Open Source Software Development

Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat.

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Research

The United States is in need of a way to engage students in science and increase performance. According to a study conducted by The Organisation for Economic Co-operation and Development (OECD), the United States is ranked as the 24th best country for science and scored below the average of the 65 countries included in the survey. Widspread apathy leads to teahcer’s inability to engage students; parents and students generally aren’t as passionate about learning as in other nations. (Roth). The United State’s ranking in science and ubiquitous apathy among students and teachers demonstrate the need to improve the quality of science education in the United States.

The apathy common in schools among students, teachers and parents is anathema to quality science education in the United States. This widespread apathy effectively decimates the ability of teachers to provide information that will be remembered to students, setting us behind the rest of the world (Crogham). Teachers are unable to engage students in their work, contributing to students’ apathy (Bishop). To begin to increase the quality of education in the United States, teachers must be able to engage students.

To engage students and combat apathy, teachers can use simulations and demonstrations that relate the material to students. Demonstrations in science have a proven affect on the ability of students to learn, increasing their retention of information drastically (Mile). Because of the noticeable affects of using demonstrations, teachers can implement them to increase the quality of education in their classes. (Shakhashiri). By using more demonstrations, teachers can combat apathy and improve education in the United States.

The Problem and Our Solution

*Catalyzing genuine interest in the age of apathy*

The cause for the United State’s subpar performance in science is caused by acute cultural differences between the United States and the countries that scored exceptionally (Steiner). Small, legislative changes could help; however, a partisan national government has caused the last Congress to be the second least productive in modern history, decimating the chance of legislative reform to the educational system (Murray). Since national changes are unlikely, the United States needs a grassroots movement to increase the quality of education.

With application in numerous other fields of science and in the creation of modern technology, physics is one of the most fundamental branches of science (*Why Physics?*). Studying physics is shown to increase performance on standardized tests and help students learn to study other areas of science (*Why Physics?)* By learning to teach physics more effectively and increasing the quality of physics education, teachers can improve the condition of science in the United States.

One of the primary obstacles teachers face in increasing the quality of science education is ubiquitous apathy among students. In the United States, disengagement among high school students is an epidemic: 40% of high school students report being disengaged in school (Crotty). This problem is exacerbated by traditional methods used to teach physics, which are characterized by a passive student listening to a teacher lecture. These methods are ineffective in engaging students and, therefore, are ineffective in teaching physics. (Dufresne). To increase the quality of science education in the United Sates, teachers must address the problem of disengagement caused by conventional methods used to teach physics by working to engage students.

Our project empowers teachers to separate themselves from traditional teaching methods and engage their students. Our project utilizes interactive learning modules that relate content to students by providing them with interactive, visual examples of content. Rather than propagating antiquated lecture intensive teaching techniques, instructors will be able to provide an overview of content and allow their students to use the simulations contained in our project to further investigate principles of physics. By enabling teachers to engage students with interactive, graphical examples, our project will decrease apathy among students, increasing the quality of science education in the United States.

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Plan of Work Log

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date | Task | Time involved | Team Member(s) Responsible | Comments |
| 1/6/15 | Made outline for project | 2 hours | Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat. | We were successful in making the outline of the project. We will meet again on the weekend to review the tools we will be using. |
| 1/10/15 | Reviewed JavaScript | 1.5 hours | Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat. | We reviewed JavaScript and talked about how we will use it in the project. Next meeting has been scheduled for next week. |
| 1/13/15 | Came to a conclusion on the proper way to do the project. | 3 hours | Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat. | At the advice from the seniors, we redid the outline for the project, deciding to take it in another direction. We will now use Java and make an applet. |
| 1/20/15 | Discussed project, found a problem. | 45 minutes | Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat. | Today, we started narrowing down the problem we will solve. We decided to teach something. Still deciding what to teach. |
| 1/27/15 | Found what problem to solve | 1.5 hours | Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat. | We decided to make a physics simulator to solve the problem of lack of engagement in physics classes. Still narrowing down what in physics to teach. |
| 2/2/15 | Decided what topics to teach | 30 minutes | Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat. | We decided to teach Kinematics, Forces and collisions in the physics simulator. Andrew will research a way to do this for next meeting. |
| 2/7/15 | Researched Physics Simulator | 1 hour | Andrew Spencer | Spent time looking for a good framework with which to build our project. Found something that looks promising. |
| 2/8/15 | Downloaded Physics Simulator, got working | 3 hours | Andrew Spencer | Downloaded the simulator and spent time figuring out how to properly implement it. |
| 2/9/15 | Wrote documentation on Simulator | 1 hour | Andrew Spencer | Wrote example code on how the simulator will work and wrote documentation on how to use it. |
| 2/10/15 | Discussed simulator | 1.5 hours | Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat. | We talked about the simulator and how it will work, reviewed example code, and planned how graphics are going to work. Vinit will implement graphics for next meeting. |
| 2/13/15 | Worked on implementing graphics | 30 minutes | Vinit Ranjan | Wrote a graphics window for the graphics to take place in. Started on making graphics working. |
| 2/15/15 | Worked more on implementing graphics | 3 hours | Vinit Ranjan | Started working more on how graphics will work. Only have one bug to fix before graphics are finished. |
| 2/16/15 | Fixed bug | 45 minutes | Vinit Ranjan | Fixed the bug. The simulator now shows a box falling from the sky. Should be a good demonstration on how graphics work. |
| 2/17/15 | Vinit presented graphics, assigned tasks and due dates. | 1 hour | Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat. | Vinit showed how graphics are going to work. We established that progress needs to be made on everyone’s part by the end of tri break. |
| 2/21/15 | Finished writing documentation | 1.5 hours | Andrew Spencer | Wrote more documentation on how the project is going to work. |
| 2/21/15 | Started outlining simulation | 2 hours | Sunwoo yim | Started planning how my simulation is going to work .Spent time reading the documentation. |
| 2/22/15 | Read documentation, understood simulation | 1 hour | Vikram Aikat | Read the documentation and started to understand how graphics is going to work. |
| 2/23/15 | Outlined simulation | 3 hours | Vikram Aikat | Outlined how my part of the simulation is going to work. |
| 2/23/15 | Started coding simulation | 2 hours | Vinit Ranjan | Started working on the coding of the simulation. Expanded the graphics currently in the simulation. |
| 2/24/15 | Started writing research | 1.5 hours | Andrew Spencer | Started writing up research for the project. |
| 2/25/15 | Started on kinematics | 4 hours | Sunwoo Yim | Found how DVAT Equations will be taught, made an environment in which the simulation will run. |
| 2/26/15 | Made environment | 3.5 hours | Vikram Aikat | Make environment for forces. Made different bodies to be acted on by the forces. |
| 2/26/15 | Worked on kinematics | 2 hours | Sunwoo Yim | Worked on filling the content on the kinematics simulation. |
| 2/28/15 | Started working on content of simulation | 2.5 hours | Vinit Ranjan | Worked on filling in the content for my part of the simulation. |
| 3/1/15 | Kept researching | 3 hours | Andrew Spencer | Finished writing the research for the project. Started on writing the design. |
| 3/1/15 | Finishing up simulation | 4 hours | Sunwoo Yim | Finishing the content for the simulation. Working on a lot of bugs. |
| 3/2/15 | Expanding graphics | 2 hours | Vikran Aikat | Made the graphics in my part of the simulation better. Worked on ensuring that the simulation teaches others. |
| 3/3/15 | Presented progress | 1.5 hours | Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat | Presented our progress on our parts of the simulation. Decided that we will have a draft of all of our parts of the simulation by next meeting. |
| 3/6/15 | Drafted simulation | 4 hours | Sunwoo Yim | Finished up the draft of the simulation (finally), will present |
| 3/6/15 | Worked on content | 2 hours | Vikran Aikat | Worked on the content of the simulation. Made the bodies the forces act on more responsive. |
| 3/7/15 | High-level design and project requirements. | 3 hours | Andrew Spencer | Finished up these two sections of the report. |
| 3/8/15 | Drafted simulation | 5 hours | Vinit Ranjan | Finished Drafting my part of the simulation. Will take bugs to the next meeting. |
| 3/8/15 | Finished up simulation | 3 hours | Vikram Aikat | Finished doing my part of the simulation. No bugs that I noticed. |
| 3/9/15 | User documentation | 2 hours | Andrew Spencer | Talked to other members of the team, started working on the user documentation. |
| 3/10/15 | Worked on bugs | 4 hours | Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat | Spent time going through the bugs in everyone’s program. Parts of the simulation seem to be working. |
| 3/13/15 | Worked on main page | 2 hours | Andrew Spencer | Spent time working on the main page for the simulation. |
| 3/14/15 | Finished main page | 4 hours | Andrew Spencer | Finished the main page for the simulation. Got all the parts working together. |
| 3/15/15 | Wrote reflection | 45 minutes | Vinit Ranjan | Wrote the reflection on my part of the project and how I did. |
| 3/15/15 | Did reflection | 1 hour | Sunwoo Yim | Wrote my reflection. |
| 3/15/15 | Reflection | 30 minutes | Vikram Aikat | Did the reflection for how my part of the simulation went. |
| 3/17/15 | Meeting | 30 minutes | Andrew Spencer, Sunwoo Yim, Vinit Ranjan, Vikram Aikat | Talked about how project went. |

Advisor’s signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Project Requirements

In planning a software project, it is important to consider the market for the product. There is no reason to spend time developing a product that will not be used. A product is especially marketable if it has considerable society value: the product should solve a widespread problem. To validate the market of a product, it is important to talk to those the product is marketed to. In addition to having an audience, the product needs to be able to interact with the audience, solving their problem in an elegant, engaging way. The requirement of a good product is one that engages the user and solves a problem; a product must have societal value. By addressing the audience of the product, the developer can effectively determine what product to build and how to effectively build an interactive application. In designing our product, we first went to teachers in our school to determine how to solve the problem of the United State’s ranking in science. Through interviewing these teachers and reading about the subject, we learned that apathy is the main cause of our subpar ranking. The teachers informed us that students generally don’t care; they are not engaged in learning. By meeting with these teachers, we learned that designing a product that engages students would have dramatic societal value.

These interviews helped us to fulfill the requirement of a software project by enabling us to determine how to ensure our product has societal value and is engaging. To combat the apathy that the teachers we met with described, we decided to build a simulation that would engage students. By fighting apathy by engaging students, our product helps to solve the problem of the United State’s ranking in science education. The great benefits of solving this problem demonstrate that our product is wanted.

High-Level Software Design

To optimize the scalability of our project and ensure that it is easy to develop in parallel, we decided early that the projects would consists of different modules all accessible by one main menu. Having all of the modules only loosely linked together would enable to team to make the modules separately, and combine them when they are done. Given the nature of our team, it was not practical to have a more interdependence product.

In addition to deciding early the different modules would all be linked to a menu, we decided early to use a physics engine in making the product. Using an engine would allow us to focus more on the content of our product, rather than getting distracted with how to program the minor details. To standardize the use of this engine, JBox 2d, we wrote documentation on how the engine should be used and provided an example of how to use graphics with the engine. By providing examples of how to use graphics with the engine, we ensured that we would be able to combine the different modules. The design of our product is characterized by pragmatic compartmentalization.

Testing

User Documentation

Team Evaluation

*Andrew Spencer*

During the project, I served as the leader of writing the documentation and the project manager. Given that this is a software based competition, it was often frustrating having to take on the more tedious part of software development. I was in charge of making the documentation for the project, writing guides on how to use the physics engine that we chose to implement while making the project, helping other team members with their problems, and making a multimedia presentation that showcased our work. I felt like we did well in planning our work, delegating who had to do what parts, and we worked well together as a team. I believe that the primary area we can improve on for next time is designing the project so that it comes together well at the end. We designed it separately, so bringing it together was hard to do at the end. As project manager, this was primarily my fault. For continuing to work on the project in the future, we will standardize how to format the modules and allow other developers to contribute.

*Sunwoo Yim*

While working on the project, I struggled with completely understanding the physics engine we were using. To improve on the project for next time, I will read the documentation more and not jump into programming right away. I felt like I budgeted my time well: I was able to get a lot done over breaks, and I was able to get help when I needed it. I was responsible for the part of the module that taught DVAT equations. The physics of the module was not difficult to understand; I felt like I had the necessary background information. This project provided a good lesson in software development, one which will aid me in future projects.

*Vinit Aikat*

I was responsible for the part of the module that dealt with energy. I am very experienced with math and physics, so the information I was trying to convey was not challenging for me to understand. I was in AP Computer Science this year, and we were doing work that related to the work I needed to do for the project, so I was able to use the information I learned in class to work on the project. I felt like I did well on the project, but I didn’t always manage my time well. To improve on the project in the future, I will ensure that I am better in managing my time.

*Vikram Aikat.*

I thought that our work on the project went well, but we could have been better at communicating. I do not feel like our weekly meetings were that helpful, they often felt like time not spent well. We should have made sure that the different parts our simulation fit well together at the end. We all worked on our different parts and did them well, but the final product was hard to get to fit together. Meaning: we had trouble making one uniform interface with which we could use all of the parts of the simulation. I thought that my work on the simulation went well, I budgeted my time well and got my part of the simulation done with time to spare.

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A physics engine JBox 2d was used in making this project. Source: www.jbox2d.org