

Spectrum Educational Consulting – CSCW Tool for Pre-service Teacher Training

by

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Abstract

Classroom Teaching is a very challenging process. Teachers go through a rigorous training process to ensure their mastery of the content material and as a part of teacher training preparation they are given instruction and strategies to properly deliver this information to students. New teachers have the credential, but will need practice to groom their instructional skills. Good instructional skills are the keys and to ensuring that students understand the content materials. Teachers are prepared to enter the classroom, but are not prepared for all the challenging circumstances that may arise during a day in the field in their own classrooms.

Pre-service teachers have an extensive teacher training process to learn more about their subject matter and to learn instructional strategies. There are many different methods of attempting to engage teachers to understand classroom environments and improve teaching capabilities. Technology holds a great potential for improving the quality of education for learners. Information technology can be utilized to aid educators if the tools are user friendly and have a great ease of use. If tools are well designed and usable, instructors will be able to use them to engage and captivate students.

Spectrum Educational Consulting mainly focuses on the problems teachers face in the classroom and helps them overcome those difficult situations and show them effective ways of teaching. Spectrum Education Consulting incorporates multimedia animations into textual case studies.

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CHAPTER 1: INTRODUCTION

Classroom Teaching is a very challenging process. Teachers go through a rigorous training process to ensure their mastery of the content material and as a part of teacher training preparation they are given instruction and strategies to properly deliver this information to students. Each teacher will have a firm foundation with a degree in that subject matter and a certificate from their state that attest that they have been approved to teach this subject matter. New teachers have the credential, but will need practice to groom their instructional skills. Good instructional skills are the keys and to ensuring that students understand the content materials. The classroom environment can also aid in the teaching process. Teachers have been instructed to face challenges in the classroom and use their knowledge and to overcome these difficulties. Teachers are prepared to enter the classroom, but are not prepared for all the challenging circumstances that may arise during a day in the field in their own classrooms.

Teachers are trained in various classroom management techniques and adopt various practices in order to make their classroom experience more fruitful and supportive of a learning environment for their students. During the preparation of their lesson plans, the teacher needs to plan episodes for lecturing, student involvement by engaging them to participate in discussions and role-plays, presenting appropriate examples or illustrations, etc. All of this preparation will provide support for teachers to be more successful in classroom teaching.

Pre-service teachers have an extensive teacher training process to learn more about their subject matter and to learn instructional strategies. Yet there has been tremendous growth in the availability of technology and mobile and wireless devices. This presents a great opportunity to support learners in different ways of learning and interacting with content matter. One recent significant change in the learning environment is the demand to provide more accessibility to applications. What if teacher training can be implemented online and can be accessed at any time? This research aims towards implementing pre-service teacher training through animated case studies. Delivering materials online gives an advantage of accessing the application any time and by any type of smart device. This practice will certainly help in reducing equipment cost in delivering education. It will be more effective and entertaining to use interactive online applications as learning media.

E-Learning consists of all forms of electronically supported learning and teaching. E-Learning is also defined as computer enabled transfer of knowledge. Educational and other forms of content are delivered via Internet, audio, video and animations. This kind of learning gives the users a chance to find and learn what they really wanted to and at a convenient time and place.

1.1 PROBLEM STATEMENT

There are many different methods of attempting to engage teachers to understand classroom environments and improve teaching capabilities. Technology holds a great potential for improving the quality of education for learners; however, if created technology is not designed with a user centric approach, it will inevitably fail to achieve the desired effect. It is hard to gauge a learner's comfort level and ability to navigate and comprehend technology,

which is generally directly correlated to the environment in which they grew up and what they are comfortable with. Information technology can be utilized to aid educators if the tools are user friendly and have a great ease of use. If tools are well designed and usable, instructors will be able to use them to engage and captivate students.

Many of the present methods available for instructing pre-service teachers are not as effective as they should be. Various data has shown that visual case studies are an important measure in improving the effectiveness of training [17]. Animated Web tutorials are a form of visual education tools. Animation can showcase one's creativity and makes even the toughest concepts easier to comprehend. Our aim is that by incorporating animation into the existing textual case studies, teachers would be able to grasp concepts much more effectively. It will allow them to practically visualize the classroom environment and get a feel of the situation. The major advantage of developing online educational simulations is that they can be accessed anytime and anyplace where Internet is supported. Many of the currently available tools are created in flash, which in many cases is outdated technology as it is not supported by many handheld devices. Interactive case studies also provide support for critical thinking and reflection skills, than a static video of an example case. The purpose of this study was to develop a low cost educator friendly, web and mobile-oriented learning environment centered on ease of use and interactive technology for the educator, so that the users can gain access to the educational content anytime and-anyplace.

1.2 RESEARCH JUSTIFICATION

With the aforementioned problems in existing tools and the advantages involved in creating animated simulations for case studies for teacher training, we have come up with a new tool called the 'SPECTRUM EDUCATION CONSULTING', which is created to support

teachers in practicing their classroom management techniques. The currently existing case studies are presented in a text-based format and for most of the teachers this static representation is what they are usually provided for content reinforcement. This project plans to utilize existing scenarios as requirements and to develop an intriguing interactive case studies application that is appealing, colorful and interactive animated case studies.

Spectrum Education Consulting incorporates multimedia animations into textual case studies. Spectrum Education Consulting mainly focuses on the problems teachers face in the classroom and helps them overcome those difficult situations and show them effective ways of teaching. Spectrum Education Consulting uses the next generation solution for web-based animation (HTML5/JavaScript), which is supported on almost all the devices than the previous generation of flash. The style of interaction utilized by these case studies will support novice teachers in classroom management and decision-making. These case studies also allow teachers to teach classes in productive ways and also help them to address various classroom challenges.

So keeping these considerations and limitations in mind, our design was a low cost, graphical user, web-based mobile interface that targets a wide range of platforms. Pre-service teachers can gain access to the animated case studies, and our hope is that teachers find it interesting to access the content online, and from a GUI through their mobile devices.

1.3 RESEARCH PURPOSE

The primary objectives of this research are to:

- Investigate pre-service teacher training methods that are currently available that facilitate teachers to understand traditional classroom experiences.

- Investigate the affordances and constraints involved in developing an online educational application that can support pre-service teachers in a capacity that is easy to use, meets all the requirements and is engaging for the learners.
- Design and develop an online educational application that can be accessed across all different mobile platforms and browsers. The application should allow teachers to interact with the system. Teachers should feel comfortable using the system and learning the workflow.
- Determine if the developed prototype is acceptable from the user interface standpoint.
- Determine if the developed prototype is acceptable for pre-service teacher training.

1.4 HYPOTHESIS

The main hypothesis of this study is that animated case studies of classroom scenarios and environments would be more helpful for pre-service teachers to deliver educational content. Teachers will have the ability to access the information anywhere and at anytime and will be more engaged if the content is delivered through easy and interactive mobile environments. Unlike traditional textual case studies, this form of content also helps pre-service teachers in understanding the problematic situations that would arise in classrooms effectively and an interactive way. This study also concentrates on involving users in the learning process by providing them control over the flow. User interactivity plays a major role in online learning environments, and this research implements this principle.

1.5 DOCUMENT REVIEW

The rest of this thesis is organized as follows: *Chapter 2* consists of literature review, which discusses existing online environments, general requirements of E-Learning, its affordances and constraints, and challenges involved for the developers. *Chapter 3* provides a

description of the existing environments and their limitations, and describes the proposed environment. *Chapter 4* goes over the detailed implementation of the proposed environment. *Chapter 5* presents the analysis of results collected from questionnaire surveys about the developed prototype. *Chapter 6* concludes the thesis along with suggestions for future enhancements.

CHAPTER 2: LITERATURE REVIEW

2.1 E-LEARNING

E-Learning is one of the widely growing fields of learning and is different from the traditional classroom learning in many ways. E-Learning encompasses online learning, web-based training and learning, and technology oriented instructions. E-Learning is also the delivery of individual, comprehensive, dynamic learning content in real time that assists various communities in developing knowledge that incorporates learners and practitioners with experts. It is a phenomenon of delivering accountability, accessibility, and opportunity that allows organizations and people to keep up with the rapidly changing global environment. The combination of Internet and learning can be termed as E-Learning. Through learner centered designs, the effectiveness of the E-Learning experience can be enhanced. Learners remember more with well-organized, extensive visuals, and screen friendly fonts [7].

E-Learning comprises of all forms of electronically supported ways of learning and teaching. Knowledge transfer enabled through the use of computer technology is the main concept of E-Learning. E-Learning is utilized as a mechanism to deliver, - education and other forms of knowledge by means of audio, video and animations, etc. Spectrum Education involves transfer of knowledge to pre-service teachers with the use of multimedia and Internet.

2.2 WEB INTERACTIVE AND MULTIMEDIA EDUCATION

Education has been revolutionized recently through the use of computing, video and telecommunication. This has been termed as the Technology Revolution [1]. Internet applications have developed at an astonishing and explosive speed. As a result, the Internet has become a choice for information source and training. In order to promote effective learning, online instructors tend to incorporate multimedia products to present subject content to students in place of textual content. PowerPoint slideshows, Videos, Flash based animations, and Audio are being included as part of the online content. Using the web to provide training and learning materials can be considered as the first stages of the learning process – that of information delivery. Web Based discussion boards are also being used to increase student-teacher, and teacher-teacher interaction. Instructor training plays a vital role in Multimedia integration.

The World Wide Web is becoming increasingly popular and is playing a vital role in providing education and training. The main factors include the increasing numbers of improved tools for developing Web based teaching and learning materials along with focused training by individuals and institutions. These new techniques offer solutions to the demands of a changing environment in addition to allowing flexibility for learning either from home or work [2]. However, a direct transfer of textually based notes into a multimedia environment may have the consequences of leaving the learners less than enthralled, and a lack of integration with other vital aspects of the learning process leads to a fragmented approach.

Three main areas fulfill the requirements of the different stages of the learning process – virtual environments, interactive simulations, and assessment. Spectrum Education Consulting supports interactive simulations by enabling the teacher to interact with the multimedia component.

Virtual Environments aim to imitate aspects of real life situations so that the learners can understand how the theory that they learn fits into practice. It is a chance to practice the application of theories in a realistic environment. Spectrum Education simulates virtual environments where the teachers visualize the real classroom environment through multimedia cases. The combination of the web, elements of multimedia and interaction adds realism to a simulated situation. Assessment is an area of great interest to the education community. Assessment helps to measure the quantitative measure of teacher performance and the effectiveness of teaching. Web-based tutorials help in self-assessment techniques viz. from simple text-based multiple choice questions that give an idea of learner's reflection and understanding of the training material, to providing feedback which helps in improving the training material.

2.3 MULTIMEDIA SYSTEMS IN EDUCATION: EFFECTS OF USABILITY ON LEARNING

Multimedia systems are used more and more in distance learning. In this kind of training, face to face interaction does not occur between the teacher and the learner. The main idea behind the implementation of multimedia systems into education is the belief that multimedia products help people to improve their learning process. Some meta analyses have been conducted to compare learning in a traditional classroom situation to learning using multimedia systems [3]. Two variables – effectiveness and time are being considered important in testing the usability of multimedia systems on learning. Various studies have confirmed that learning is more effective when the information is presented utilizing a multimedia application. Training involving computer-based instruction has the advantage of saving time. Learners save 70% of their time using multimedia learning than learning in traditional classrooms [4]. In spite of various studies supporting that multimedia products are effective tools to improve learning, some studies also

reveal that the effectiveness of multimedia systems on the learning processes decreases over time [5]. However these findings do not deny the effectiveness multimedia systems have on other learning environments. There is thus strong support to maintain that multimedia systems are effective for supporting the learning process.

Various studies have discussed the way in which the level of usability of the system can affect the effectiveness of a multimedia training course. Three studies have been performed on a multimedia training course. In the first study, the usability of the system has been evaluated by performing a heuristic evaluation. In the second study, the usability of the system was tested by involving end users [3]. Results from these studies were used to determine the level of usability of the system. These results also gave some indication of its effectiveness as a training tool. An experiment was carried out to evaluate the students' learning performance. The system being tested is an educational tool developed to support learning about the limits of functions.

First study: heuristic evaluation – Usability is a key issue in human–computer interaction. Spectrum Education involves interaction of the learners with the system. Usability is widely accepted as a general indication of the quality of the user interface. Usability is referred to as a multi-factorial concept which relates to the ease of use, effectiveness, and user satisfaction of a system [6]. The choice of method used for usability evaluation is affected by factors such as time, money, and other theoretical considerations. Heuristic evaluation is an expert-based approach involving some reviewers, who are experts in the field of human-computer interaction, to test the system in order to detect potential pitfalls in the user interface [6]. Reviewers apply their expertise and the use of general human factors principles in actively identifying violations in the multimedia user interface. This method has various advantages, such as cost effectiveness, and most importantly, it is quick and easy. The experts used the following

guidelines: (a) use simple and natural dialogue; (b) use the user's language; (c) minimize user memory load; (d) be consistent; (e) provide feedback wherever necessary; (f) providing clearly marked exits; (g) provide good error messages; (h) prevent errors (i) allow the user to feel in control of the system. Spectrum Education follows these guidelines in the development of animated simulations for elementary teachers in order to improve the learning process of the teachers. Both the reviewers examined the system with these guidelines and took notice of the violations from the given guidelines.

Second Study – user based evaluation - The user-based approaches involved real-end users interacting with the system. Many techniques, including video recording of the interactions are utilized to obtain measurements of relevant variables. Although this method is time consuming and relatively expensive, the results coming out from this evaluation are effective since the end users are directly tested during their interaction with the system. The test was done in three phases. In the first phase, the users were given a questionnaire which was aimed at obtaining information about their computer experience. The questions given were related to the amount of experience users had with using the computers. In the second phase, users interacted with the application. The user experience while they are interacting with the system is observed using video recording. In the third phase, users are given a post questionnaire to evaluate the effectiveness of the system. Overall subjective evaluation, ease of learning and how to use the system, evaluation of the graphical aspect of the user interface are all tested in this phase. The analysis of the interaction test was conducted by referring usability problems to the same principles adopted in the heuristic evaluation. The user's mistakes along with the reasons were identified.

The results obtained from these two phases have been collected and studies were completed. The first phase results help to improve the user interface, while the second phase results help in improving the effectiveness of the multimedia system. Spectrum Education also uses a questionnaire that analyzes the targeted audience interaction with the developed system and their behavior while interacting with the system.

Computer Supported Collaborative Learning is a great innovation in the field of E-Learning, which is used mainly to improve teaching and learning. Computer Supported Collaborative Learning takes help from the latest information and communication technology [24].

Communication technologies are generally categorized as asynchronous and synchronous. *Asynchronous* activities use technologies such as blogs, discussion boards, etc. The main concept behind this kind of communication is that participants may engage in the exchange of information without the presence of other participants. (e.g., include Electronic mail). Asynchronous learning also gives learners the ability to work at their own pace.

Synchronous activities involve the exchange of ideas and information with one or more participants during the same period of time. A face to face discussion is an example of a synchronous communication. *Synchronous* activities occur with all participants joining in at once, as with an online chat session or a virtual classroom or meeting.

Virtual classrooms and meetings can often use a mix of communication technologies. Participants in a virtual classroom use icons, referred to as emoticons to communicate feelings and responses to questions or statements. Other communication technologies that are available in a virtual classroom include text notes, microphone rights, and breakout sessions. Breakout

sessions allow the participants to work collaboratively in a small group setting to accomplish a task.

Learners get control over the content, the learning sequence, and the pace of learning through the use of E-Learning. Even multimedia content allows them to tailor their experiences to meet their personal learning objectives. This way of learning has advantages such as providing learners with high levels of learning effectiveness. Learners are more satisfied with learning materials and learning environments. Growth in technology, digitization, and development of the Internet has influenced our society in many aspects. E-Learning helps to integrate these technologies and knowledge and consent learners to learn new knowledge at anytime and anywhere with no time and space constraints [7].

In *asynchronous* online courses that are a form of E-Learning, students proceed at his or her own pace. If they need to listen to a lecture a second time, or think about a question for a while, they may do so without having the fear that they will need to hold back the rest of the class. Through online courses, students may earn their diplomas more quickly, or repeat failed courses without the embarrassment of being in a class with younger students. Students also have access to an incredible variety of enrichment courses in online learning, and can participate in internships, sports, or work. Spectrum Education is a form of asynchronous online teaching material developed for elementary teachers that gives the teacher's time to prepare and get an understanding of the real time classroom difficulties. It is also asynchronous in the way that the teachers can prepare and understand the content at their individual pace.

Moreover, in traditional face-to-face learning, learning activities and plans are all arranged from the teacher's perspective. Conventional patterns of education are adopted. One instructor is responsible for teaching a group of students on a particular area and evaluates their

skills through regular tests. The teacher's materials are the only source of learning materials. In many cases, this does not support the student's learning style nor improve each individual learner's competence. It is simply not possible for one person to give each student one-on-one interaction and personalized instruction in a traditional classroom setting. It is not uncommon for the learners to become bored or frustrated. Some learn better by visual means, others with auditory means, and others with hands-on practice. E-Learning can be useful and may be interesting for these kinds of students. Many people argue that the traditional educational system is the best choice, since standardized tests are necessary for measuring a student's performance. But interestingly, studies show that these tests are not very effective, as they come at the expense of learning [8]. However, there are certain disadvantages with this kind of E-Learning. Similar to the traditional classroom, learning is completely dependent on the knowledge and experience of trainers or teachers. Hence, there is a mismatch from the demand of trainees and expectations from the trainers. Although learners can proceed at their own pace, interactivity is not effective, since there is no two-way communication between the trainer and trainees. Online forums along with these E-Learning strategies can be helpful in improving the interactivity of the learner. The evaluation mechanism is also one of the drawbacks. It means theoretical improvement of knowledge is only tested instead of what skills trainees can develop. It ignores experimental learning, which decreases the effectiveness of learning. Spectrum Education achieves these objectives of individual learning and asynchronous learning. Spectrum Education also follows the guidelines to improve the effectiveness of the system while taking into consideration the disadvantages of E-Learning.

All these factors tell us the importance of E-Learning and its benefits as well as its drawbacks. However, E-Learning can be more beneficial when taken to the next level [8].

Spectrum Education involves using E-Learning in educating pre-service teachers by helping to prepare them for the classroom environment with exercises in classroom management. Also, utilization of multimedia and interactivity in the case studies helps them to get a feeling of how the real classroom environment may be. These case studies also help new teachers by providing examples of effective teaching to students. This research is also developed with an aim to provide learner access to the system across various browsers and mobile phones, etc.

2.4 ONLINE EDUCATIONAL DESIGN INSTRUCTIONS

Spectrum Education involves designing educational content and delivering the same through electronic media and the Internet. Several design instructions and guidelines have been mentioned in various studies so that the final system that is delivered is effective for end users [9]. Some of the instructions include:

- Providing text alternatives for any non-text content
- Design web pages to appear and operate in predictable ways
- Prepare content to be easier for users to see and hear content
- Separating foreground from background
- Enabling access to all functionalities from the keyboard.

Universal Design is a design, which describes the ways that a system will be designed to support a broad audience, including people with a variety of learning styles and learning preferences. The inclusion of multimedia support through audio, images, and video appropriately on web tutorials is designed to improve the effectiveness of training. Technology serves to enhance understanding of mental processing, cognitive sciences, artificial intelligence, learner choice and mandates from thinking about models that guide the design of instruction. These design instructions improve the content that is provided to the learner.

Spectrum Education involves educational content that is developed online. By following these design guidelines in the development of Spectrum Education, the system developed is designed to improve the user experience. It also helps the end user feel comfortable when interacting with the system.

2.5 MULTIMEDIA CASES IN ELEMENTARY TEACHER TRAINING

Caroline and Gary investigated the teacher's ability to learn, apply their learning in lesson plans, and retain knowledge of classroom disclosure from a single module of a multimedia case study with K-12 teachers [10]. Data collection and analysis included teacher development of lesson plans and learning and application of various discourse strategies.

Technology-based programs serve as a strategy in increasing a teacher's experience with technology and also to improve their knowledge of learning standards. Some of the beneficial attributes of multimedia programs for elementary teacher learning are learner control and multiple modalities accommodating learning styles. The need for teachers to learn strategies for implementing classroom disclosure is supported in a growing body of literature [10]. Disclosure can be defined as the way in which ideas are exchanged. Disclosure can be teacher to class, teacher to student or student to student. Teachers promoting the classroom have various advantages for students, including a classroom environment of reasoned enquiry, increased conceptual development, increased knowledge of a domain area, and improvement of skills related to knowledge [11]. Reports explain the teacher's role in encouraging classroom disclosure. This helps for a democratic classroom environment in which students feel free to share beliefs and opinions. Teachers often struggle in learning how to acquire disclosure skills.

Reflection often functions as an advanced organizer that prompts ideas and strategies that teachers pay attention to while learning from multimedia systems. Spectrum Education achieves

this strategy by allowing teachers to consider reflection questions after the case study. Providing opportunities for reflection in teacher professional development programs suggested an increase in teacher's ability in various areas, including developing skills in analyzing their own teaching. Also reflection mechanisms help teachers develop structures of personal pedagogy, and align an approach to teaching with selected teaching strategies. Professional teacher development programs involving multimedia should involve reflection techniques.

Multimedia cases aim for the professional development of prospective teachers in elementary education. These cases simulate and facilitate the prospective teacher's reflection on learning and teaching. They consist of animations of classroom events as well as audiotape information and text.

Bitter and Pryor (2006) investigated whether teachers can improve their ability to implement classroom discourse after their interaction with multimedia professional development programs. Gains in knowledge of discourse, ability to reflect on practice, and ability to promote classroom discourse have been observed among teachers involved in the program. Teacher's perceptions of the effects of what they had learned and their reflection in the real class have been studied. Analysis of the teacher included in the development program was tested in accordance with the National Council of Teachers Professional standards for teaching.

- Posing questions and tasks that elicit, engage, and challenge each student's thinking.
- Listening carefully to students' ideas.
- Asking students to clarify and justify their ideas.
- Deciding what to pursue in depth from among the ideas that students bring up during a discussion.

- Deciding when to provide information, when to clarify an issue, when to model, when to lead, and when to let a student struggle with a difficulty.
- Monitoring students' participation in discussions and deciding when and how to encourage each student to participate.

The main questions that were asked of the teachers after the program are:

- What do you remember about using the module?
- What do you remember learning from the module?
- Have you used what you learned in your teaching?
- What is the effect of using discourse standards on your student's achievement?

This analysis provides a view of how the multimedia development program improves the teacher's ability in various aspects of the classroom environment and also allows improving the program [12].

Various frequencies of NCT standards applied by teachers for discourse have been determined. It is observed that teacher's role in discourse was applied most frequently (31%). "Listening carefully" and "asking students to clarify and justify" were used by teachers (21%). Teachers applied the remaining indicators less frequently. The knowledge and application findings reveal that learning to apply discourse standards from a multimedia module appears to have much impact on professional teacher development programs. Spiro, Feltovich, Jacobson, and Coulson (2000) suggested that prompted reflection propels a learner to make sense of complex knowledge which results in a better understanding of new steps and processes.

In addition, the multimedia model of program allowed teachers to remember the content for a long time. Pryor's study revealed that after one year, an interview with the teachers who were involved in the development program revealed that the teachers still remember the video

and multimedia modeling section of the program. Studies also revealed that teachers applied various reflections from the development program.

Spectrum Education also involves reflection. It allows teachers to view a real time class situation. This enables teachers to retain knowledge they achieve from these case studies for a long time (i.e. through visual reinforcement) and use them in their classroom environment. Spectrum also provides opportunities to reflect recursively on strategies useful in classroom discourse. Studies also found that with much more integration of multimedia into development programs and the addition of various text and video vignettes, providing analytic prompts could be helpful in improving teacher's knowledge.

Multimedia cases bring various changes in teacher education by shortening the gap between theory and practice. By utilizing Information and Communication Technology in multimedia cases, a powerful and flexible learning environment can be created [13].

Koc, Perker & Osmanoglu examined the importance of using video case studies with in-service and pre-service teachers. They found that the case studies were very helpful for the professional development of the teachers [16]. Results also proved that as a result of watching video cases, both pre-service and in-service teachers showed gains in their ability to discern and interpret the features of classroom teaching. The video case studies also improved the quality of teacher discourse and reflection. Researchers conducted a study to test the effectiveness of video case discussions in promoting the quality of teacher reflection and discourse in general. Some important outlines of the research that Deniz conducted take into consideration teacher understanding of the case study. Research also made the teacher that was in the video case study available in the discussion between the in-service and the pre-service teachers. This was helpful in validating the interpretations of the teachers to the video case. Spectrum Education also helps

teachers think about the case study with the help of several reflection questions. Deniz and Yusuf mainly focused on two research questions. They studied to what degree the teachers are able to make theory-practice connections in response to a video case of a course instruction and what dimensions of teaching are discussed in response to a video case of the course instruction. Three different mathematics course methods were taken into account to use as the courses in video cases for the data collection. One teacher was the instructor for all the courses. Two courses were designed for pre-service teachers and one of them was for elementary teachers. The courses were intended to help the pre-service teachers understand on how the mathematics is structured and learned to improve the teaching of mathematics in elementary classrooms. Content analysis techniques have been used to explore the research questions. Content analysis is a method that uses a set of procedures to make valid inferences from the text [17]. Results suggested that the video case discussion has great potential in helping teachers make strong theory-practice connections; however, research also noticed also several limitations.

Ellen Van developed a prototype approach for developing multimedia cases. The prototyping approach consists of a cyclic process of design, development, and formative evaluation of prototypes. This approach intends to bring the complexity of professional practice into educational programs. Cases are crafted with a beginning, middle, and end and are situated in a specific event or in series of events. Merseth divides cases into three main categories.

Firstly, cases as exemplars may highlight a principle, a theoretical point of view, or an instructional technique. These cases are often referred as paradigm cases of professional practice.

Secondly, cases also serve the purpose of providing opportunities to practice analyses and contemplate action. These kinds of cases present problematic situations that require problem solving or decision making steps. These cases are derived usually from real world situations.

Thirdly, cases can be perceived as stimulants to personal reflection (Merseth, 1996). These kinds of cases are being developed for personal study and self-reflection. These kinds of cases increase the ability to learn from experiences by means of reflection. Experts often think of cases as powerful tools which encourage learning from experience.

Cases have been used to develop critical thinking skills and improve and increase reasoning among the pre-service teachers. Cases for teachers are also of much importance in the field of subject specific contexts to develop pedagogical and professional knowledge. Cases are also helpful in extending the meta-cognitive skills of the teachers. (Manouchehri, 2002). By analyzing cases, teachers get an opportunity to understand what happens in a classroom when given a specific scenario. Teachers also gain perspectives on teaching in settings different from their own classrooms. Cases on various topics and situations also reflect the situations that can arise in classrooms when teachers teach on the topic from the case. Cases also give the teachers an opportunity to prepare on a new topic that they are not familiar with and handle the classroom environment without getting panicked.

There is a wide increase in interest in integrating information technology into the use of cases in teacher education. Several advantages are accounted to this idea. Unlike written cases, video cases provide much more interest to teachers and help them understand of the context of the scenario. Various studies have also proved that visually acquired information is remembered for a longer time [17]. Thus, multimedia enriched case studies lend themselves to potentially helping teachers and help connect theory and practice better.

Multimedia can be perceived as an extension of hypertext. This includes integration of media such as audio, video, graphics, animation, and modeling to transform the linear text structure of cases into a more attractive and appealing fashion. These are superior in supporting

the learning process. Multimedia cases can simulate more than one action at a time and gives a realistic view of the case. This helps in getting hold of more attention from the teachers (Jonassaen and Reaves). Multimedia tools are considered cognitive tools for educational purposes. These enhance the human being's power of problem solving, thinking, and learning. Multimedia cases give educational advantages for teacher learning stimulating an active learning attitude, allowing the possibility to revisit classroom events in order to get a good understanding of them and showing the cases from myriad perspectives and offering support for classroom teaching. Masingila and Doerr (2004) reported that multimedia cases support pre-service teachers understand the complexity of teaching, guide their instructional practices, and help connect their own practice with the teacher in the video case.

Multimedia cases are more complicated and time consuming to produce than written cases. Learners are not hindered by the information in the multimedia cases. Teaching with multimedia cases needs extra effort for the teacher educators since they need to learn to handle the technology factor. Multimedia cases cover in depth knowledge in a very short period of time. Multimedia cases also include information from case studies in the form of moving patterns, pictures, and stills. Multimedia cases may also lead to overgeneralizations than the written cases because it is more appealing than the text. Despite these disadvantages of multimedia cases, they have the great potential of improving teacher education by bringing classroom practice into existence. Designers of multimedia cases should be aware of the potential pitfalls and should make an effort to overcome them while structuring the cases. Four basic factors conceptualize the issues underlying the design of hypermedia systems: users, their tasks, the information space in which the task is being performed, and the environment or context in which all of these interact.

2.6 PERSPECTIVES ON ONLINE LEARNING

Teachers enter new instructional environments coupled with new pedagogical approaches that stress learner-based responsibility and computer-supported collaborative learning. There are a lot of factors that impact online learning: use of design, paying attention to the people involved (students, teachers etc.), and many dimensions of social interaction such as learning and professional socialization. Online teaching is not just moving a face to face course into an online course management system. Online training must focus on delivering information across space and time, including library materials, lectures, and course notes [14].

For educators, the primary concern in an online training mainly concentrates on whether online programs result in learning outcomes that are good as those achieved through traditional means. Various studies reveal that there are no major drawbacks with online learning [15].

There are better and worse practices in online training. Courses that are transferred from the traditional environment to online courses successfully require new pedagogical techniques, syllabi, assessment mechanisms, and an understanding of particular needs of learners. Computer-supported cooperative work and computer-supported collaborative learning are two main technological aspects that bring technology and design considerations to the fore. From a computer science perspective, attention to technology and its affordances need to be mainly considered in the design of online learning [19].

Also, due to the differences in background knowledge, learning styles, and preferences, individual students may need to take very different approaches towards learning [18]. A learning style is the concept that different people learn in different ways. Some people might learn a concept very quickly, while others may find the same presentation very hard to grasp. One of the approaches that might be done to overcome these differences in the learning styles of students is

the development of various learning content depending on the student. Adaptive educational hypermedia systems help achieve this constraint by introducing the concept of constructing personalized learning content for each person according to the person's learning style. Christopher and Frederick proposed a framework for this approach. Concept spaces and concept filters were used to support an adaptive interface. Concept space represented a set of knowledge whereas concept filters are modifiers applied to determine the type of content space to be delivered. Results showed that the concept of visual manipulators and concept filtering mechanism have provided ordinary and non-technical teachers with a tool to construct adaptive courses. This is a growing mechanism which overcomes some of the difficulties of online learning environments.

Some of the issues surrounding E-Learning systems are pedagogical issues [20]. The technology used by the teachers and students account for these issues. Some of the barriers to teach online include the following:

- Lack of skills and knowledge needed to design and teach online classes.
- Lack of support, training, and help needed for planning online instruction.
- Lack of time to plan, design, and teach online.

Moving technology into the educational transactions by focusing on technology and studying the ways through which technology affordances shape interaction among learners-content will help in understanding technology mediated interaction. Technology-mediated interaction influences social presence, structure, learner control, and feedback [21]. Researchers and computer scientists can facilitate E-Learning by collaborating with each other, leading to improvements in the development of E-Learning technologies.

Vrasidas [20] points out various questions that should be asked and addressed while developing e- learning systems. Some of them are listed below:

- Does the technology affordance permit and constrain certain kinds of interactions?
- How does technology-mediated interaction shape structure, learning, learner control and social presence?
- What technologies can be used to undertake the kinds of tasks that learners and teachers cannot easily perform?
- What combination of technologies, content, context, and instructional methods are appropriate for the goals of instructional learning?

Spectrum Educational Consulting development explores these questions at the development phase. By constantly monitoring the development with the learners, we try to achieve the best use of technology in achieving the goal. Also, scenarios are controlled with the hands on interaction of learners. Thus, the final E-Learning content developed is in accordance with the best use of technology and the content.

Vrasidas also lists some principles for designing effective online learning content:

- Learner–Centered: Online learning tools should be focused on the learner. They should allow learners to take control of their learning.
- Engaged and Active: Learners engage in interesting activities that also motivates them in learning.
- Online Learning should be a constructive process, situated in real world contexts to depict the actual meaning.

- Online Learning needs to be reflective in that learners engage in reflective thinking about their actions. Online learning should provide tools that support reflecting on the learning process.
- Online learning should also support feedback.

Spectrum Educational Consulting follows these guidelines in the development of online educational content. Spectrum Education Consulting involves reflection questions that are used to improve a user's interactivity with the system. It also depicts real world contexts.

Blended Learning is the combination of traditional face-to-face classroom learning integrated with emerging technologies like pervasive learning, virtual class rooms, online training, web based study materials, etc. [23]. Blended Learning is a form of integrated learning experience which achieves complete knowledge. It overcomes some of the disadvantages faced by the learners in the E-Learning method. The goal of blended learning is to produce the most effective and efficient learning methods by combining the features of a traditional classroom and online learning methods. Once Spectrum Educational Consulting achieves these goals, the plan for this project is to also, utilize this E-learning application to convey these materials through blended learning to improve the learning experience.

CHAPTER 3: METHODOLOGY

3.1 MOTIVATION

Computing technologies have been applied to education for decades. Access to information has become an easy and an interactive process helping the learner to have access to the content of his choice. Ready availability and easy access to applications has been flourishing with the advent of web. Easy access to content has supported the concept of E-Learning. Learning through the Internet offers many advantages. Learners have control over the content, the learning sequence, and the pace of learning through the use of E-Learning. Also interactive multimedia content allows them to tailor their experiences to support their personal learning objectives. E-Learning offers higher level of learning effectiveness. Learners are more satisfied with learning materials and learning environments.

Pre-service teacher training is one of the fields in which the extent of E-Learning is growing rapidly. Introduction of E-Learning into pre-service teacher training widely reduces the costs involved versus teacher training that takes place in a traditional classroom environment. However, E-Learning introduced various techniques that can reduce difficulties for the learners. Most of the case studies utilized in teacher training were mostly in textual form. These textual case studies allow teachers to get an understanding of various problems faced in the classroom. However, they cannot create a visual impression of the classroom environment to teachers. We can overcome this difficulty by transforming case studies from textual forms into visual forms.

This helps teachers to grasp concepts much more effectively. Visual forms of case studies also allow teachers to practically visualize the classroom environment and get a feel of the situation.

There are various forms in which textual case studies can be shown in visual forms. Animated simulations are a form of visual case studies. Animation in education has its impact on learning, creativity, and behavior. Animation shows one's creativity and also allows the toughest concepts in a more visual manner to help make them easier to understand. By incorporating the concept of E-Learning and animated simulations into pre-service teacher training, learners can overcome various constraints of former methods of teacher training.

The learner should have the provision of accessing the content anytime and anywhere. If we can overcome this barrier, then the learner can be given access to the information irrespective of time and place. Growth of mobile technologies in recent years is promising and is a new revolution that can be comparable with the growth of Web and Internet technologies. The cost of mobile access to the Internet is steadily decreasing. These mobile technologies have enabled a new way of communicating. Mobile devices are part of normal daily interaction. Developing content that can also be accessed from mobile devices increases the accessibility of applications.

In addition to the above flexibilities to the learners, they also need to interact in the learning process. By involving learners in the learning process, it helps them to understand the concepts and not deviate from the case study. Another advantage is that the style of the interaction utilized by these case studies will support novice teachers in classroom management and decision making. The interactive case studies will provide more support for critical thinking and reflection skills than a static video of an example case.

By incorporating various case studies along with reflection questions, teachers get well prepared to face all kind of situations in a traditional classroom environment. By also

incorporating content online using multimedia, it gives teachers the opportunity to view these case studies at any place. Implementing pre-service teacher training with all these features can overcome constraints with respect to time and place and have a profound impact of the training modules availability to teachers for learning reinforcement.

This research aims to implement the case studies for pre-service teacher training through animated simulations to reduce time and place constraints, increase user interactivity, and create a visual impression of the classroom experiences to the teachers.

3.2 IDENTIFYING A LIST OF POTENTIAL QUALITY INDICATORS

For any online learning environment, various factors are utilized in deciding the quality of the application. Some of the quality indicators are listed in Table 1. The main quality indicator in a learning environment is the interactivity between the learner and the application. The environment should be learner-centered and should be easily accessible and easy to use.

3.3 CURRENT ENVIRONMENTS

Pre-service teacher training has been implemented so far using textual and visual forms. The visual forms implemented so far have not been successfully able to overcome all constraints. The proposed learning environment consists of animated simulations of case studies

CANDIDATE INDICATORS OF QUALITY IN AN ONLINE COURSE

- Connection with the teachers
- Learner - centered
- Expectations clearly articulated
- Immediately engages the learner
- Anytime, anyplace learning as the new prototype (Spectrum Education Consulting) works on mobile phones also
- Feedback clear, timely and meaningful
- Self paced schedule

Table 1: How quality in an online course can be improved

3.3.1 TEXTUAL CASE STUDIES

Initially, case studies for pre-service teacher training were in textual forms. These case studies are textual descriptions of an author who narrates the case study. At the end of the case study, reflection questions based on the situation allow teachers to think and analyze the situation in the case study. After the case study, narrator explains his analysis on the reflection questions and shares his thoughts.

3.3.2 FLASH BASED ANIMATION

Previous version of Spectrum Education Consulting involved developing animated simulations of case studies using flash. A screenshot of this version is shown in Figure 1 and 2.



Figure 1: Screenshot of former spectrum application

The prototype version one of pre-service teacher training had case studies developed using animated simulations; however, there were various drawbacks. One of the major drawbacks of this version was user interactivity. Learners didn't have the ability to interact with the application. Another drawback with the system, was the aesthetic quality of the simulation, it did not look very realistic because the character animations were not smooth and resembled a cartoon flip book and not continuous. Also the transitions from scene to scene needed improvement and jumped from one scene to another with need for smoother transitions. Another drawback was the supportability of the application in all browsers. The next version of spectrum application uses the next generation solution for web based animation (i.e. HTML5/Javascript) which is supported on more devices (e.g. web and any mobile device) than the previous generation of flash and does not require user to upgrade or add additional software or plug-in. In the below figure, the version of pre-service teacher training, the application uses animated simulations. However, this application has no user interactivity associated with it. The user cannot control the flow of the application.



Figure 2: Former Version of Spectrum (Flash Based)

3.3.3 INTERACTIVE CLASSROOM MANAGEMENT SIMULATIONS

In Classroom Management Simulations by Pearson, this is an application of classroom management simulations, that allows user interactivity, but it lacks the feature of visual simulations. A screenshot of the simulation is shown in Figure 3. Even though it shows animated figures, these are just static pictures. This application is useful in ways that it allows teachers to think about the real-time situations, but it does not fully provide the visualization needed to react to classroom experience. Teachers can only answer the reflection questions effectively when they are provided with a visual experience of the classroom experience, which this form of training lacks.

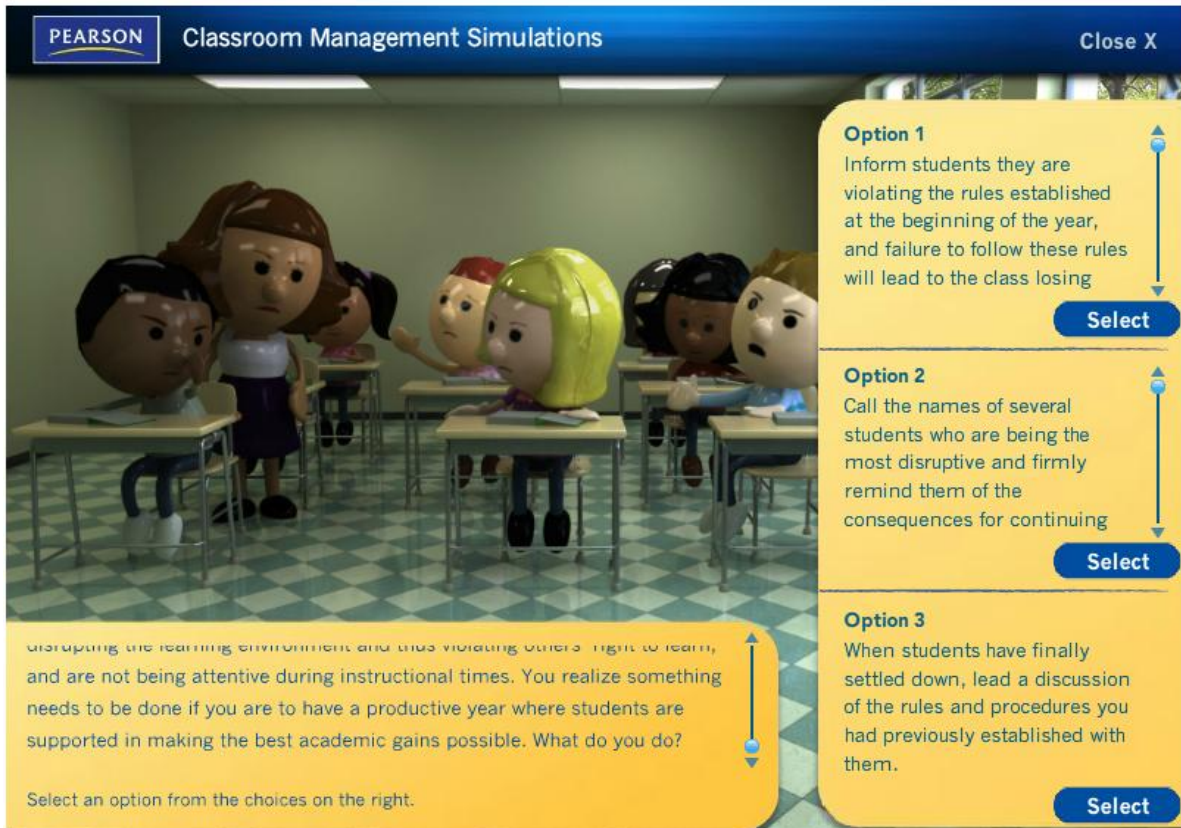


Figure 3: Classroom Management Simulation by Pearson (Flash Based)

3.4 PROPOSED EDUCATIONAL ENVIRONMENT

The planned educational environment (Spectrum Educational prototype two) consists of a learning environment for teachers. It is poised to replace the current environments which are not portable to multiple browsers and platforms. The proposed educational environment also supports user interactivity. It was developed to overcome usability issues and to convert text based scenarios to animated scenarios.

We will be addressing the differences between former pre-service teacher training methods and the proposed new teacher oriented learning environment. In almost all previous forms of pre-service teacher training, none of them successfully implemented all the features needed to make teacher training fruitful. The textual forms don't visualize the class environment.

Some of the teacher training methods, which implement visual forms of case studies lack features such as user interactivity and good usability.

In the proposed environment, the user has the ability to control the flow of the application. The user can also interact with the application and also have the ability to reflect their opinions on the case study. The proposed environment provides reflection questions at the end of case study, which allows teachers to reflect their ideas and also gives them an opportunity to prepare for various classroom environments that they could face while teaching.

3.5 MODELLING AND LIFE PROCESS

Requirements Analysis: This is the phase where the requirements are defined and the developer gathers information to support details to help create the kind of system he needs to develop. It's a well-defined picture of the problem statement and justifies how the developed prototype aims to solve this problem. In the Spectrum Education scenario, the prototype investigates creating a system that will support new teachers in classroom management strategies. There are many ways in which pre-service teacher training can be fruitful. Online learning environments can be helpful in supporting content reinforcement and critical thinking and evaluation (e.g. reflection questions). Our requirements have identified that instructors that are training teachers will benefit from Spectrum Education as an online learning environment to structure and provide lessons to students with the added benefit of easy access, repeatability and the potential to support for large numbers of teachers and students remotely.

Design: This phase aims to develop a solution for the problem statement that the developer will solve through coding. The solution developed describes a possible way to attend the requirements identified in previous teacher training applications. Here we will propose a solution to this problem.

Based on feedback from Spectrum Education prototype one, Our design for prototype two will be, made more interactive and helpful to teachers by providing them control over the content. To support visual learners, long text based scenarios were converted into animated scenarios. The prototype goes through the revision cycle each time to detect flaws at each step of the process. Figure 4 shows the prototyping model.

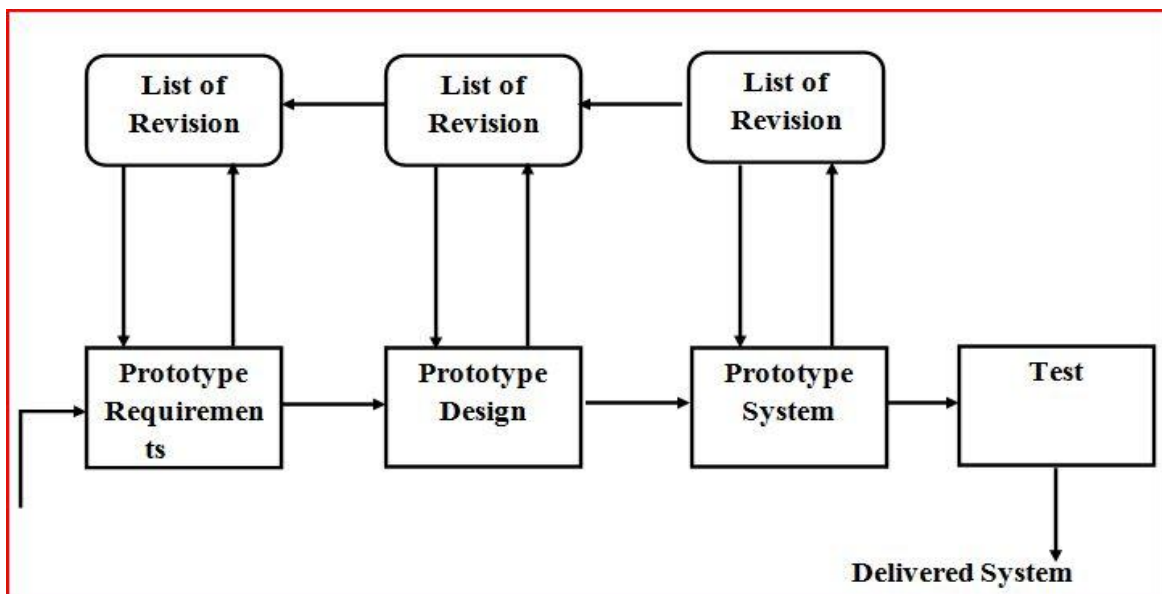


Figure 4: Prototyping Model used in Spectrum Development

Implementation: In this phase, the main focus will be on coding a solution from the design phase. The code was written in HTML5 and JavaScript. As discussed, we developed this Spectrum Education prototype version two to be able to work on mobile phones also, so the development has been done keeping this point in mind.

Testing: This is the phase where the developed code has to undergo testing to see whether the code is validated according to the requirements and design class model. However, when a system passes the initial testing, it doesn't mean it's right, it only means it passes the test. This is why incremental testing and development is essential to achieving a robust system. The testing

for this prototype version is done using a questionnaire using ‘SurveyMonkey’ where the teacher education specialists, Human Computer Interaction specialist, and students will be sent a form with all the questions, and the results will be analyzed and further improvement to the system will be done. Figure 5 shows the modeling process.

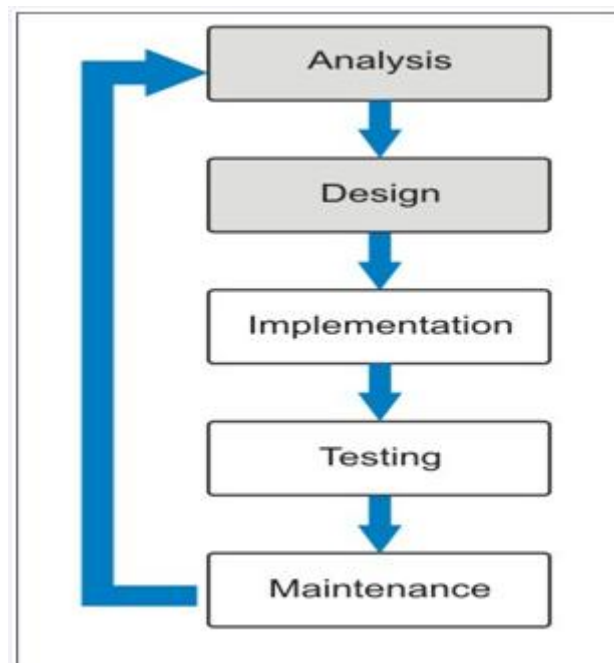


Figure 5: Modeling Process used In Spectrum Prototype

3.6 SPECTRUM PROTOTYPE USE CASE SCENARIOS

A. User

Primary Actor: User

Secondary Actor: None

Description: This use case scenario is for users who need to register for the first time to log into the system where all the files related to Spectrum Education are kept. The user can view the animated simulations related to Spectrum Education Consulting. The request sent by the user goes to Database (DB) Admin; the DB Admin accepts the request and approves the login credentials.

Pre Conditions: The user should have a desktop/laptop/mobile phone in working condition with internet connectivity on any of the mentioned devices.

Post Conditions: The DB Admin must have knowledge on approving log in credentials for the requested users.

Basic Flow:

- The user sends a registration request to DB Admin with his email, username and password.
- The DB Admin can accept/reject the request based on the availability of username.
- If the DB Admin rejects the request then the user has to select a new username.
- If the DB Admin accepts the request, the user will have the login credentials.
- Once the user has the log in details received from the DB Admin, he can access files related to Spectrum application.
- The user can view the simulations which are provided on the Spectrum webpage.

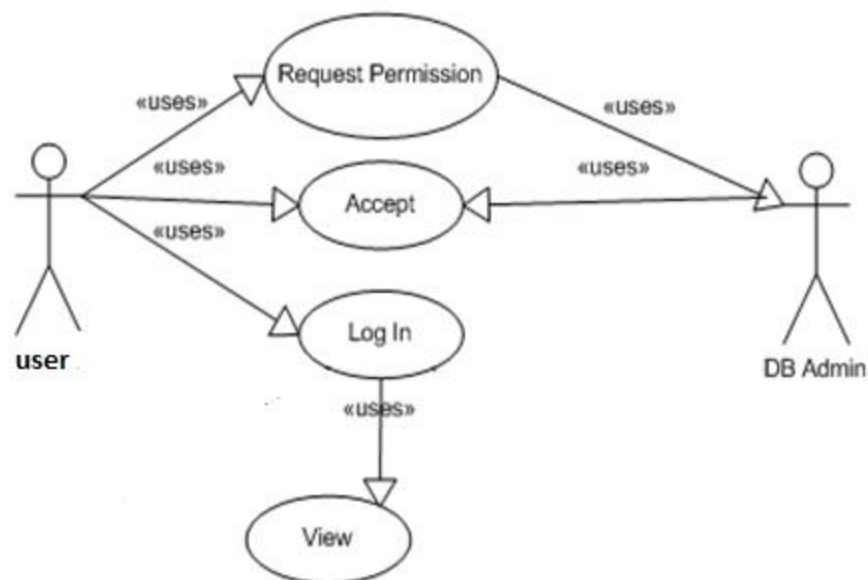


Figure 6: Use Case

B. Use Case User – Animated Simulation

Primary Actor: /user

Secondary Actor: None

Description: Once the user gets the acceptance from DB Admin, he/she logs in to the homepage of the Spectrum Education Consulting. The user can navigate and go through the scenarios and case studies.

Pre Conditions: The user should have a desktop/laptop/mobile phone in working condition with internet connectivity on any of the mentioned devices. The user should have login credentials.

Post Conditions: After the user goes through all the case studies, he/she will gain knowledge which will be useful to him/her in their classroom teaching process.

Basic Flow: (for example a user navigates through 2scenarios)

- The user goes into Spectrum application homepage by entering his username and password.
- Then he/she can navigate to the scenarios/case studies by pointing the mouse over to the ‘View Animated Scenarios’ Link.
- The user then goes through the animated simulations. At the end of the simulation, users are given a reflection question.
- The user selects an option to the reflection question and proceeds to an another scenario.
- The teacher is prompted to another reflection question in the middle of the scenario. The user selects an option.

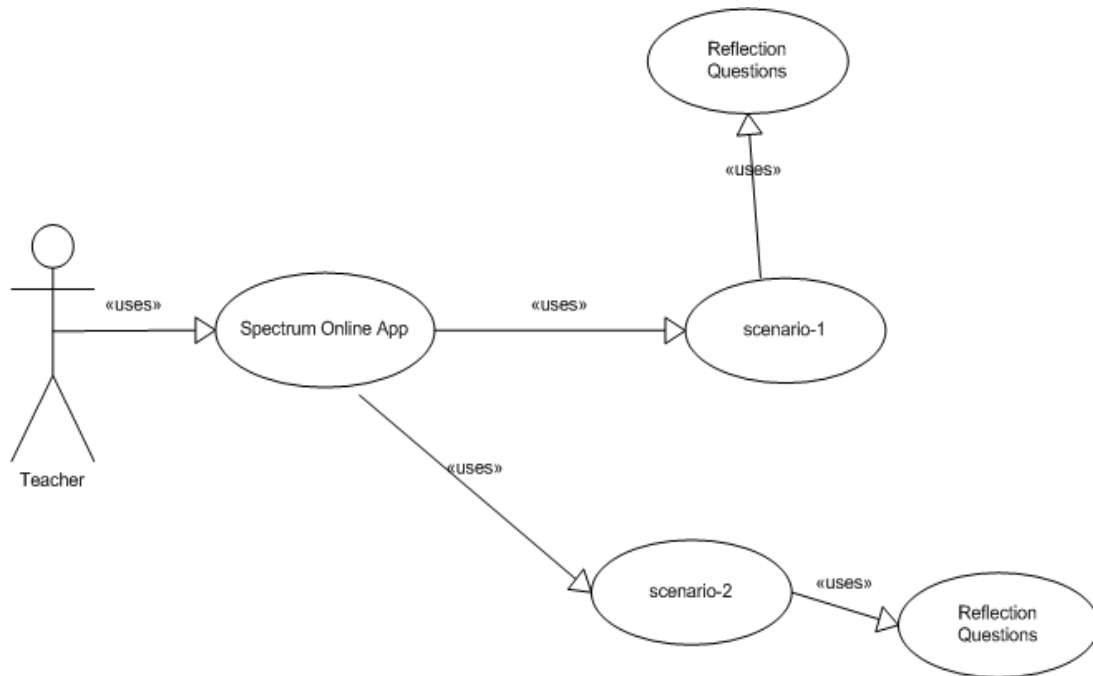


Figure 7: Use Case for Teacher

- Based on the option the user selects, the user is redirected to a different ending of that scenario.
- The user also is provided with the correct option for the question and is provided the reasoning with animated simulations.

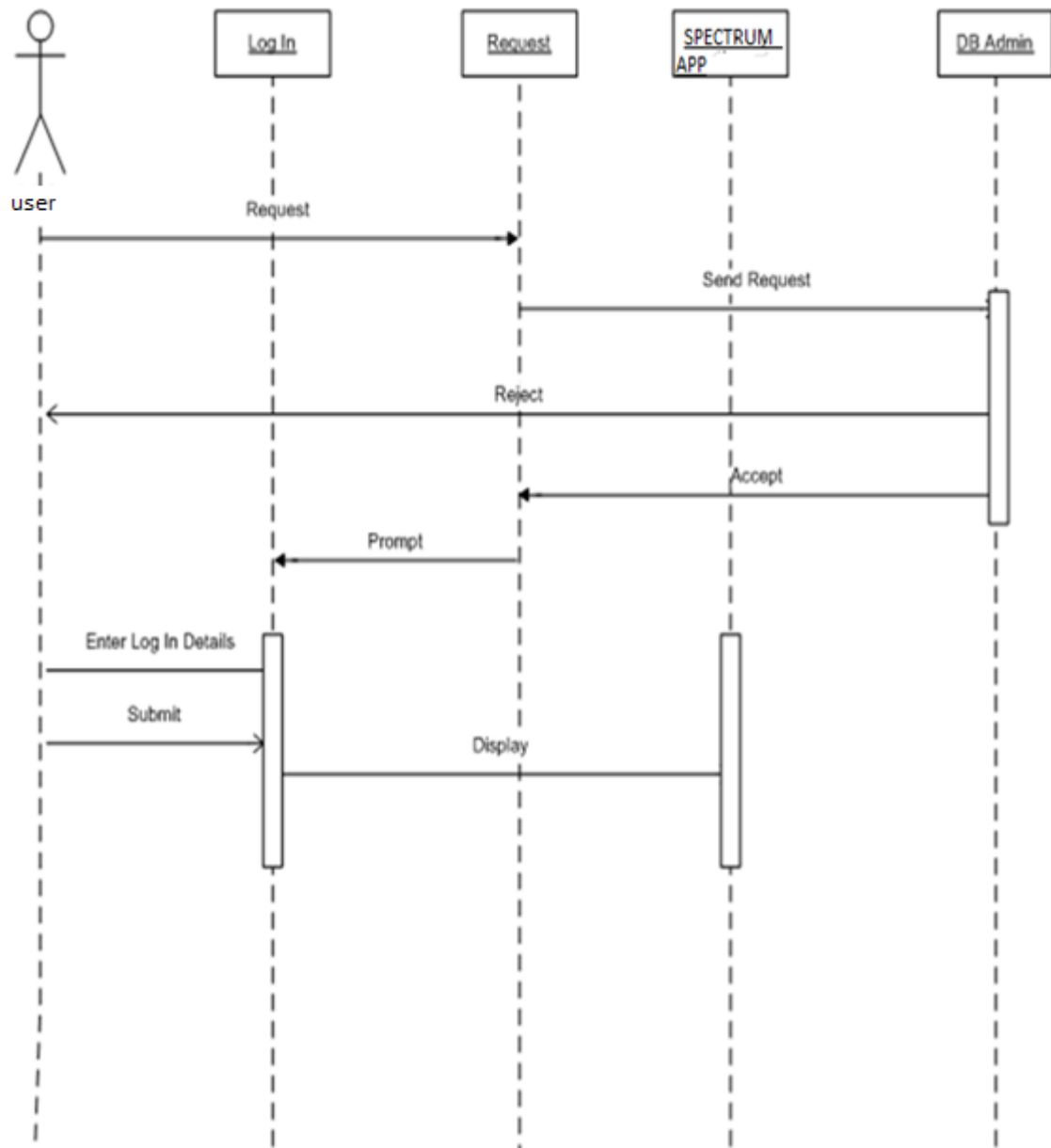


Figure 8: Sequence Diagram from Admin Point of View

3.7 DESCRIPTION OF INTIAL STUDY:

Initially, a study was conducted to analyze the needs of the teachers to use an online environment for teacher training case studies. Also the planned environment needs to work on mobile devices so that the content can be accessed from anywhere.

The goals of the study were to (a) familiarize pre-service teachers with the new Spectrum Education Consulting prototype, (b) to improve usability features of Spectrum compared to other teacher training methods, (c) to visualize classroom environment to teachers using animated simulations, (d) to allow teachers to interact with the system, (e) to allow teachers to improve their reflection skills by allowing them to answer to the reflection questions on the scenarios. Once the planned environment is developed, a survey was designed to evaluate the application.

A series of tasks were given to the testing participants which can be done in their leisure time, and once the task was completed, they were asked to do the questionnaire which asks for their experiences while using the system.

3.7 TESTING THE EDUCATIONAL ENVIRONMENT

We plan to test the Spectrum Educational Consulting application with the help of an online survey that is taken by teacher education specialists, graduate students, Human Computer interaction experts in HCI lab at Auburn University in CSSE department. The students and the teachers will compare the previous forms of pre-service teacher training methods to the new one named Spectrum Education Consulting and express their views and provide feedback based on their experiences. The results from their feedback are shown as surveys in Chapter 5.

3.7.1 TEST ENVIRONMENT AND EXPERIMENT

Data collection will take place using the secure sockets layer on [surveymonkey.com](https://www.surveymonkey.com) for post questionnaire. Data collection will be done by three sets of people -Auburn University Graduate Students in CSSE department who are doing their research in Human Computer Interaction lab, Human Computer Interaction Specialists and Teacher education specialists who teach different case studies to pre-service teachers. Data is stored electronically within Survey Monkey.

Hardware:

- Servers have redundant internal power supplies.
- Data is on RAID 10, operating system on RAID 1.
- Database is log-shipped to standby server and can failover in less than one hour.

3.7.2 HYPOTHESIS AND VARIABLES

The main hypothesis of this research is that online learning environments incorporated with animated simulations of textual forms of case studies are instructive for pre-service teachers in understanding various difficulties that could be faced in classroom teaching process. The teachers can access the information anywhere and at anytime and will be more engaging if the content is delivered through easy and interactive online environments. Online learning environment better supports learners as opposed to structural educational environments. Accessing the environment requires computers, and the user can access them at limited restrictions like time and place. With the revolution in mobile technology, mobile devices have become the basic essential element in human lives. This research also tends to support the mobile platforms. If we can use them as a media to deliver the information, the user can access it irrespective of time and space. In order to test these hypotheses, a set of variables were configured. The questionnaire is comprised of set of questions, each having ratings for the user to specify his level of agreement of how comfortable he feels with the application. The same can be mentioned about the prototype by answering questions related to the information quality and interaction quality.

The surveys are given to participants who are doing their under graduate, Master's or Doctoral degree at Auburn University in Department of CSSE and to teacher education specialists. Our evaluation includes graduate students who have usability training. This will

support this research in assessing the usability of the prototype. These studies will identify the positive and negative features for future requirements. The participants should have taken COMP 7620 or COMP 6620 courses so that they have usability training knowledge. Teacher education specialists help in determining the effectiveness of the interactive case study and simulations. Teacher educators will be helpful in assessing the information quality of the application developed.

Likert-type scale was used for post-questionnaire. SurveyMonkey was used for the online surveys. A Likert scale is a psychometric scale which is mostly used in questionnaires, and is most widely used scale in survey research. Numerical values are assigned to each potential choice and a mean figure for all the responses is computed at the end of the evaluation or survey. Bi-polar questionnaire structure is used when responding to the Likert scale. Generally the Likert scale corresponds to five rating on the scale. The main reason for using Likert scale rating for this experiment is because they have odd number of possible ratings on the scale, and we used seven rating scale here .

3.7.3 EXPERIMENTAL PROCEDURE

Since the experiment surveys are to be entered on the Internet, the participant can take the surveys in their leisure time.

- An email is sent to the participants describing the study and why they are chosen.
- The email consists of a link to the information letter that describes in detail about the research and gives the option for the user to continue to the animated simulations
- The participants will take their own time in understanding the prototype (Time is limited to the participant)

- Then the participants will answer a set of questions which is a questionnaire.
(questions based on usability, information quality, interaction quality)

All the links will be through online survey. The questionnaire will take not more than 10 minutes.

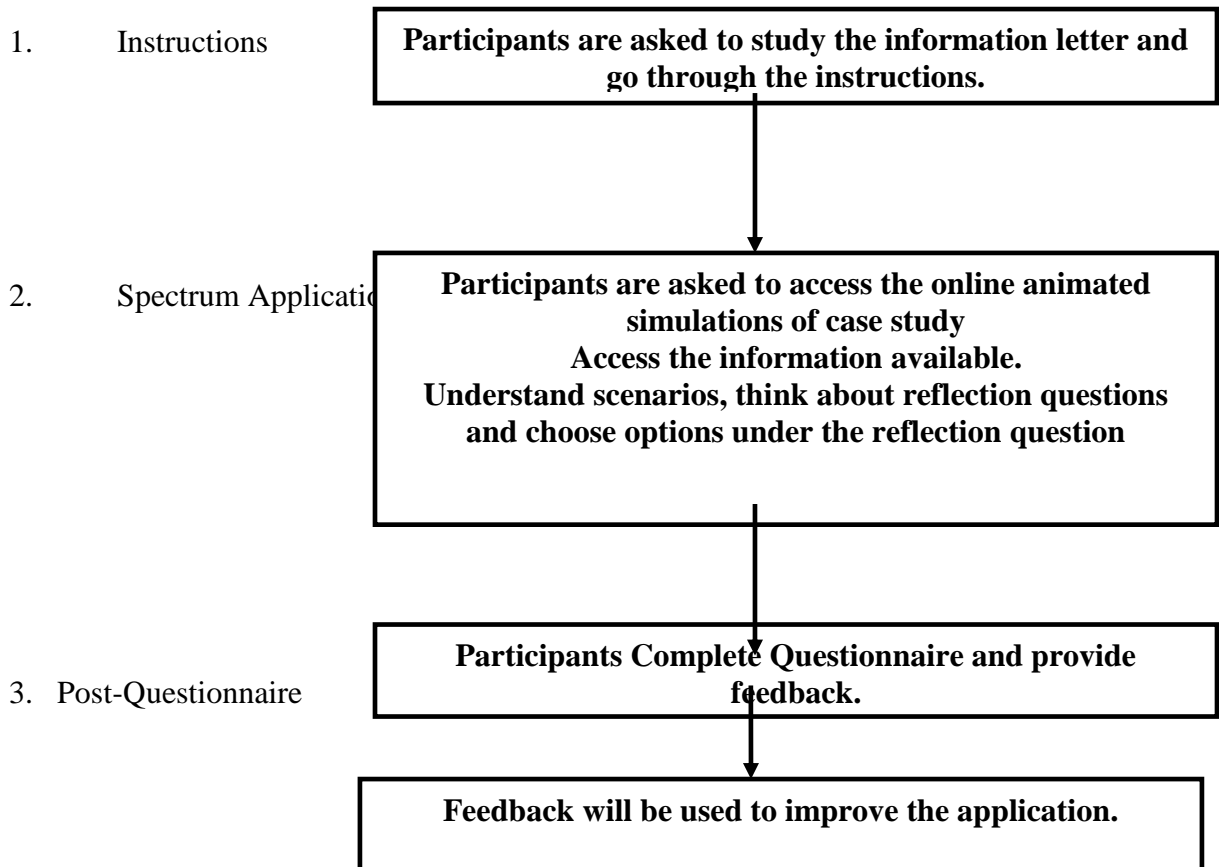


Figure 9: Spectrum Education Consulting Survey Flowchart

CHAPTER 4: IMPLEMENTATION

As we discussed in earlier chapters, we designed and developed the prototype by using HTML5, PHP (Hyper Text preprocessor), JavaScript, and MySQL. We used Adobe Dreamweaver, which is a web development application tool that supports various syntaxes. This chapter discusses the details behind successfully configuring and developing the proposed model for pre-service teacher training. For developing and implementing the model, there are some essentials required that we will discuss in detail. Figure 10 shows the homepage of spectrum prototype.

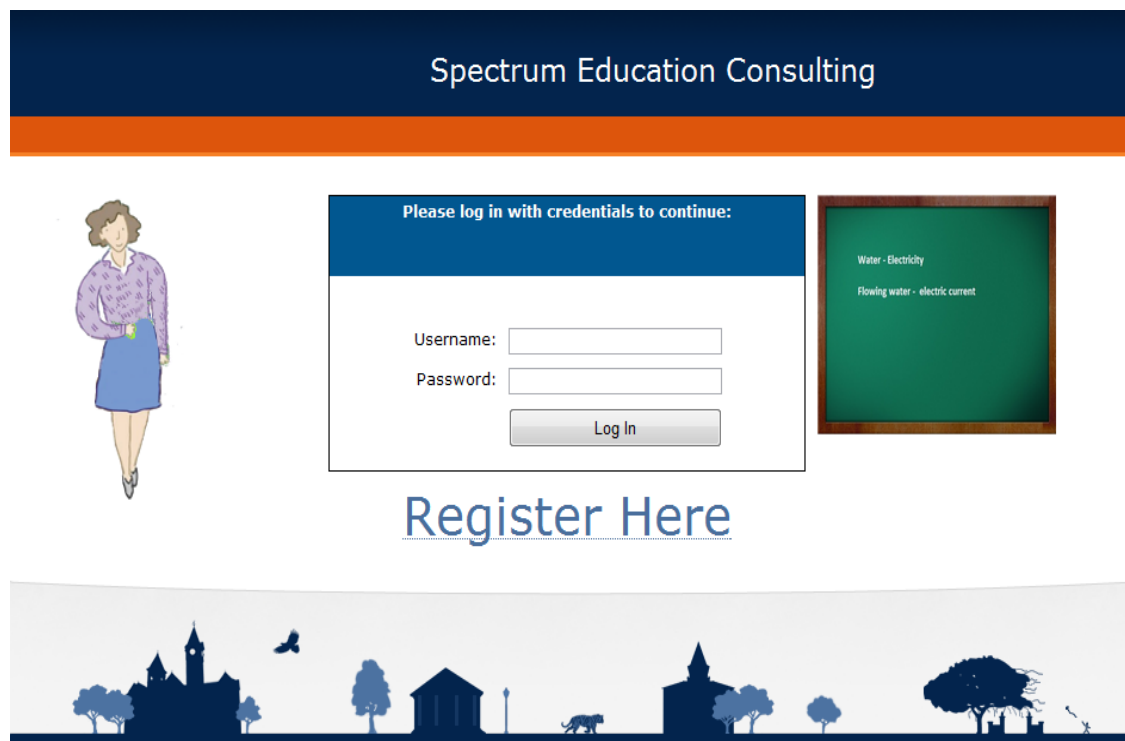


Figure 10: Spectrum Educational Consulting Home Page

4.1 TECHNOLOGIES USED

As we discussed earlier in this chapter, the technologies used are HTML5, PHP, and JavaScript. The proposed model includes a registration panel. In this panel, teachers can register themselves and gain access to the developed prototype. They can actively interact with the content. They can also take a look at the scenarios posted. The login and registration pages were developed using PHP. The animated simulations were developed using HTML5 and JavaScript. MySQL was used to create the database to store the login and registration information. In the following sections we will provide more details of these technologies.

4.1.1 HTML5:

HTML5 is a language for structuring and presenting content for the World Wide Web, a core technology of the Internet. It is the fifth revision of the HTML (Hyper Text Markup Language). In this version of HTML, various new features are introduced to help Web application authors. There are several, new elements introduced into this version of the application based on research into prevailing authoring practices with special attention given to defining clear conformance criteria for user agents in an effort to improve interoperability. HTML5 introduces a number of new elements and attributes that reflect typical usage in modern websites. Also, one of the main features that HTML5 introduced is has removed the requirement of needing an Adobe Flash player to watch videos. This is the main rationale for animated simulations in this application to be developed using HTML5 instead of Adobe Flash so that we can support all browsers and all mobile devices.

HTML5 provides mobile device users richer web applications and improved usability. The new features of HTML5 standardize the use cases and technologies that are common

in Smartphone-optimized mobile web applications. With HTML5, advanced web application features are available in all mobile browsers supporting the markup language, using the same standard syntax and displaying the same standard behavior [2]. Using HTML5 reduces the task of developing the same application for different browsers, saving money and, most importantly, time.

In particular, HTML5 has added many new syntactical features. Some of them include the <video>, <audio>, and <canvas> elements. These features are designed to make it easy to include and handle multimedia and graphical content on the web without having to resort to proprietary plug-ins and APIs.

4.1.1.1 KEY FEATURES OF HTML5:

- *Video elements* - Designers can build web pages without having to resort to plug-ins. Built in video controls makes the feature more attractive and easy to use.
- *Application cache*: We can now store web apps much like emails locally.
- *Canvas for Images* – The canvas element that comes with HTML5 allows manipulating graphics and photos, enabling easy rendering of images.

4.1.1.2 CANVAS ELEMENT:

The canvas element is part of the HTML5 markup language which allows for dynamic and scriptable rendering of 2D shapes and bitmap images. It is a low level, procedural model that updates a bitmap and does not have a built-in scene graph. The canvas element consists of a drawable region defined using HTML code with height and width attributes.

In developing animated simulations for Spectrum Education, the canvas element is used for animations and loading pictures onto the web page. The canvas element supports building graphs, animations, games, and image composition [3]. The element is supported by the current versions of Mozilla Firefox, Google Chrome, Internet Explorer, Safari, and Opera [4]. A code snippet involving the canvas element is shown in Figure-11.

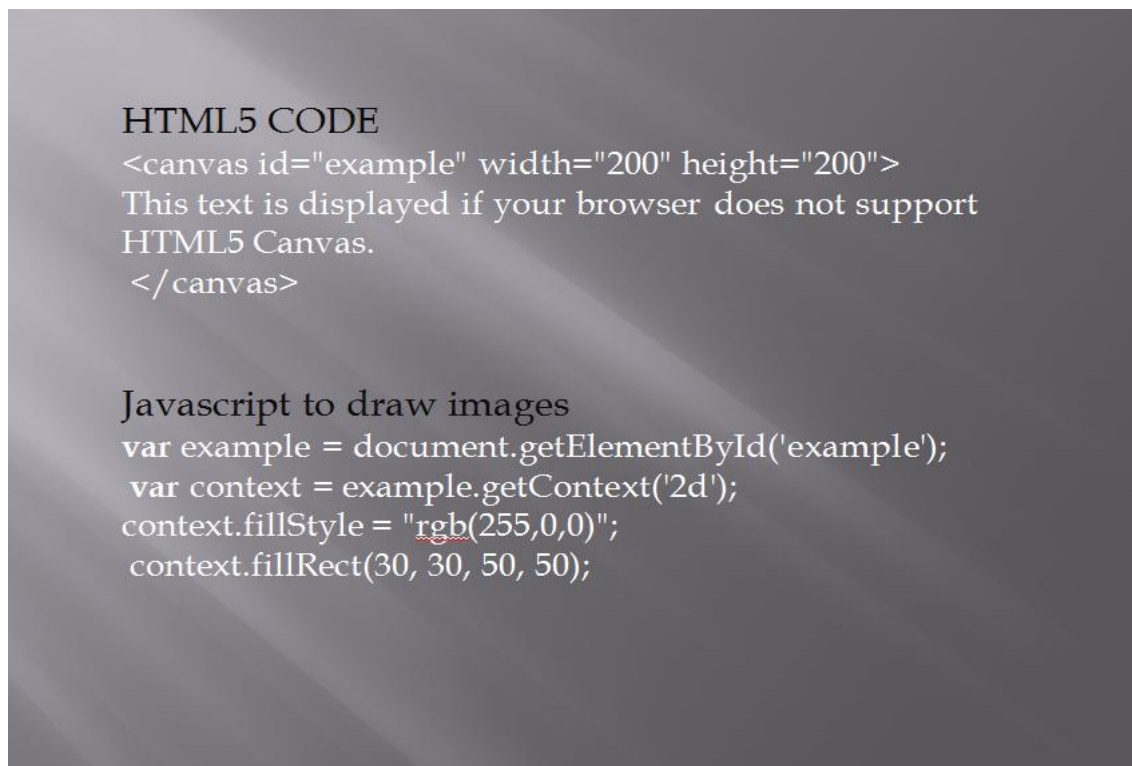


Figure 11: Code Snippet using Canvas element

4.1.2 JAVASCRIPT:

JavaScript is an implementation of the ECMAScript language standard and is primarily used in the form of client-side JavaScript, implemented as part of a web browser in order to provide enhanced user interfaces and dynamic websites. JavaScript is used to draw objects into the canvas element. Since JavaScript is the only language that the most popular browsers share

support for, it has become a target language for many frameworks in other languages, even though JavaScript was never intended to be such a language.

4.1.3 MySQL:

MySQL is a relational database management system (RDBMS) that runs as a server providing multi-user access to a number of databases. The SQL phrase stands for Structured Query Language. The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. Free-software-open source projects that require a fully-featured database management system often use MySQL. For commercial use, several commercial editions are available; and offer additional functionality. A few applications that utilize MySQL databases include: Joomla, WordPress, MyBB, phpBB, Drupal and other software built on the LAMP software stack. MySQL is also used in many high-profile, large-scale World Wide Web products, including Wikipedia and Facebook.

4.1.3.1 HOW DOES MYSQL WORKS

MySQL is a powerful Relational Database Management System (RDBMS) which we will use to learn the basic principles of database and data manipulation using Structured Query Language (SQL) statements. SQL is a database language that is used to retrieve, insert, delete and update stored data. This is achieved by constructing conditional statements that conform to a specific syntax. MySQL is a database server program and is installed on one machine, but can 'serve' the database in a variety of locations. The MySQL Server is installed on a server and can be accessed directly via various client interfaces, which send SQL statements to the server and then display the results to a user. Some of these are:

A Local Client: A program on the same machine as the server. An example of this is the command line MySQL client software we will be using in the rest of the MySQL workshops (although there are other programs including graphical interfaces).

A Scripting Language: Can pass SQL queries to the server and display the result.

A Remote Client: A programmer on a different machine that can connect to the server and run SQL statements.

Remote Login - You may be able to connect to the Server Machine to run one of its local clients.

We used the database tables to store the details like usernames, passwords, and emails of the registered users and instructors. Tables are further created to store the course contents. The data can be dynamically added and deleted. Stored procedures are written to dynamically insert, delete and update data.

4.2 DEVELOPMENT

4.2.1 PAPER PROTOTYPING

Paper Prototyping is a method which is used for the usability testing of Web Sites, Web Applications and conventional software. For developing the prototype initially, the paper prototype was designed. The requirements were gathered and analyzed based on Evolutionary Prototyping (EP). EP allows a continuous refinement of the system and is based on the acknowledgement that designers may not understand all the requirements and will build on those well understood requirements while adding features as they understand the requirements more fully. Initially all the features that are needed to include in the system are designed and analyzed

based on the existing systems and a model was proposed. Figure 12 and Figure 13 shows examples of some of the initial paper prototypes.

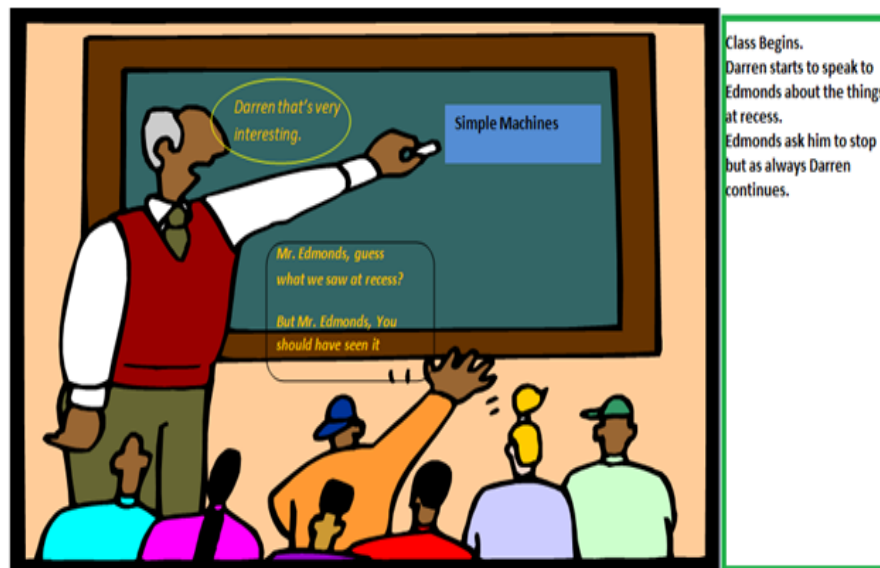


Figure 12: Paper Prototype

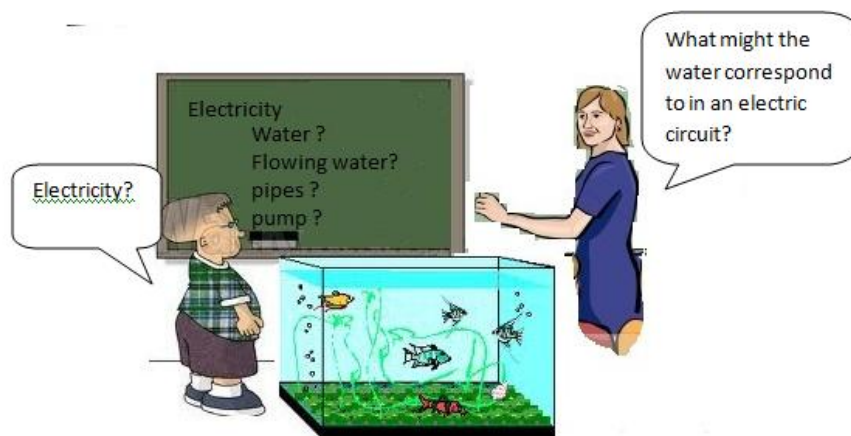


Figure 13: Paper Prototype

In Spectrum Education Consulting: - Tool for pre-service teacher training, we designed several case studies for the teachers where the main goal was to involve teachers into the animated simulation.

Also the final goal was to make the case studies in such a way that animated case study had good usability, likeliness, eases of use, and explains exactly to the point what the case study is meant for. Initially, we hand sketched each and every scene along with the description as paper prototypes. We hand sketched the case study scenarios in such a way that it clearly mentioned:

- Concepts and Terminology: Whatever terms we use, it must be understandable to the target users. Do the target users understand the terms what we've chosen?
- Content: The interface must provide the right information so that the users can make some decisions at the end of the case studies as each and every case study ends with a set of questions where the student has to solve them by understanding the animated case study. Does the interface have extra information that the user needs to know or is it anonymous to the target user?
- Page Layout: Paper prototypes must be drawn considering the page layout and its size, and platforms that are going to be deployed in the final stages etc.
- The paper prototypes were initially tested and checked by Dr. Cheryl D. Seals and by Dr. L. Octavia Tripp. Once the paper prototypes are reviewed, we thought of the tools to convert the paper prototypes into animations. We used HTML5 and Adobe Dreamweaver to convert the paper prototypes into complete animated case scenarios. The animated case studies are designed in such a way that they also work on mobile phones.

4.2.2 DEVELOPMENT

As discussed earlier, the model includes a registration portal. From this section, teachers register themselves and to gain access to the content. The registration and login is developed using PHP. PHP Session variables help in determining the session of a user and logs the user out once his session expires. This session logic was utilized for the user login and logout interfaces. For the registration and login, PHP uses MySQL connection to test the user's credentials. Teachers who are new to the application will need to register themselves into the system by providing their email, choosing a username and password.

Once the registration is complete, the teachers will login with the username and password created. Once he logs in, he will be directed to the home page that includes links to all the scenarios and also the information regarding Spectrum Educational Consulting. The animated simulations were developed using JavaScript and HTML5 features. A screenshot of the animated simulation is shown in Figure 14.

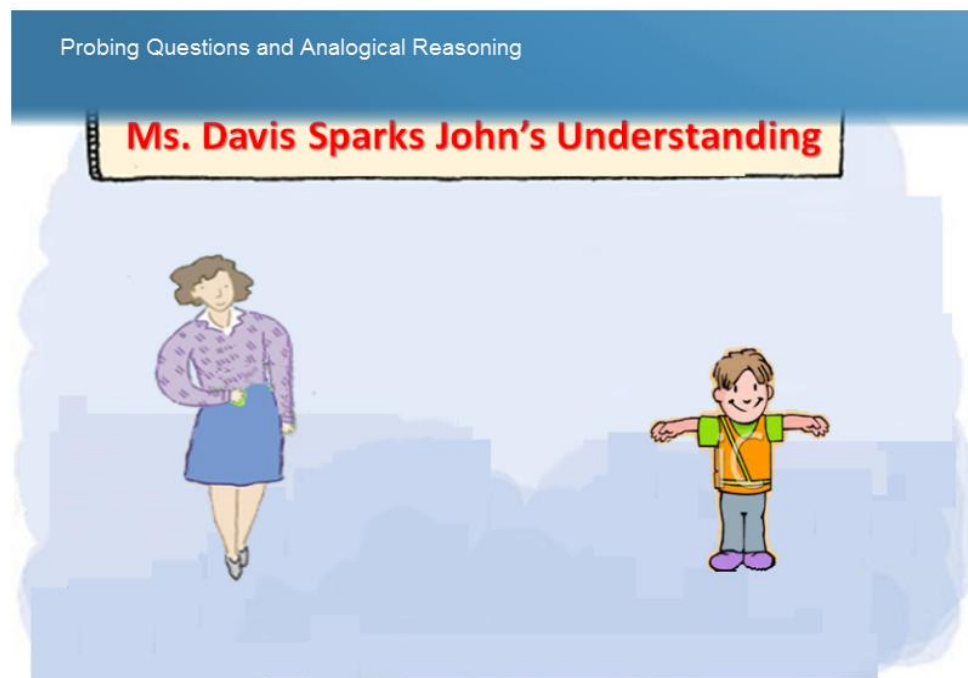


Figure 14: Animated case study

For the development of animated simulations, all the images required to develop the scenario are collected and are edited using Paint, Photoshop, and Gimp. Gimp is an image manipulation tool. Using Gimp, various images are converted into different forms so that we can represent characters in the case study in different forms. These images are called sprites which are used as characters in the development of animated simulations. Some of the screenshots of sprites are shown in Figure 15 and Figure 16, which shows the characters in different forms. Once the sprites were developed, we needed to construct the scenario by loading the sprites. Then, we needed to write the code to animate the sprites and illustrate the different scenes.

Each case study consists of an animated simulation. The animated simulation is navigated by the user with the aid of user interacting specifically through a click of the mouse. The animated simulation involves various sequences of steps. In each sequence, a scene is developed using the images and characters required in the scene. At the end of the case study, reflection questions are given to the teachers which enable them to think and understand different challenges that may be faced with in their own classroom. Also, to further involve teachers in this

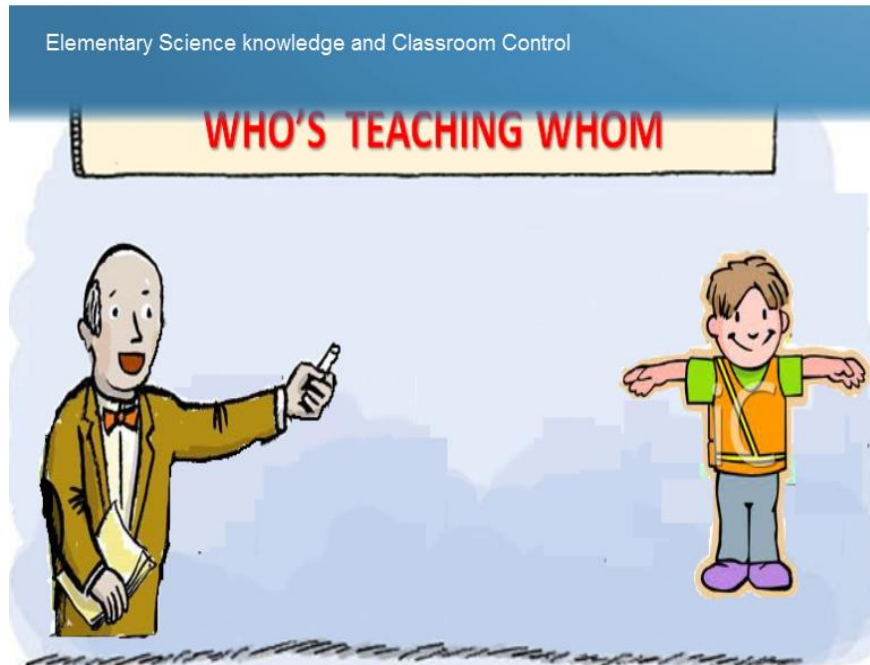


Figure 15: Animated case study

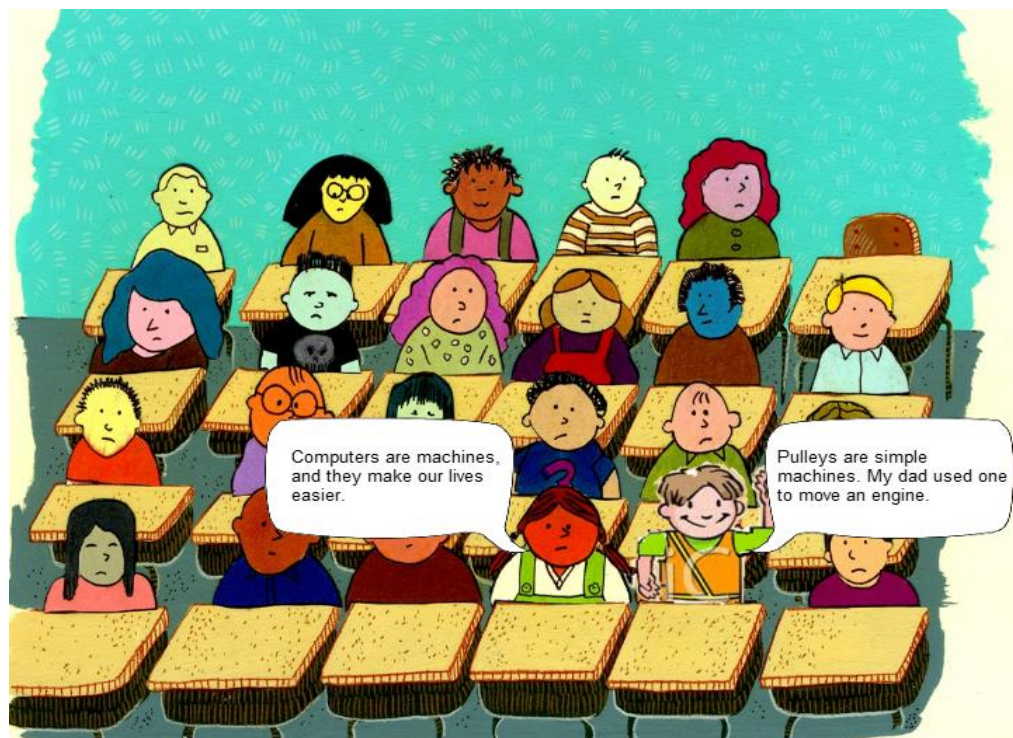


Figure 16: Classroom sequence in animated case study

learning process, they are given options for reflection questions so that they may choose one of the scenario options. Once teachers select an option, they are notified of the correct answer through animated simulations and also given justifications. Depending on the answer they select, they are navigated to the appropriate ending of the scenario. Following is a screenshot which shows the animated simulation involving reflection question.

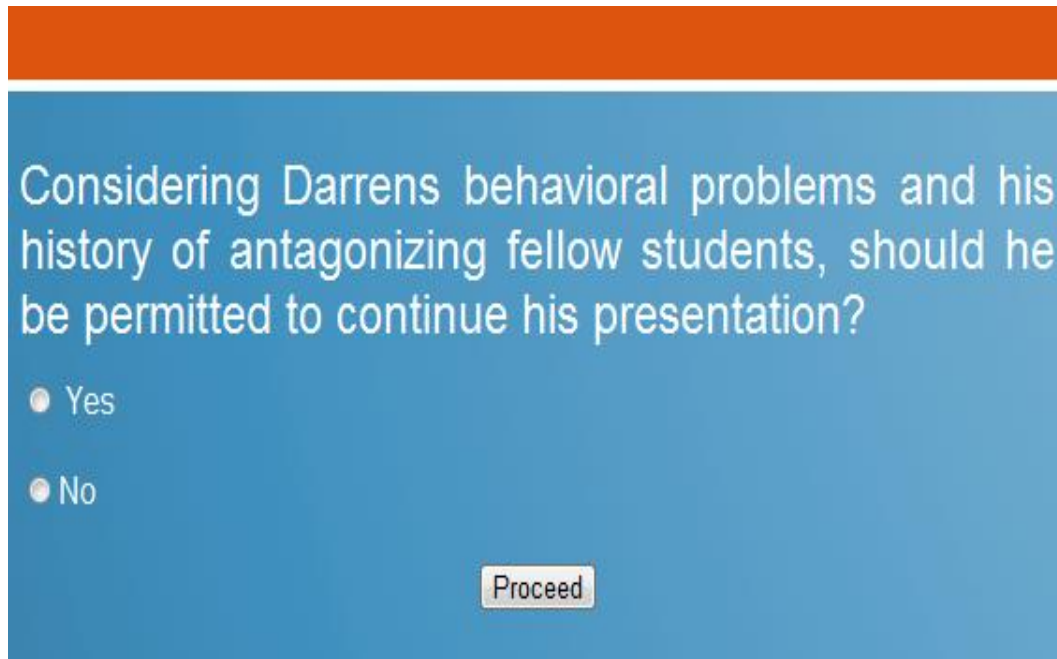


Figure 17: Reflection Questions

Figure 18 shows the justification to the option teacher chose for the reflection question. The final development answers all the research questions stated in Chapter -1. The application is interactive for teachers and also allows them to participate in the flow of the learning process. The animated simulations developed are more useful and make a deeper impact on teachers than the other forms of teacher training methods. Also the animated simulations allow teachers to view the classroom environment and also allow them to get prepared for different types of problematic environments that they could face.

Analogies can be powerful science teaching tools.

Students who are provided with analogies learn scientific concepts in more meaningful ways.

The teaching with analogies model (TWA) provides guidance for using analogies to help students learn

1. Introduce the target concept (unfamiliar)
2. Review the analogue concept (familiar)
3. Identify relevant features of target and analogue
4. Map similarities
5. Indicate where analogy breaks down
6. Draw conclusions

Figure 18: Justification for teacher's answer to reflection question.

CHAPTER 5: RESULTS AND ANALYSIS

As stated in chapter 1, the primary objectives of this study are to address the following research questions:

- Investigate pre-service teacher training methods that are currently available that facilitate teachers to understand traditional classroom experiences.
- Investigate the affordances and constraints involved in developing an online educational application that can support pre-service teachers in a capacity that is easy to use, meets all the requirements and is engaging for the learners.
- Design and develop an online educational application that can be accessed across all different mobile platforms and browsers. The application should allow teachers to interact with the system. Teachers should feel comfortable using the system and learning the workflow.
- Determine if the developed prototype is acceptable from the user interface standpoint.
- Determine if the developed prototype is acceptable for pre-service teacher training.

To address these research questions, a series of studies were conducted in spring 2011 and summer 2011. The existing pre-service teacher training tools were studied and discussed in earlier chapters. Spectrum Educational Consulting, an online educational tool is designed to address all these research questions. The developed tool is tested with three groups (students, teacher education specialists, and human computer interaction specialists) of users using a questionnaire survey. The results from these surveys provided information about users perceived

the developed application and if the proposed application is acceptable for pre-service teacher training. There were 32 users who have tested the application and gave their opinions through online survey. The user survey consisted of three sections. The first section had questions regarding the system usability. The second section had questions regarding information quality and the third section had questions regarding interaction quality. Likert-type scale was used for the questionnaire.

5.1 RESULTS OF USABILITY FOR SPECTRUM:

The results from this section of the survey gave the user's perception of the system from the usability point of view. Data was collected on a seven point scale, 'strongly disagree' being the lowest and 'strongly agree' being the highest. On a scale of 1-7, the average rating in each of the satisfaction categories was nearly 5. Their response to the system was better than expected by the researchers. We anticipated that the response would rate about 4 out of 7.

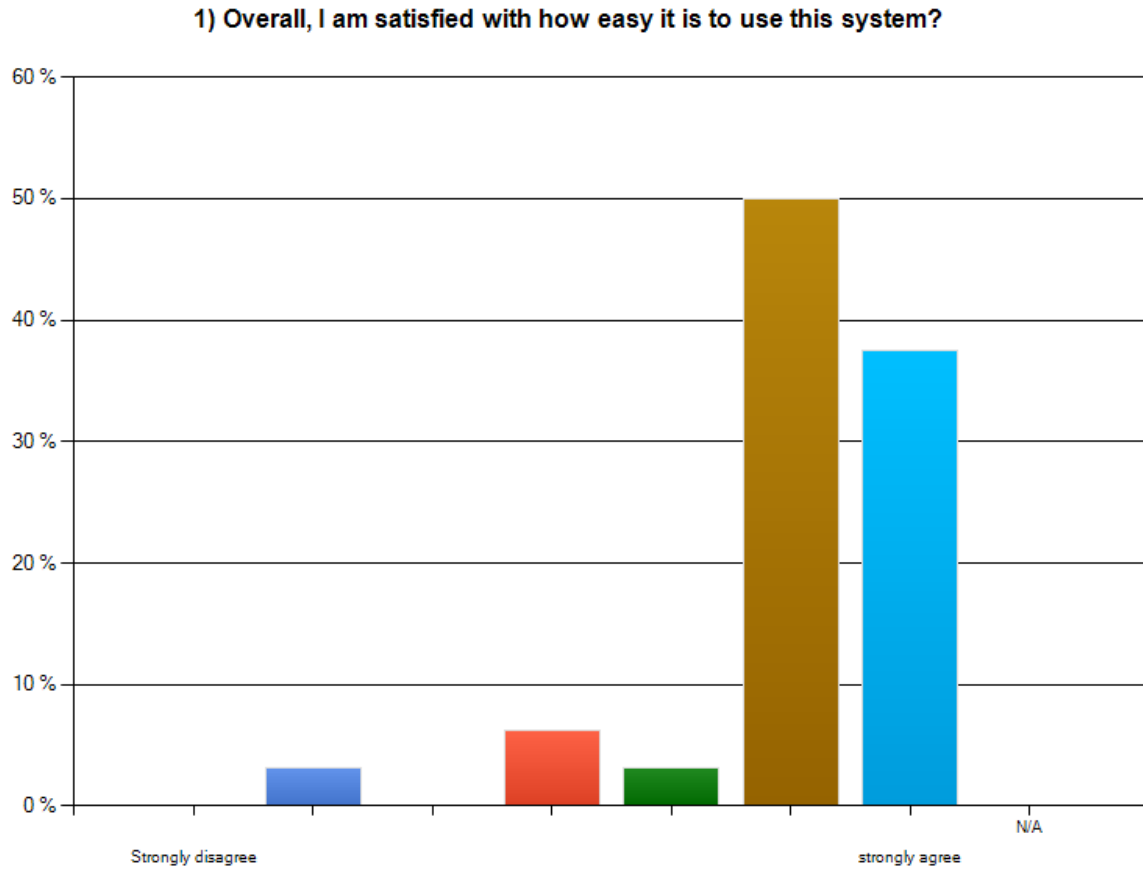


Figure 19: Bar chart showing the participants' response to 'How easy it is to use the system?'

Eighty-five percent (85%) of the participants indicated they were satisfied about the ease of the use of the system. Figure 19 shows the participants' responses to the usability question 'Overall, I am satisfied with how easy it is to use this system?' regarding the Spectrum Education application. However, a small amount of the participant population indicated that they did not find it easy using the system. This indicates that we need to provide greater support and improved usability for novice with less computing efficacy. Average response to all the usability questions in the survey indicated a positive response to the application from the usability viewpoint.

6. 6) I feel comfortable using this system.									Create Chart	Download
	Strongly disagree						strongly agree	N/A	Rating Average	Response Count
Overall reaction to the system.	0.0% (0)	3.1% (1)	0.0% (0)	9.4% (3)	34.4% (11)	21.9% (7)	31.3% (10)	0.0% (0)	5.66	32
									answered question	32
									skipped question	0

Figure 20: Percentages for participants' view on user's comfort with the system

Figure 20 shows the response to the participants view on how comfortable they were when using the system. The average response was a positive indication with respect to comfort with using the system with 97% of users finding the system comfortable to use with only one user (i.e. less than 3%) that did not find the system comfortable to use.



9. 9. Rate the system Usability:								 Create Chart	 Download
	Dull	2	3	4	5	6	Stimulating	Rating Average	Response Count
Overall Reaction to the system	0.0% (0)	0.0% (0)	3.1% (1)	15.6% (5)	50.0% (16)	28.1% (9)	3.1% (1)	5.13	32
								answered question	32
								skipped question	0

Figure 21: Participants' response to the overall reaction to the system

Figure 21, 22, 23, and 24 shows participant's response to the overall reaction to the system. The system was tested against the following range of usability factors – (dull – stimulating, rigid – flexible, terrible – wonderful, frustrating – satisfying). The results indicated that the majority of users found the system Flexible, Wonderful, and Satisfying.



10. 10. Rate the system Usability:								 Create Chart	 Download
	rigid	2	3	4	5	6	flexible	Rating Average	Response Count
Overall Reaction to the system	0.0% (0)	0.0% (0)	3.1% (1)	12.5% (4)	53.1% (17)	15.6% (5)	15.6% (5)	5.28	32
answered question									32
skipped question									0

Figure 22: Participants' response to the overall reaction to the system (Usability Factor: Rigid-Flexible)



11. 11. Rate the system Usability:								 Create Chart	 Download
	terrible	2	3	4	5	6	wonderful	Rating Average	Response Count
Overall Reaction to the system	0.0% (0)	0.0% (0)	3.1% (1)	15.6% (5)	43.8% (14)	18.8% (6)	18.8% (6)	5.34	32
answered question									32
skipped question									0

Figure 23: Participants response to the overall reaction to the system (Usability Factor: Terrible-Wonderful)



12. 12. Rate the system Usability:								 Create Chart	 Download
	frustrating	2	3	4	5	6	satisfying	Rating Average	Response Count
Overall Reaction to the system	0.0% (0)	0.0% (0)	3.1% (1)	9.4% (3)	50.0% (16)	15.6% (5)	21.9% (7)	5.44	32
answered question									32
skipped question									0

Figure 24: Participants' response to the overall reaction to the system (Usability Factor: Frustrating-Satisfying)

Table 2 represents the summary of data reported by the three sets of participants regarding system's usability. Judging by how users rated the system, we can see that most of them responded that the developed system had great usability features. This supports one of the goals of the research, which was to build a learning environment that was intuitive, user friendly and easy to use and learn.

Rating Weight	Strongly disagree	2	3	4	5	6	Strongly agree	N/A	Rating Average
It was simple to use this system.	0	1	0	0	8	12	11	0	5.97
It was easy to learn to use this system.	0	0	1	0	14	6	10	0	5.77
I can effectively complete my work using this system.	0	0	0	2	11	10	9	0	5.81
I am able to complete my work quickly using this system.	0	0	0	1	8	15	7	0	5.90
I am able to efficiently complete my work using this system.	0	0	0	2	10	10	9	0	5.84
Layout /Colors of the interface is visually appealing	0	0	0	2	4	12	13	0	6.16
Understanding the content (Difficult - Easy)	0	0	0	3	13	9	7	0	5.63

Table 2: Questionnaire results for System Usability

5.2 RESULTS OF INFORMATION QUALITY FOR SPECTRUM:

The results from this section of the questionnaire survey give the user's perception of the system from the information quality point of view. Data was collected on a seven point scale, 'strongly disagree' being the lowest and 'strongly agree' being the highest.

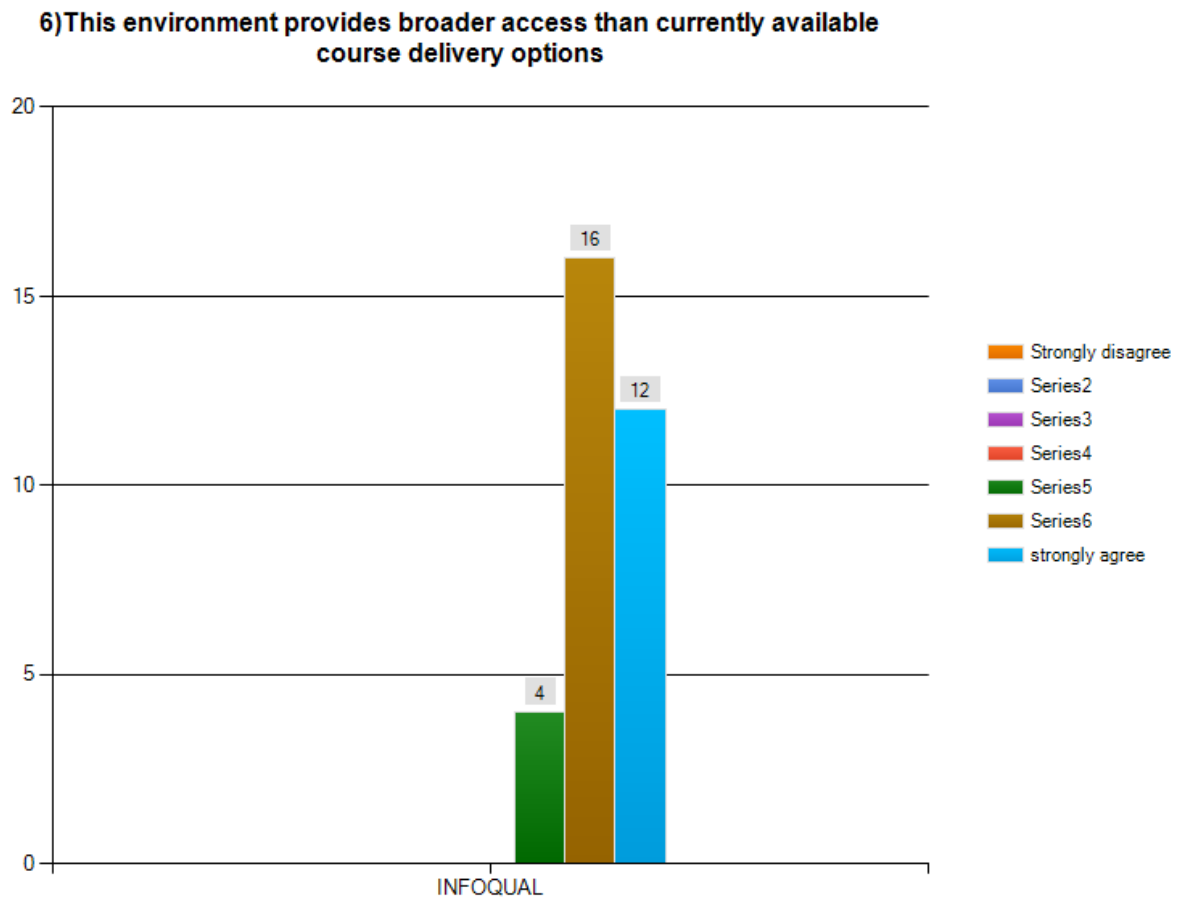


Figure 25: Participants' response to system's Information Quality

More than 90% of the participants indicated that the developed system provides them broader access than currently available pre-service teacher training methods. These results indicate that animated simulations of the case studies are helpful for the teachers in preparing for the classroom environments than the previous forms. Table 3 represents the summary of data reported by participants regarding system's information quality.

Rating Weight	Strongly disagree	2	3	4	5	6	Strongly agree	N/A	Rating Average
It is easy to navigate through the scenarios.	0	1	0	0	7	11	14	0	6.22
The information provided with the system is easy to understand.	0	0	1	1	3	13	15	0	6.31
The information is very much helpful for me to prepare for classes.	0	0	0	1	2	18	11	0	6.22
Interaction between scenarios improved my reflection skills.	0	0	0	0	5	11	16	0	6.34
Based on this experience, I will use Spectrum to access the course materials in the future.	0	0	0	1	3	17	11	0	6.19
The organization of information in the scenarios is clear.	0	0	0	0	5	8	19	0	6.44

Reflection Questions allowed me to think about different problems that I could face while teaching classes.	0	0	0	1	2	14	15	0	6.34
Feedback to the reflection questions through animation was more helpful than the textual form.	0	0	0	1	4	11	16	0	6.31

Table 3: Questionnaire results for Information Quality

The results in the table indicate an average rating of more than 6 for all the questions regarding the information quality of the system. The average rating for the responses to the questions regarding whether the reflection questions were helpful for the users was almost 7. This indicates that the developed system was useful for the teachers to think about different problems that they could face in classroom. The responses also indicated that participants felt the feedback to the reflection questions given through animation was more helpful than provided through textual forms.

8. 8)I was able to practically visualize the classroom environment through animated simulations							Create Chart	Download		
	Strongly disagree					strongly agree	N/A	Rating Average	Response Count	
INFOQUAL	0.0% (0)	0.0% (0)	0.0% (0)	3.1% (1)	6.3% (2)	40.6% (13)	50.0% (16)	0.0% (0)	6.38	32
answered question									32	
skipped question									0	

Figure 26: Participants' response to visualization of classroom environment

One of the goals of the research was to allow teachers to visualize the classroom environment and get a feel of the situation. Figure 26 shows participant's response to the question if they were able to practically visualize the classroom environment through animated simulations. Almost 95% of the participants responded that they were able to visualize the classroom environment through the developed animated simulations. This supports one of the goals of the research.

5.3 RESULTS OF INTERACTION QUALITY FOR SPECTRUM:

The results from this section of the questionnaire survey give the user's perception of the system from the interaction quality point of view. Data was collected on a seven point scale, 'strongly disagree' being the lowest and 'strongly agree' being the highest.

Figure 27 shows participant's response to their overall satisfaction of the system. An average rating of 6 indicates that most of the participants were satisfied with the overall system. However, in order to improve user's feel of the system, various improvements need to be made in respect to system's usability, user's experience while interacting with the system.



4. 4) Overall, I am satisfied with this system.								 Create Chart	 Download	
	Strongly disagree						strongly agree	N/A	Rating Average	Response Count
INTERQUAL	0.0% (0)	0.0% (0)	0.0% (0)	3.2% (1)	22.6% (7)	41.9% (13)	32.3% (10)	0.0% (0)	6.03	31
answered question									31	
skipped question									1	

Figure 27: Participants' responses to 'Overall Satisfaction with the System'

5.4 PARTICIPANTS COMMENTS:

Some of the participants made specific comments, in regard to the system, in the feedback section of the questionnaire. Below are some of the various positive and negative aspects made by participants in regards to the system.

5.4.1 POSITIVE ASPECTS:

Anonymous Participant: 'Reflection Questions are of great use to teachers.'

Anonymous Participant: 'Classroom environment beautifully represented.'

Anonymous Participant: 'More helpful for class preparation.'

Anonymous Participant: 'Doesn't require prior knowledge of using similar applications.'

Anonymous Participant: 'Helpful in improving reflection skills.'

5.4.2 NEGATIVE ASPECTS:

Anonymous Participant: 'need to improve user interface (interactions).'

Anonymous Participant: 'audio could be added.'

Anonymous Participant: 'features like live chat, should be included.'

From all these questionnaire results, we have met the objectives and evaluated the system prototype as very successful and the information that we received from users will provide information to improve future versions of this system.

CHAPTER 6: FUTURE WORK AND CONCLUSIONS

6.1 FUTURE WORK

Many online features are provided by new web technologies for use in courses like interactive demos, self-study quizzes, tutorials and distance education, etc. Spectrum Educational Consulting tool for pre-service teacher training was developed to enhance pre-service teacher training and improve teacher's awareness of the classroom environment and classroom management strategies. As this work has evolved, many teachers have shared their views and opinions. At present the prototype is interactive, but static and in future plans are to make the prototype more dynamic by adding discussion boards, RSS news feeds, forums etc. Discussion boards add interactivity to the application and also allow two-way communication. There are features that have been identified as future work to be added before Spectrum Education can robustly be tested and utilized widely by teachers. All the case studies were animated using HTML5, Gimp (GNU image manipulation program), and Microsoft Power point animations and more case studies need to be added to support entire classroom management class. Adobe Dreamweaver was used as a development environment to write code that achieves animations. As this prototype works on mobile phones, the researcher will plan work on future versions of Spectrum prototype to support even more mobile operating systems and testing of efficiency on other platforms. Other features such as audio can also be implemented in the animated simulations to make the application more interactive and keeps the users more engaged. Also once the application is being used by large number of teachers, we plan to introduce new features into the application such as teacher trainer creation of case studies. An advanced concept that

might be provided in the future is to enable administrators to create scenarios without being involved in the coding process (i.e. end-user creation of scenarios). This involves creation of standard reusable elements like classroom, teacher, students, speech bubbles into a work-frame area, etc. Administrators who will be teacher education specialists can utilize direct manipulation techniques to arrange the standard user interface widgets and elements, and create a scenario. This implementation requires advanced coding and validation. There are also plans for the Spectrum Education prototype to be introduced to teacher training classes at Auburn University. Teachers are more apt in accepting new challenges once they receive training and introduction to this software and instructed in the advantages that this beneficial application will provide to them. The hope of this project once realized will provide major improvements in the teacher training process.

6.2 CONCLUSION:

Spectrum Educational Consulting is a great tool for aiding pre-service teachers to facilitate the classroom teaching process in a way that is interactive and engaging. Using this tool to expose new teachers to more classroom management techniques and more classroom environments will be a wonderful aid for teachers. Spectrum Educational Consulting also allows teachers to practically visualize classroom environments through animated simulations. This tool can also be accessed very easily as it is an online learning environment and works also on mobile phones. The flexibility of the workspace was intriguing, pre-service teachers were open minded about using a new technology and once they found out that the learning environment was easy to use, they were more open to the idea of using this structure. Interactive content is a key when developing online content for learners; we have found that ‘Spectrum Educational Consulting’ provides interactive content that is user friendly to support teachers in their teacher training

process. The style of interaction utilized by these animated simulations will support novice teachers in classroom management and decision-making. These simulations also allow teachers to teach classes in productive ways and also help them to address various classroom challenges.

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APPENDIX A

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2. PROJECT TITLE: Spectrum Education Consulting					
3. Karthik Vemula Graduate Student CSSE DEPT 3347281279 kxv0003@auburn.edu					
PRINCIPAL INVESTIGATOR TITLE PHONE AU E-MAIL					
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5. LIST ANY CONTRACTORS, SUB-CONTRACTORS, OTHER ENTITIES OR IRBs ASSOCIATED WITH THIS PROJECT:					
6. GENERAL RESEARCH PROJECT CHARACTERISTICS					
6A. Mandatory CITI Training Names of key personnel who have completed CITI: Karthik Vemula <input checked="" type="checkbox"/> Cheryl D. Seals <input checked="" type="checkbox"/> CITI group completed for this study: <input checked="" type="checkbox"/> Social/Behavioral <input type="checkbox"/> Biomedical PLEASE ATTACH TO HARD COPY ALL CITI CERTIFICATES FOR EACH KEY PERSONNEL			6B. Research Methodology Please check all descriptors that best apply to the research methodology. Data Source(s): <input checked="" type="checkbox"/> New Data <input type="checkbox"/> Existing Data Will recorded data directly or indirectly identify participant? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Data collection will involve the use of: <input type="checkbox"/> Educational Tests (cognitive diagnostic, aptitude, etc.) <input type="checkbox"/> Interview / Observation <input type="checkbox"/> Physical / Physiological Measures or Specimens (see Section 6C) <input checked="" type="checkbox"/> Surveys / Questionnaires <input checked="" type="checkbox"/> Internet / Electronic <input type="checkbox"/> Audio / Video / Photos <input type="checkbox"/> Private records or files		
6C. Participant Information Please check all descriptors that apply to the participant population. <input checked="" type="checkbox"/> Males <input checked="" type="checkbox"/> Females <input checked="" type="checkbox"/> AU students Vulnerable Populations <input type="checkbox"/> Pregnant Women/Fetuses <input type="checkbox"/> Prisoners <input type="checkbox"/> Children and/or Adolescents (under age 19 in AU) Persons with: <input type="checkbox"/> Economic Disadvantages <input type="checkbox"/> Physical Disabilities <input type="checkbox"/> Educational Disadvantages <input type="checkbox"/> Intellectual Disabilities Do you plan to compensate your participants? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No			6D. Risks to Participants Please identify all risks that participants might encounter in this research. <input type="checkbox"/> Breach of Confidentiality* <input type="checkbox"/> Coercion <input type="checkbox"/> Deception <input type="checkbox"/> Physical <input type="checkbox"/> Psychological <input type="checkbox"/> Social <input checked="" type="checkbox"/> None *Note that if the investigator is using or accessing confidential or identifiable data, breach of confidentiality is always a risk.		
Do you need IRB Approval for this study? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - BUA # _____ Expiration date _____					
FOR OHSR OFFICE USE ONLY					
DATE RECEIVED IN OHSR: 6-27-11 by 6B DATE OF IRB REVIEW: 5/15/11 by KSE DATE OF IRB APPROVAL: 5/15/11 by KSE COMMENTS: original in 4/28/11; renewed APR - KSE 5/15/11 1st revs. in 6/15/11; APR by SRA final revs. in 6/26/11 - approved SRA					

The Auburn University Institutional Review Board has approved this document for use from 5/15/11 to 5/15/12

Protocol # 11-154 EX-1105

RECEIVED

JUN 27 2011

APPENDIX B



AUBURN UNIVERSITY
SAMUEL GINN COLLEGE OF ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

INFORMATION LETTER
For a Research Study Entitled
—SPECTRUM EDUCATION CONSULTING:
Online Animated case study for pre service teachers---

You are invited to participate in a research study to describe your experiences with online educational tools and will be introduced to a prototype in form of animated case studies designed for pre-service teachers. This study is being conducted by Karthik Vemula as a part of his thesis work, under the direction of Dr. Cheryl D. Seals in Auburn University Department of Computer Science and Software Engineering. You were selected as a possible participant because you are a graduate student in Computer Science department at Auburn University and are age 19 or older.

What will be involved if you participate? If you decide to participate in this research study, you will find a link at the end of this letter to an electronic form of textual case study. Once you go through the case study, you will be given a link to an animated version of the case study which is a web page containing animation of the textual case study to assess the usability and effectiveness of the case study in animated form. Next a set of questions relating to overall satisfaction, usability of the prototype will be given to you via another link to select an answer from a list of selections provided. This survey will be used in the future to refine our design and research. The approximate time for completing the case studies and the survey will not exceed 10 minutes.

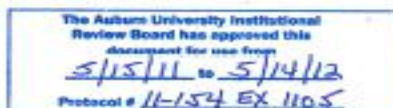
Are there any risks or discomforts? There are no anticipated risks associated with this study.

Are there any benefits to yourself or others? Information collected during this study will help us identify how effective and intuitive the prototype environment is and how it rates in comparison to textual case study content and also in further usability development of the prototype.

Will you receive compensation for participating? No compensation for participation will be given.

Are there any costs? There are no costs associated for participating.

If you change your mind about participating you can withdraw at anytime during the study by simply closing your browser. Once you've submitted anonymous data, it cannot be withdrawn since it will be unidentifiable. Your decision about whether or not to participate, or to stop



participating, will not jeopardize your future relation with Auburn University, Department of Computer Science and Software Engineering.

Any data obtained in connection with this study will remain anonymous. Your name, email address and other identifiers are not collected during the survey and will not be associated with the data provided. Information collected through your participation may be used to publish in professional journal, conference submissions, thesis and dissertations and/or presented at professional meeting.

If you have any questions about this study, please ask them now or contact Karthik Vemula at rve0001@auburn.edu (334 728 1279) or Dr. Cheryl D. Seals at sealscd@auburn.edu (334 844 6319)

If you have questions about your rights as a research participant, you may contact Auburn University office of Research Compliance or The Institutional Review Board by phone (334)-844-5966 or e-mail at hsubjec@auburn.edu or IRBChain@auburn.edu

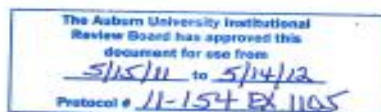
"The Auburn University Institutional Review Board has approved this document for use from May 15, 2011 to May 14, 2012. Protocol #11-154 EX 1105."

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. IF YOU WISH TO PARTICIPATE IN THIS STUDY PLEASE SELECT YOUR CHOICE BELOW

Clicking on the "agree" button below indicates that:

- You have read the above information
- You voluntarily agree to participate
- You are at least 19 years of age

If you do not wish to participate in the research study, please decline by clicking on the "disagree" button.



APPENDIX C QUESTIONNAIRE

SYSTEM USABILITY									
1) Overall, I am satisfied with how easy it is to use this system?									
	Strongly disagree							strongly agree	N/A
Overall reaction to the system:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) It was simple to use this system.									
	Strongly disagree							strongly agree	N/A
Overall reaction to the system:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) I can effectively complete my work using this system.									
	Strongly disagree							strongly agree	N/A
Overall reaction to the system:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) I am able to complete my work quickly using this system.									
	Strongly disagree							strongly agree	N/A
Overall reaction to the system:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) I am able to efficiently complete my work using this system.									
	Strongly disagree							strongly agree	N/A
Overall satisfaction to the system:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) I feel comfortable using this system.									
	Strongly disagree							strongly agree	N/A
Overall reaction to the system:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) It was easy to learn to use this system.									
	Strongly disagree							strongly agree	N/A
Overall reaction to the system:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8) Please give us your reflections on learning while using the system.									
	Difficult	2	3	4	5	6	Easy	N/A	
Understanding the content	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Time to learn to use this system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. Rate the system Usability:

Dull

2

3

4

5

6

Stimulating

Overall Reaction to the system

10. Rate the system Usability:

rigid

2

3

4

5

6

flexible

Overall Reaction to the system

11. Rate the system Usability:

terrible

2

3

4

5

6

wonderful

Overall Reaction to the system

12. Rate the system Usability:

frustrating

2

3

4

5

6

satisfying

Overall Reaction to the system

13. Layout/Colors of the interface is visually appealing.

Strongly disagree

strongly agree

N/A

Overall Reaction to the system

INFORMATION QUALITY

1) It is easy to navigate through the scenarios



2) The information provided in the system is easy to understand.



3) The information is very much helpful for me to prepare for classes.



4) The organization of information in the scenarios is clear.



5) Based on this experience, I will use Spectrum to access the course materials in the future?



6) This environment provides broader access than currently available course delivery options



7) I will recommend the tool to others



8) I was able to practically visualize the classroom environment through animated simulations



9) Reflection Questions allowed me to think about different problems that I could face while teaching classes

	Strongly disagree							strongly agree	N/A
INFOQUAL	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10) Interaction between scenarios improved my critical thinking and reflection skills.

	Strongly disagree							strongly agree	N/A
INFOQUAL	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11) Feedback to the reflection questions though animation was more helpful than the textual form.

	Strongly disagree							strongly agree	N/A
INFOQUAL	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12) List the most positive aspect(s):

1.
2.
3.

13) List the most negative aspect(s):

1.
2.
3.

INTERACTION QUALITY

1) The interface of this system is pleasant.

Strongly disagree strongly agree N/A

INTERQUAL ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

2) I like using the interface of this system.

Strongly disagree strongly agree N/A

INTERQUAL ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

3) This system has all the functions and capabilities I expect it to have.

Strongly disagree strongly agree N/A

INTERQUAL ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

4) Overall, I am satisfied with this system.

Strongly disagree strongly agree N/A

INTERQUAL ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐