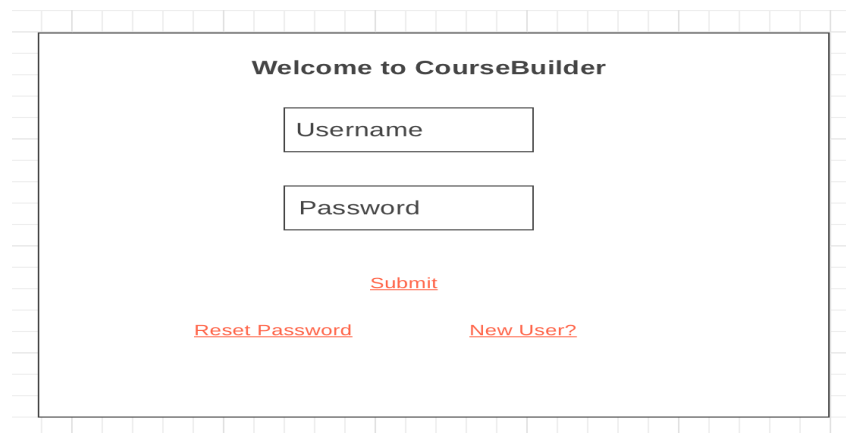


Figure 7: Login Wireframe

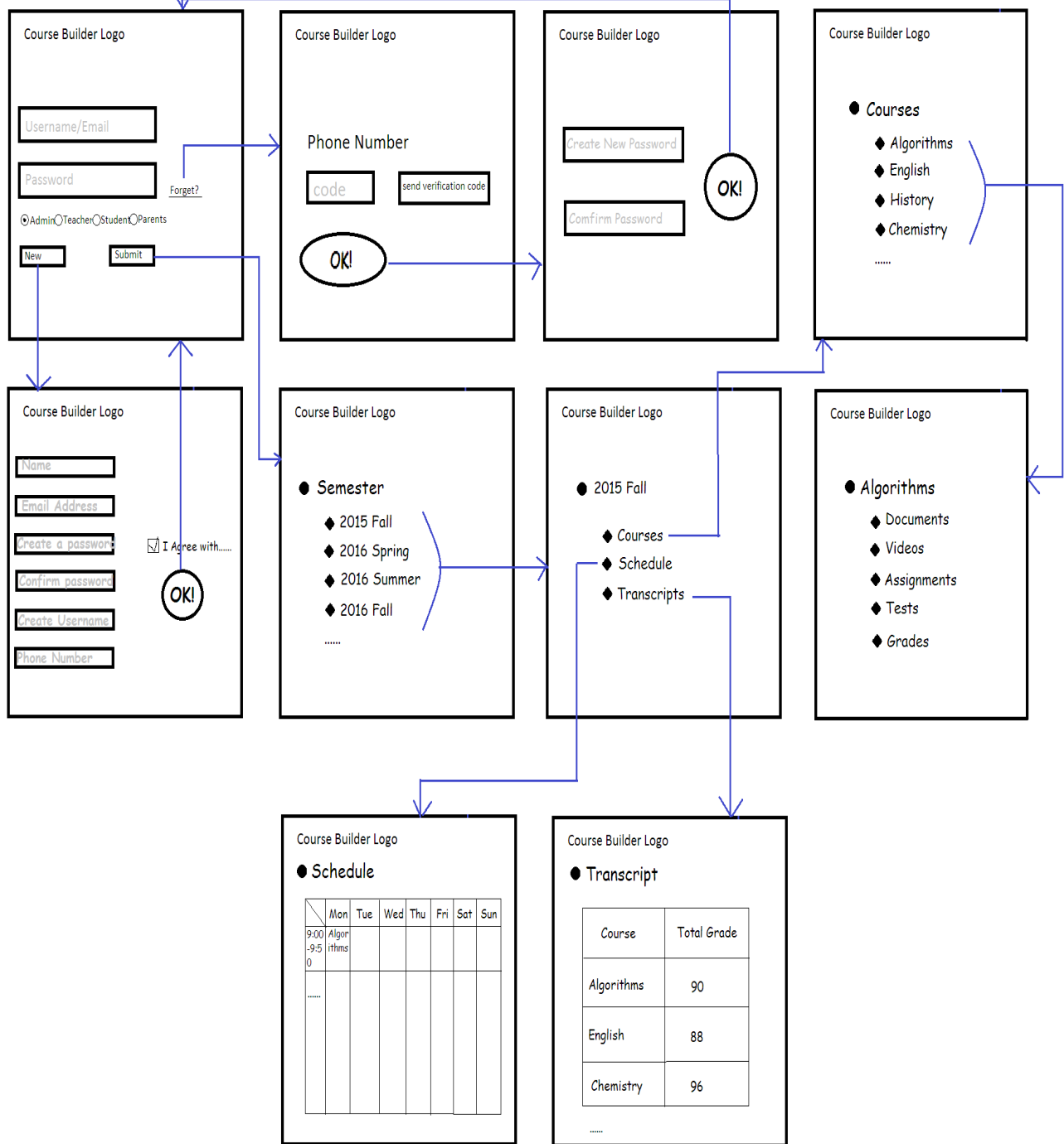


Figure 8: Website Design Wireframe

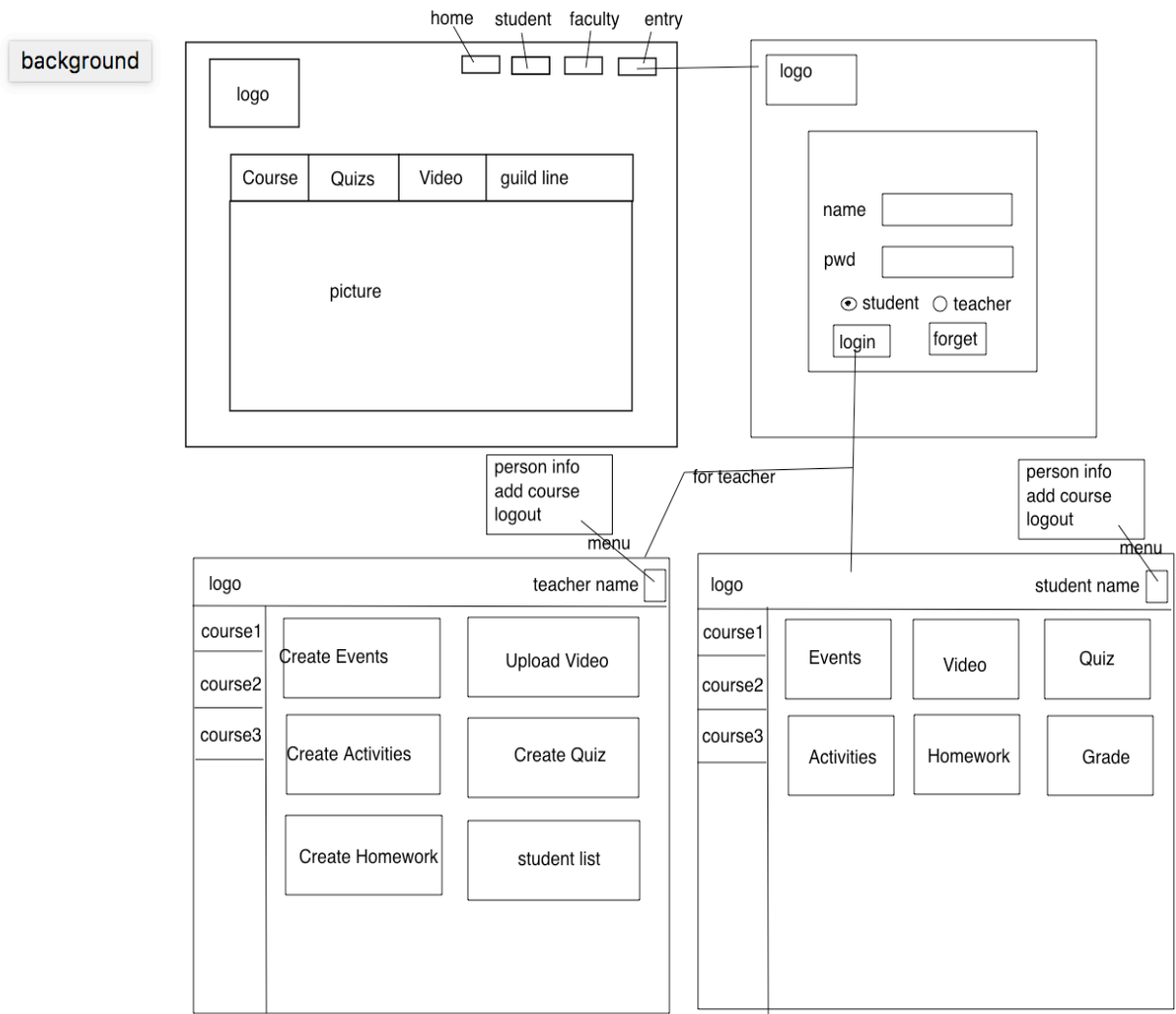


Figure 9: Website Structure Wireframe

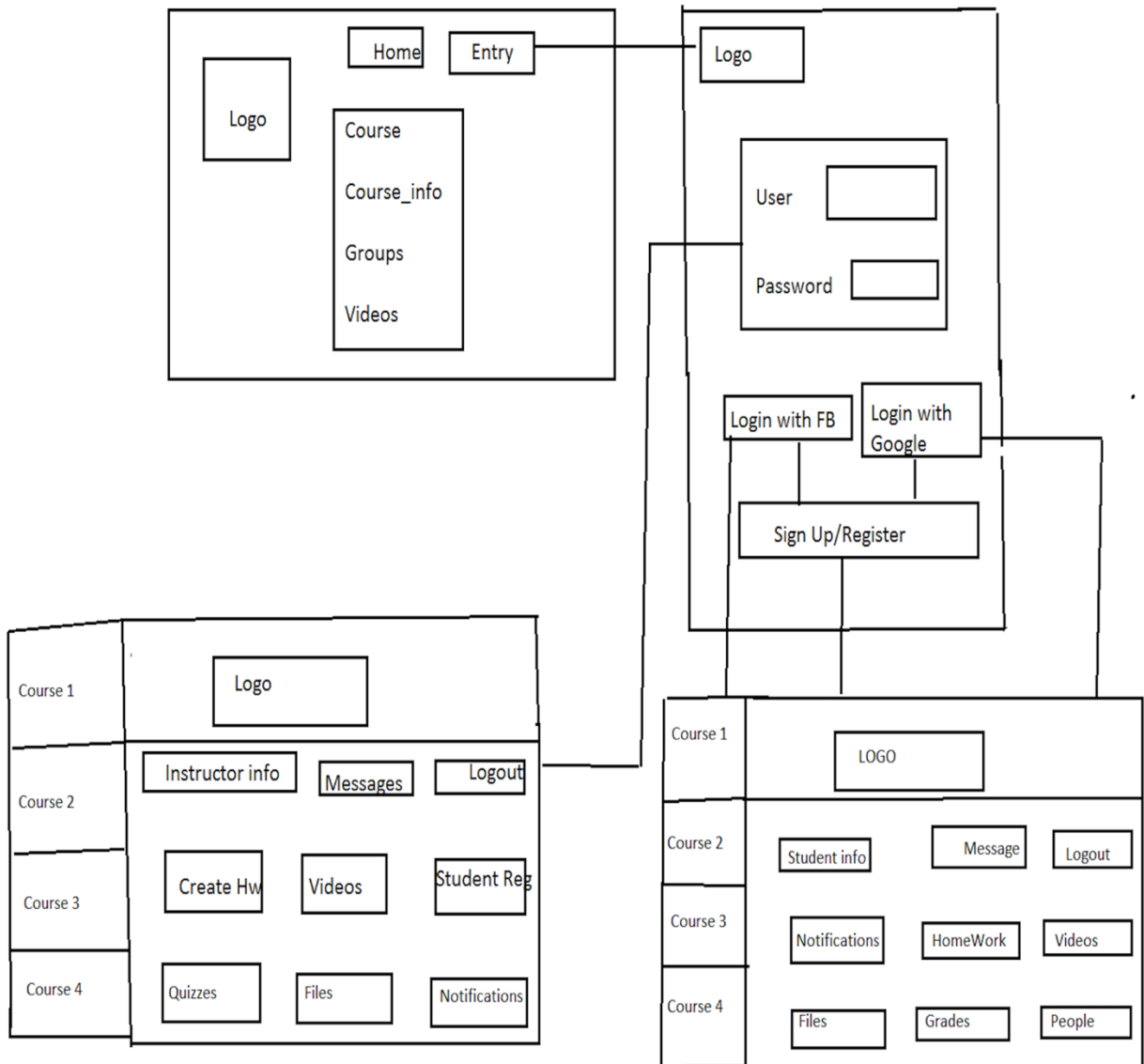


Figure 10: Initial Wireframe

4.5 Prototype

We come to the website completion based on the prototype built, we made sure that prototype which is built was like the product, so that reworks have reduced. The product is determined by the prototype which we designed based on the questions we asked

ourselves during product development [24]. All the data, which is used for the testing is directly put into the prototype, so that while developing the site it will be easy. Testing is performed based on the prototype we developed. It is easier to change the product in its initial phases and it is less expensive also, this is the major importance of holding a prototype.

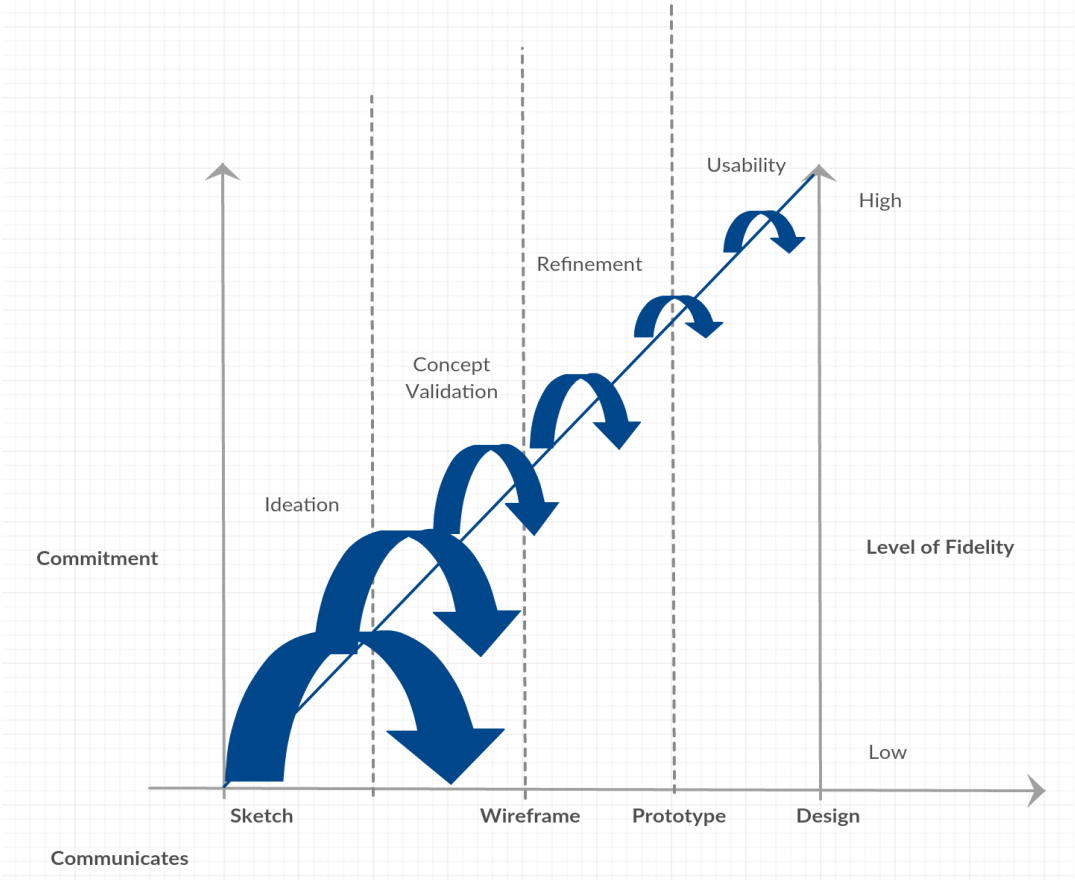


Figure 11: Design Steps [24]

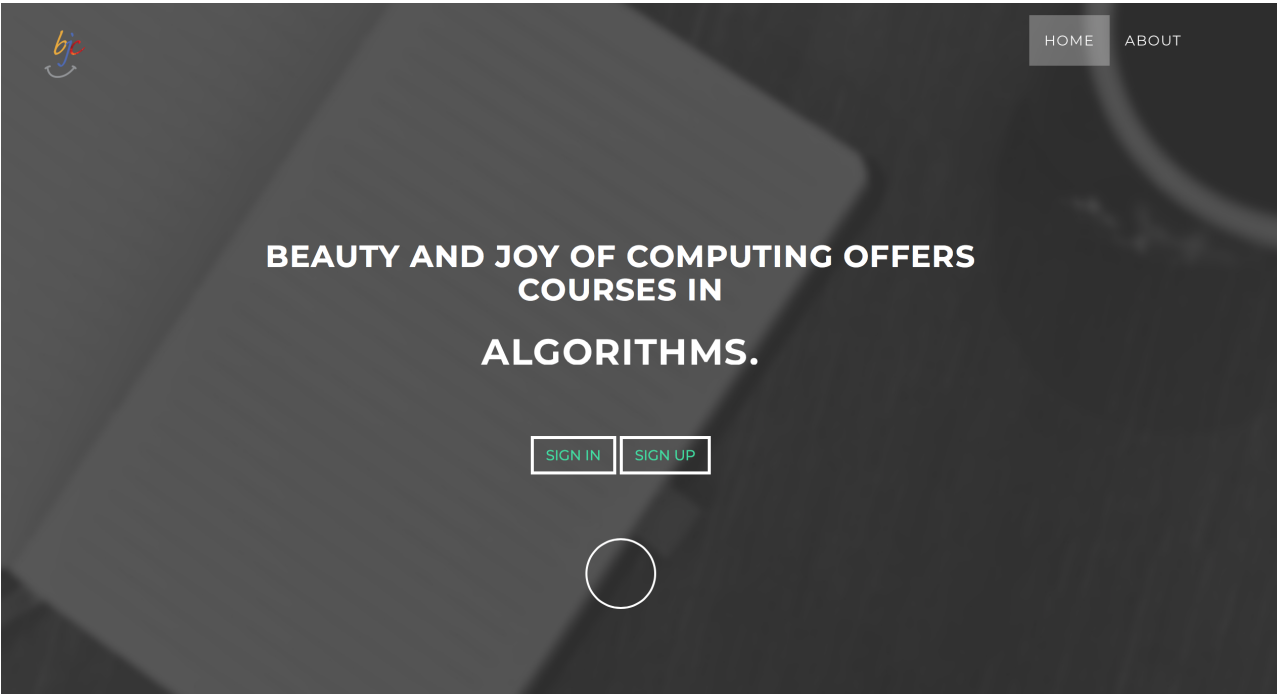


Figure 12: Home Page - Prototype Version

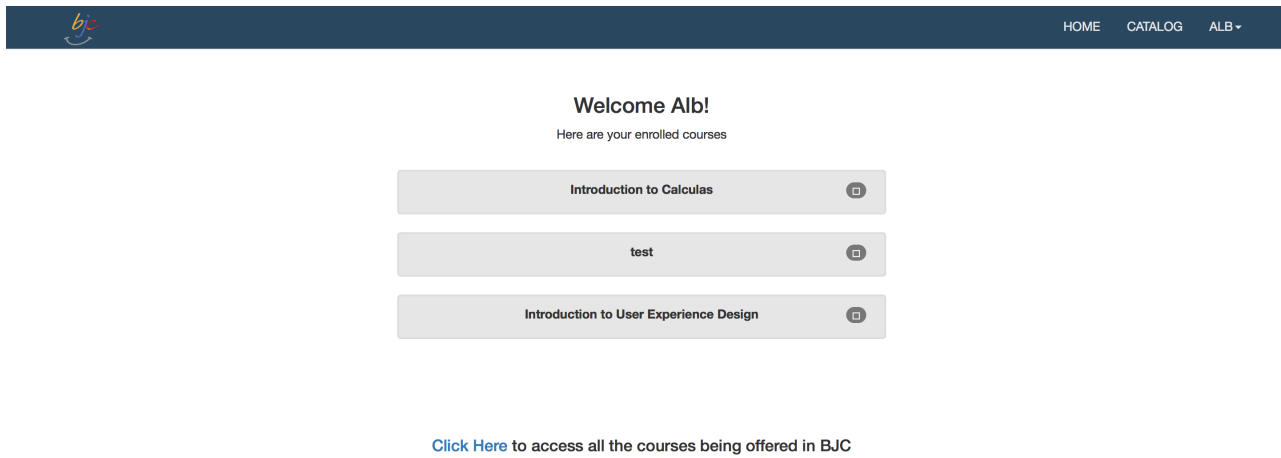


Figure 13: Enrolled Courses Page, Prototype Version

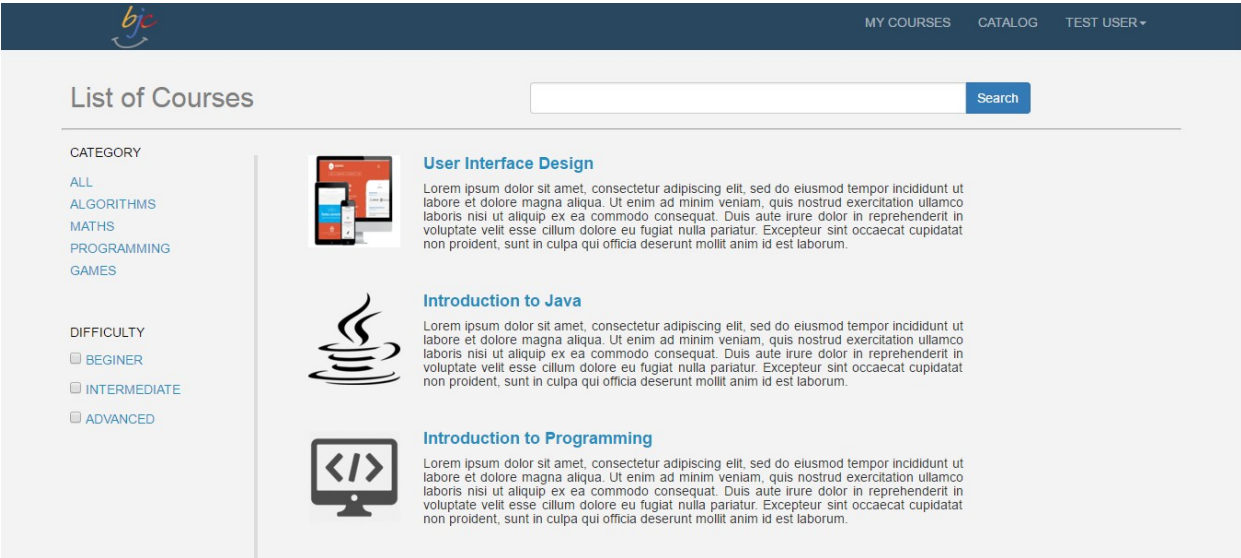


Figure 14: Catalog Page-Prototype Version

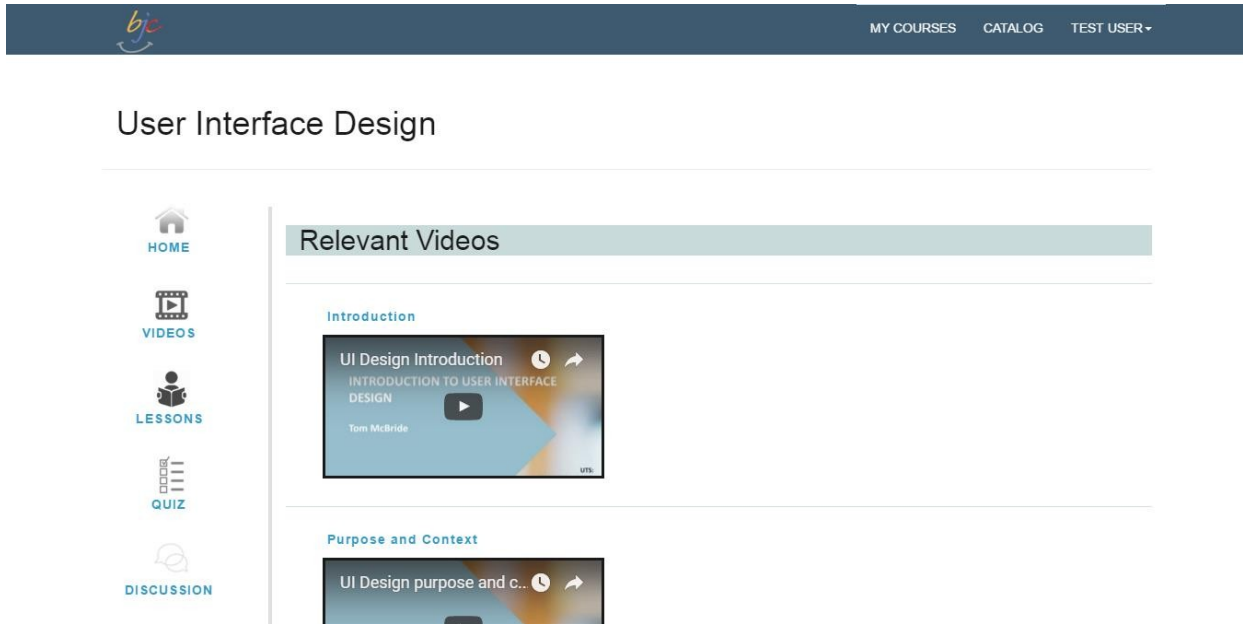


Figure 15: Course Content Page-Prototype Version

4.6 Usability Testing

Usability Testing is accomplished in the prototype model itself. Around 28 students from our Human Computer Interaction (HCI) has participated in the survey. This survey consists of questions related to often they participate in these types of surveys. Prototype was given to them once the survey was finished.

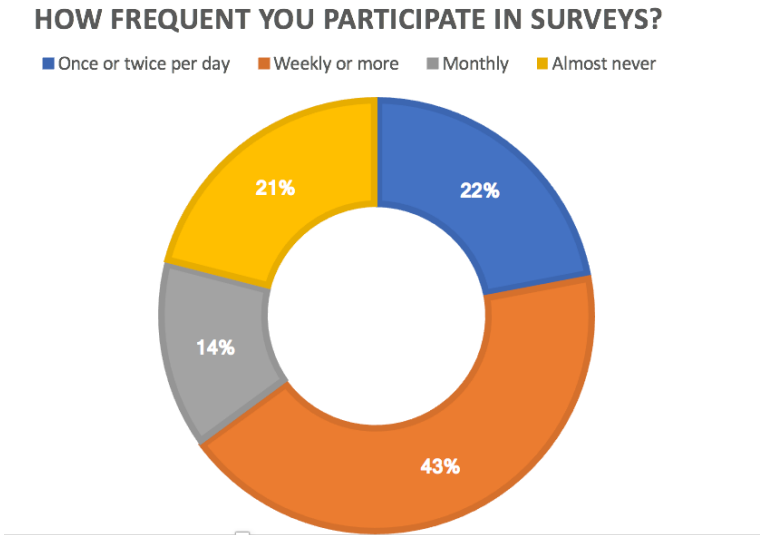
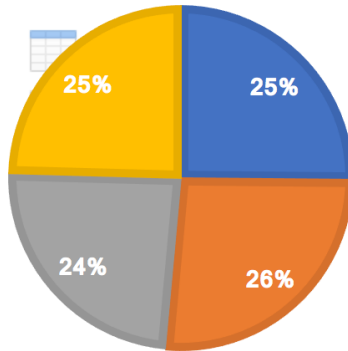


Figure 16: Pre-test Survey Question

Once the users complete their activities with the prototype, post-test survey is presented to them. Questions in this survey varied from asking for suggestions about adding new features and user experience.

IN THE SCALE OF 1-5, PLEASE SELECT THE FOLLOWING OPTIONS(5=HIGHEST, 1=LOWEST)

■ Functional Performance ■ User Friendliness
■ User Interface Design ■ Operational Performance



	Excellent	Very Good	Good	Poor	Very Poor	Total	Weighted Average
Functional Requirements	53.57% 15	32.14% 9	14.29% 4	0.00% 0	0.00% 0	28	4.39
User Friendliness	67.86% 19	14.29% 4	17.86% 5	0.00% 0	0.00% 0	28	4.50
User Interface Design	39.29% 11	32.14% 9	28.57% 8	0.00% 0	0.00% 0	28	4.11
Operational Performance	53.57% 15	28.57% 8	17.86% 5	0.00% 0	0.00% 0	28	4.36

Figure 17: Post-Test Survey

Around 68% of the users found the E-learning was better than the classroom approach. All of them believed that the website has consistency throughout. Feedbacks from the post-test surveys have been very encouraging. A few of the positive open-ended participant responses were as follows:

“The site is very simple”

“Very helpful for students who are interested in STEM”

“User Interface is beautiful”

There were few improvements needed from the participants:

“Few options may be bigger in size”

“Materials opens in another tab”

CHAPTER 5. COURSEBUILDER

5.1. Introduction

Our aspiration was to make learning very easy. The website was developed by keeping in mind that teachers can create and edit courses, whereas students will be able to pursue it. The learning process of the student will be commenced by seeing the videos, then go through the material and then complete the quizzes. All the suggestions from the participant have been incorporated to our final version.

5.2 Tools and Technologies

Frontend technologies like HTML, CSS, PHP, JavaScript with Bootstrap framework and backend technologies like MySQL are used to build the website. HTML stands for Hypertext Markup Language, is one of the most commonly used programming languages for creating web pages. CSS stands for Cascading Style Sheets it is used to design the webpages. And it acts as the presentation layer of the website. Bootstrap is a framework which contains features like buttons, forms and various other components for HTML and CSS built design templates [27].

JavaScript is one of the most commonly used web scripting language. Interactive web sites are developed by using this. It offers dynamic and interpreted programming language experience [25]. JavaScript is supported by all the browsers without having a necessity to have additional plugins or software. Client Side scripting of HTML is facilitated by JQuery which offers cross platform libraries for JavaScript. Animations, communications with AJAX, document traversing and event handling are facilitated.

PHP stands for Hypertext Preprocessor acts as the server-side technology for front end development however it is utilized for common programming purposes also. MySQL is one of the commonly used databases which follows Relational Database Management System (RDBMS) model. SQL (Structured Query Language) is being used in MySQL.

5.3 Project Implementation

5.3.1 Presentation Layer (Front End)

Wireframes are created as the first step of the developmental process in order to make our coding part easy. Then a prototype which is quite like our final product has been developed and usability testing were performed on it. Improvements from the participants were taken and the necessary features were added to make the user experience better.

We built the website from scratch. Powerful front-end like PHP, HTML, JavaScript, JQuery and Bootstrap are being used. Response factor is got from the JQuery. Navbar class is modified by using JQuery when user scrolls down the page. Navbar is available on the top of the page. This improves the navigation, as the scrolling activity is not required from the user anymore. Recognizable icons were used to make the website more affable. Additionally, nearly all the elements have extra properties, this happens when the user moves around the elements. Everything makes the user experience better.

Welcome Alb!

Here are your enrolled courses

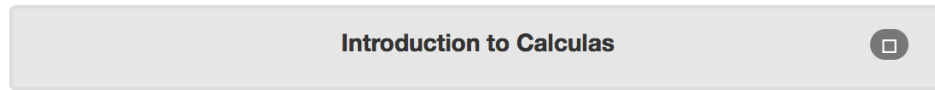


Figure 18: Navigation Bar Basic

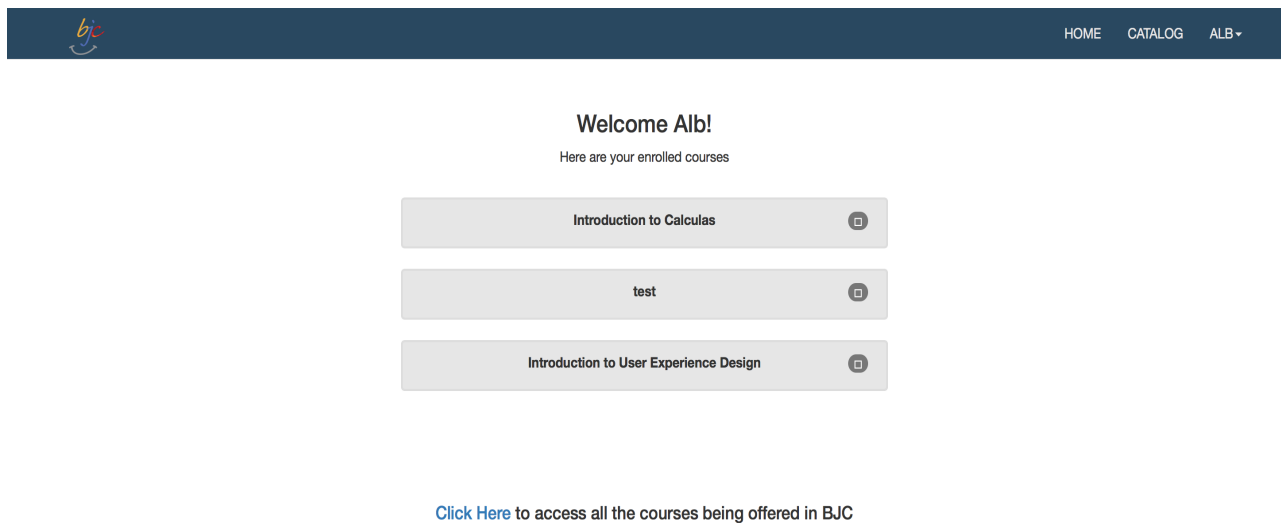


Figure 19: Complete Navigation Bar

Many of the libraries are being used to create symbols, icons, many other important features. One of the most important out of those libraries are Glypicons [31].

View Courses

Following are the courses created by you. Click on Edit/Delete links to begin

NOTE : Delete will remove all the contents (files,quizzes) of the course. This action cannot be undone!

#	Course Name	Difficulty	Category	
1	Introduction To User Experience Design	Beginer	Programming	Edit Course Edit the course details

Figure 20: Popover Property

5.3.2 Data Access layer (Back End)

Database is being constructed by using MySQL and the connection between the database and front end is being provided by PHP. Stored procedure is used to reduce the redundancy of the code. RDBMS feature is being very useful in most of the scenarios. Database data dictionary is being used as the storage platform for stored procedures. Overhead execution is being stopped by the usage of the stored procedure when compared to the dynamic SQL. Network traffic is being avoided by running stored procedure precisely on database engine.

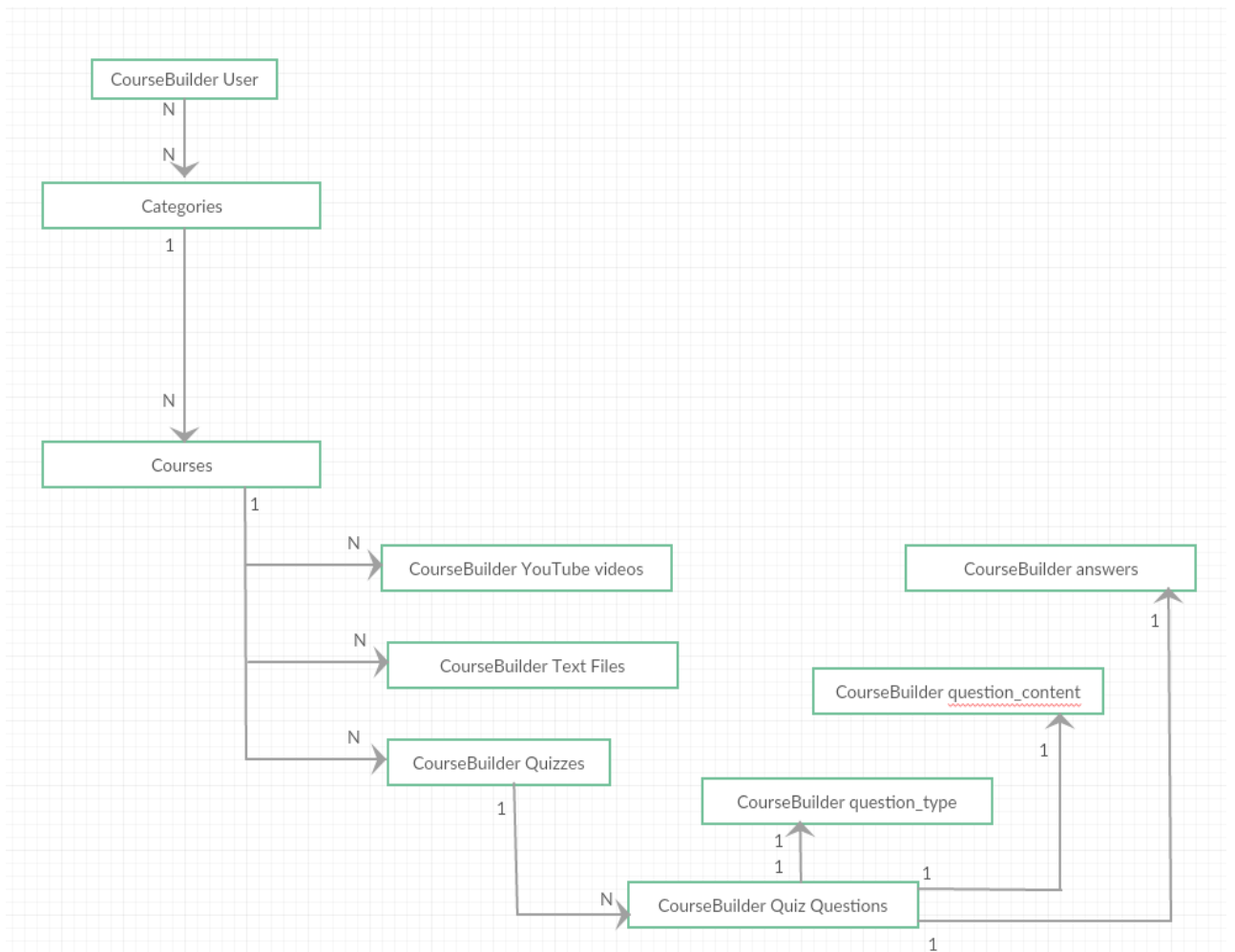


Figure 21: Database Table Relations

Both the front end and the back end is being connected by using PHP. All the activities in the website is kept track of by having a unique id. Unique id will be created during each login of the user, unique id is assigned through using session variables. Stored information is recycled to be used along different pages [33]. Session ids are created by each activity of the user. POST and GET methods were used to send and receive data through HTTP protocol.

Motto behind using PHP is to make a connection with SQL stored procedures. Parameterizing is passed-down to accomplish the similar statements functionalities again and again with great ability [34]. Prepare and execute are the two stages of the execution of the statement preparation. Template of the statement is being sent to the database server in the prepare stage. Syntax check is performed on the server and then the internal belongings are introduced.

Benefits of using Statement templates

- Construction on the query is possible only once during parsing and these times are being reduced by the prepared statements.
- Bandwidth to the server is being minimized by sending only the required parameters whenever necessary, and the entire query is not required.

BLOB stands for Binary Large Object and the text files are stored only in this format in the database. BLOB is an accumulation of single entity in the form of binary data in a DBMS. Multimedia objects like images, audio and video are BLOB's.

We are deriving out the unique ids of the videos and load it into the database. E.g.: <https://www.youtube.com/watch?v=pvAsqPbz9Ro>, is being stored by the database as pvAsqPbz9Ro, this process is carried out in the below code.

```
$videoname = $_POST['youtubevideoname'];  
$url= $_POST['youtubelink'];  
parse_str(parse_url($url, PHP_URL_QUERY), $variables);  
$suburl = $variables['v'];
```

Figure 22: Extract Video ID

Displaying the video is being carried out by the Iframes. URL of the video is obtained out of the database and is being fixed on the iframes.

```
echo "<div class='container-fluid'>";  
echo "<div class='col-md-12'>";  
echo "<iframe width='640' height='405' frameborder='0'";  
|src='http://www.youtube.com/v/" . $row['videourl'] . "?autoplay=1'></iframe></div>";  
echo "</div>";  
echo "</div>";
```

Figure 23: Display Videos

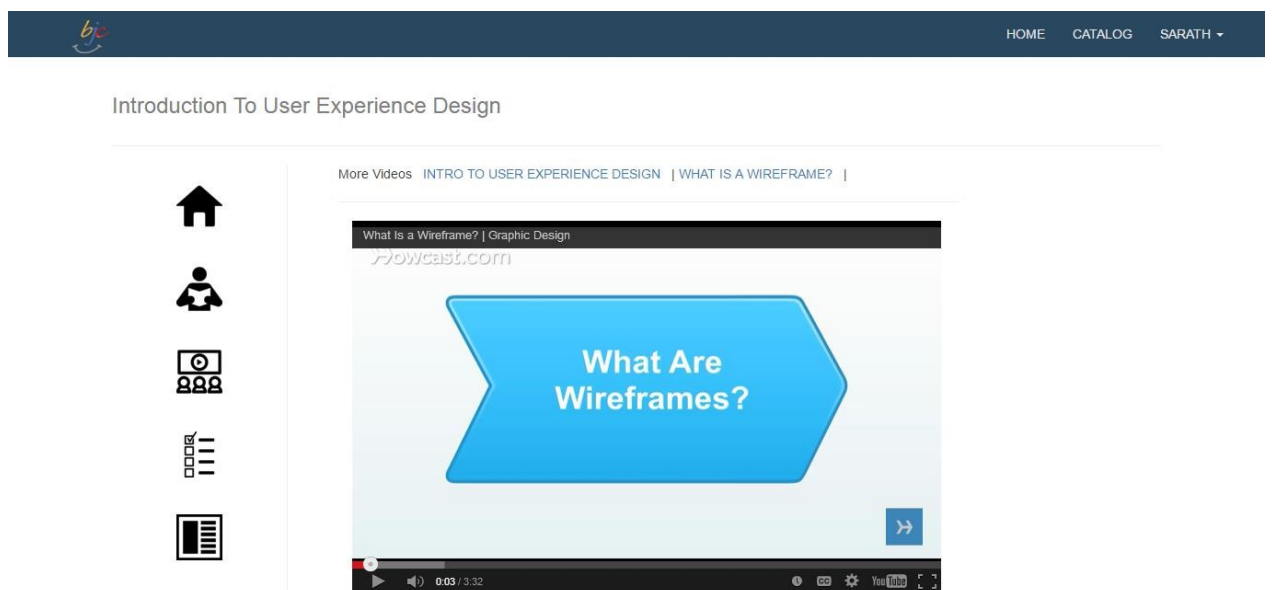


Figure 24: Video Page

5.4 Quiz Implementation

Once they finished going through the necessary materials, students can test their knowledge by taking the quizzes. Question type varies from multiple choice to true or false methods. Quizzes for the specific courses are associated with them when they are queried and stored in a PHP array. Arrays are being stored in two types questions array and choices array. Learner's answers are being stored as response array. When the learners finish the quiz, and press the submit button, POST request for response array is sent where the answers are verified and scores being generated. After the scores are amended to the database, quiz is noted as finished for the respective student.

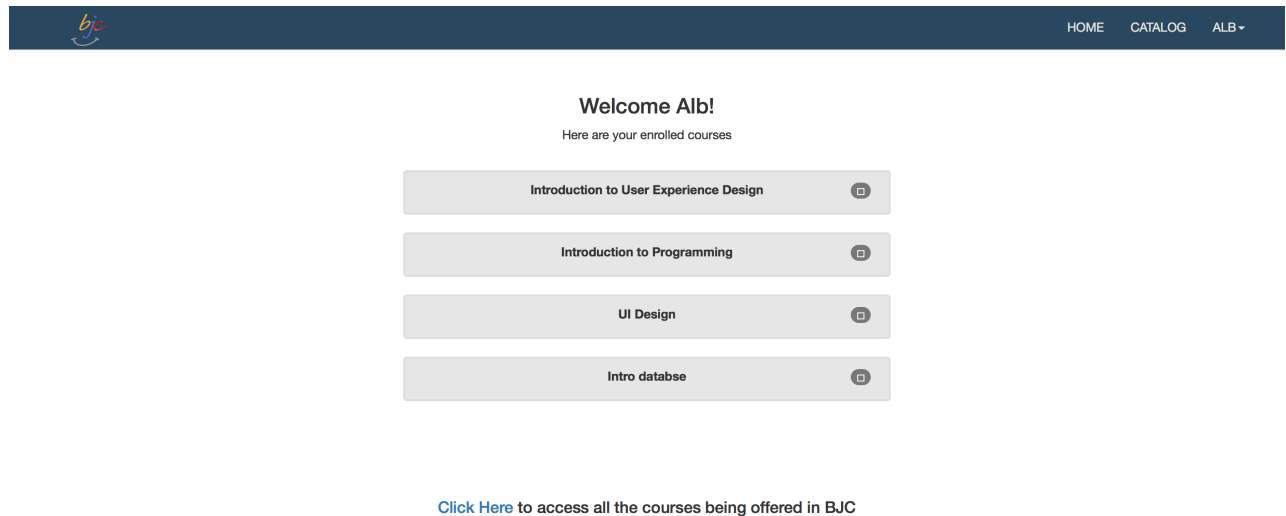


Figure 25: Student Home Page

List of Courses

- CATEGORY**
- ALL
 - GAMES
 - MATHS
 - PROGRAMMING
 - SCIENCE

- DIFFICULTY**
- BEGINNER
 - INTERMEDIATE
 - ADVANCED



Introduction to User Experience Design
 This is a course regarding introduction to User Experience Design.



Introduction to Programming
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Introduction to Calculas
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Introduction to Algebra
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Figure 26: Catalog Page

Introduction To User Experience Design



What is this course about?
 This is a course regarding introduction to User Experience Design.



How to learn? ▾
 There are 2 videos related to this course



What to read? ▾
 There are 2 reading materials related to this course



How to test my knowledge? ▾
 There are 3 quizzes which contain a total of 5 questions



Figure 27: Course Content Page

Welcome Sarath, Hover over the icon's below to begin



Figure 28: Instructor Home Page

5.5 Results and Analysis

This results and analysis discuss whether the website satisfies the stated requirements. This is determined by the series of prequestionnaires, postquestionnaires, and Evaluation. Evaluation of our aim and what we achieved is explained in a detailed manner.

5.5.1 Evaluation

Evaluation is planned to be executed in the way that the reason to build the application should be completely satisfied. The product is expected to work within required specifications. Everyone in the team is planned to test the product so that it works in satisfactory manner and is designed to meet 2017 design criteria. We want to ensure a good usability and we will test with a user population. Functional requirements are used to generate tasks that one will test the pilot and usability testing.

5.5.2 Usability Testing & Evaluation Rubrics

1. Overall Reaction to the Software
2. Reading Characters on the Screen

3. Highlighting simplifies task
4. Organization of information
5. Sequence of Screens
6. Use of terms throughout System
7. Terminology related to task
8. Position of messages on screen
9. Prompts for input
10. Computer informs about its progress
11. Error messages
12. Learning to operate the system
13. Exploring new features by trial and error
14. Remembering names and use of commands
15. Performing tasks is straightforward
16. Help messages on the screen
17. Supplemental reference materials
18. System Speed
19. System reliability
20. System tends to be
21. Correcting your mistakes
22. Designed for all levels of users

Preview & Test Print Next

PAGE 1 Page Logic More Actions P1

QUESTION BANK

Search for questions

Recommended Questions

Previously Used Questions

All Categories 500+ questions

Community 33 questions

Customer Feedback 173 questions

Customer Satisfaction 100 questions

Demographics 93 questions

Education 277 questions

Events 74 questions

BUILDER

THEMES

LOGIC

OPTIONS

+ Add Logo

CourseBuilder 2016 Post

+ Add Page Title

1. Please specify your rating for the following aspects of FYFL application

	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
The homepage is attractive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The typography (lettering, headings etc) is attractive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to find my way around the site	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to remember where to find things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is straightforward to perform tasks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to navigate back and forth through different case studies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The overall application is easy to use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The application is appropriate for a mobile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 29: Survey Monkey Questionnaire 1

The application is appropriate for a mobile device.

People with limited computer experience can use the FYFL application.

Based on this experience, I will use FYFL in the future.

2. Please rate the course builder system application with respect to following aspects:

	Very High	High	Moderate	Low	Very Low
Flexibility	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
User Experience	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy to Understand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Task Completion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. Does the system support adding multiple levels of lessons for users to take as a content producer?

Yes
 No

4. Are there other aspects of user registration that have not been addressed?

Figure 30: Survey Monkey Questionnaire 2

5. Overall, I would recommend the tool to others (ie. teachers, job training professionals, etc.).

Yes
 No

6. Please list the most positive aspects of the course builder application you observed

7. Please list the most negative aspects of the course builder application you observed

Figure 31: Survey Monkey Questionnaire 3

5.5.3 Prequestionnaire

For CourseBuilder there is no specified user entrance criteria for the study.

5.5.4 Testing

Scenarios:

There are several scenarios for students to interact and ways to utilize CourseBuilder website to find details related to their courses, class videos, quizzes, access notifications, and file access.

Task Scenario #1 Functional Requirements:

1. The System should support novice user in finding information about courses.
2. The System should support novice user in finding information about Quizzes.
3. The System should support novice user in finding information about Class Videos.
4. The System should support novice user in finding information about Class files.

Scenario #2 for Teachers:

Teachers can utilize CourseBuilder website to post course materials, class videos, post quizzes, create files, create assignments.

Task Scenario #2 Functional Requirements:

1. The System should support teacher in posting information about the courses.
2. The System should support teacher in creating courses.
3. The System should support teacher in posting class videos.
4. The System should support teacher in posting class files.

Scenario #3 for new Users:

The user should give their Email, Name, Password and confirm it to create their account, this option is available when they are logging by selecting the new user, already having account user can login by using their credentials.

Task Scenario #4 Functional Requirements:

1. System should allow the already existing users when they log in
2. System Should allow users to create account when they are new
3. System can even allow viewing information for guest users

Task List for Usability Participant

1. Reviewing Course Materials
 - a. Lessons, Reading materials, Media
 - b. Video and Quizzes)

5.5.5 Post Questionnaire

The following are examples of post-evaluation questions:

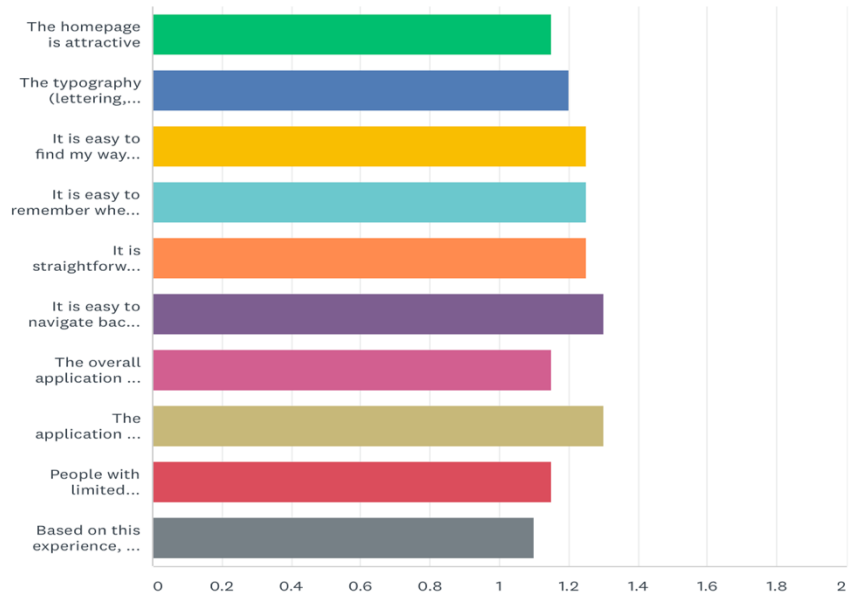
Design dialogue to yield closure?

Offer simple error handling?

Permit easy reversal of actions?

Reduce short-term memory load?

5.5.6 Results



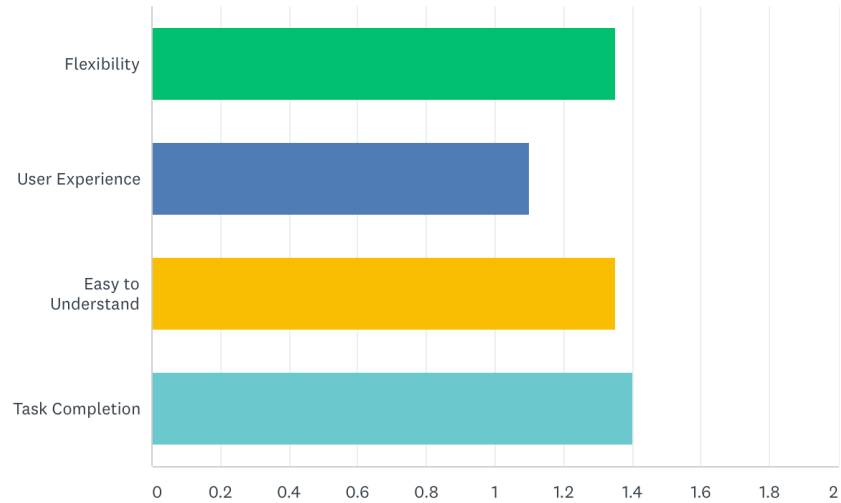
	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE	TOTAL	WEIGHTED AVERAGE
▼ The homepage is attractive	85.00% 17	15.00% 3	0.00% 0	0.00% 0	0.00% 0	20	1.15
▼ The typography (lettering, headings etc) is attractive	80.00% 16	20.00% 4	0.00% 0	0.00% 0	0.00% 0	20	1.20
▼ It is easy to find my way around the site	80.00% 16	15.00% 3	5.00% 1	0.00% 0	0.00% 0	20	1.25
▼ It is easy to remember where to find things.	85.00% 17	5.00% 1	10.00% 2	0.00% 0	0.00% 0	20	1.25
▼ It is straightforward to perform tasks.	80.00% 16	15.00% 3	5.00% 1	0.00% 0	0.00% 0	20	1.25
▼ It is easy to navigate back and forth through different case studies.	80.00% 16	10.00% 2	10.00% 2	0.00% 0	0.00% 0	20	1.30
▼ The overall application is easy to use.	90.00% 18	5.00% 1	5.00% 1	0.00% 0	0.00% 0	20	1.15
▼ The application is appropriate for a mobile device.	80.00% 16	10.00% 2	10.00% 2	0.00% 0	0.00% 0	20	1.30
▼ People with limited computer experience can use the FYFL application.	85.00% 17	15.00% 3	0.00% 0	0.00% 0	0.00% 0	20	1.15
▼ Based on this experience, I will use FYFL in the future.	90.00% 18	10.00% 2	0.00% 0	0.00% 0	0.00% 0	20	1.10

Figure 32: Hypotheses 1 Survey Results

By the above survey results hypotheses 1 is being proved that students find CourseBuilder easy to use. Approximately 90% of students find the overall application is easy to use.

Please rate the course builder system application with respect to following aspects:

Answered: 20 Skipped: 0



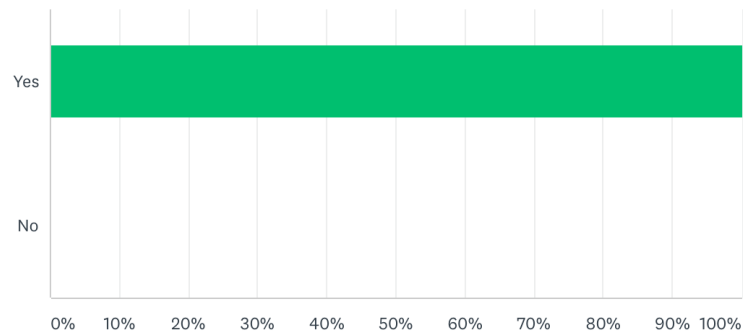
	VERY HIGH	HIGH	MODERATE	LOW	VERY LOW	TOTAL	WEIGHTED AVERAGE
Flexibility	75.00% 15	15.00% 3	10.00% 2	0.00% 0	0.00% 0	20	1.35
User Experience	90.00% 18	10.00% 2	0.00% 0	0.00% 0	0.00% 0	20	1.10
Easy to Understand	70.00% 14	25.00% 5	5.00% 1	0.00% 0	0.00% 0	20	1.35
Task Completion	70.00% 14	20.00% 4	10.00% 2	0.00% 0	0.00% 0	20	1.40

Figure 33: Hypotheses 2 and 3 Survey Results

Hypotheses 2 and 3 are being supported by the above survey results as 75% of students feel that the system has good flexibility and 90% of students feel that system User Experience is very high.

Overall, I would recommend the tool to others (ie. teachers, job training professionals, etc.).

Answered: 20 Skipped: 0



ANSWER CHOICES	RESPONSES	
▼ Yes	100.00%	20
▼ No	0.00%	0
TOTAL		20

Figure 34: Hypotheses 4 Survey Results

Hypotheses 4 is supported by the above survey results as all the students reported that they will recommend CourseBuilder to others. Hypotheses 5 is supported by the above survey results as many students feels that CourseBuilder will help them in the learning process along with the traditional approaches.

Please list the most positive aspects of the course builder application you observed

Answered: 20 Skipped: 0

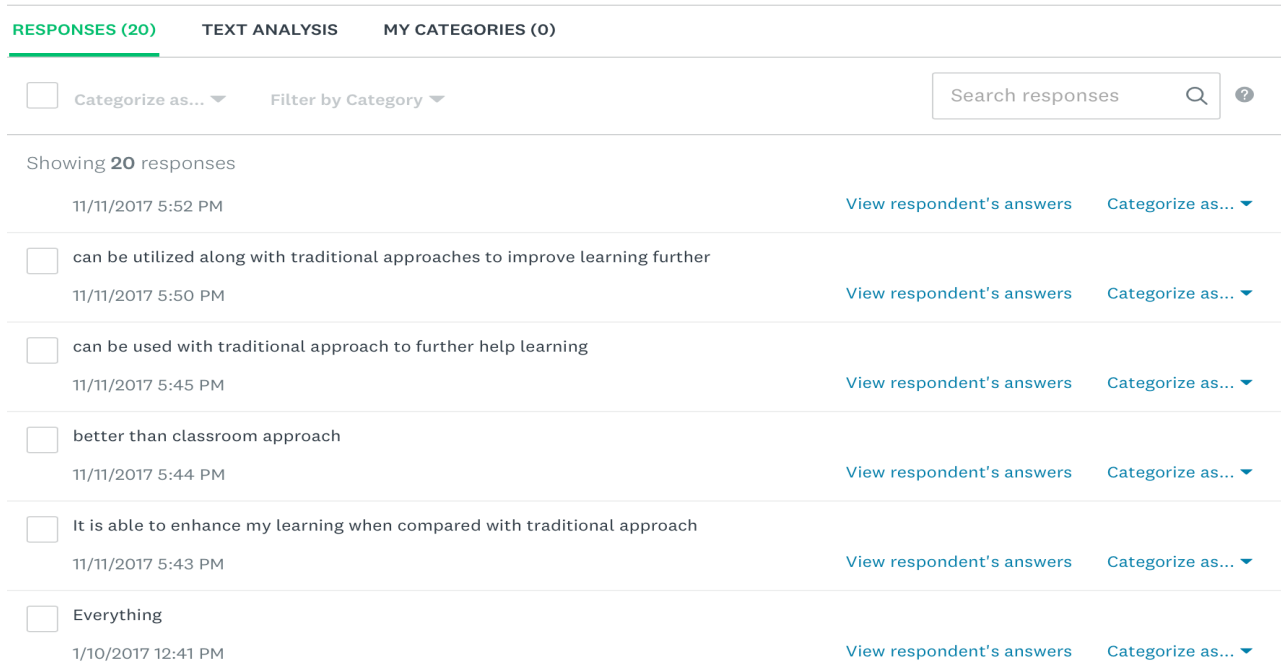


Figure 35: Hypotheses 5 Survey Results

5.5.7 Analysis of Evaluation

The researcher gathered feedback to assess the usability of the CourseBuilder project. Users (i.e. 20 expert users with experience in system design and evaluation) were requested to respond to an online Survey Monkey questionnaire to assess system effectiveness and user satisfaction of CourseBuilder system. Many of these questions were in the form of Likert-style questions and bi-polar ranking scales. Most the users at found “The homepage attractive”, “The typography (lettering, headings) attractive” and at least 80% of the users reported that overall application was easy to use, and that people with limited computer experience can use the CourseBuilder application and reported that based on this experience, they will use the application in the future.

CHAPTER 6. CONCLUSIONS AND FUTURE WORK

6.1 Conclusions

The CourseBuilder application is being iteratively developed and we will utilize the results to improve the next interaction of design and development. The CourseBuilder was a participatory design project. We worked as a collaborative project team and scheduled regular meeting with a client to ascertain their feedback on the iterative designs. We meet as often as needed to coordinate successful work process and coordination. The most challenging aspect was to keep members apprised of new updates to system deliverables. With a new team, the lack of good feedback can be very frustrating and detrimental in the development process, but due to continuous group interaction and patience, the team solved most of the coordination the issues and made rapid progress in team development. The most significant part of our work was to make the learning system easy for everyone, and we are very proud that we were able to achieve that goal. The first phase of CourseBuilder was a team development project and the work of this thesis was to develop the second phase of CourseBuilder to improve the usability, ease of use, aesthetics, user interface view and to add the ability for end users to create quizzes, which was not present in the initial phase of development.

6.2 Future Work

Our future work starts from the option of having text based or summary answers available for the quizzes. At present only true or false or multiple-choice questions were being supported. Right now, only doc files can be uploaded in our website, the next iteration of this system will support the reviewing of course materials that are available in .ppt and .pdf file

formats. Only YouTube videos can be uploaded in our site in this stage of the research project, however option to support other video formats will also be necessary. These added options will make the teachers comfortable while creating, uploading or editing the videos. In this evolving world, various STEM related courses should be supported by our website, which will make our website more supportive of teacher's computer supported work communities.

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