Technology Solutions for Increased Student Motivation

Player Experience Design in Software-Based Learning Systems

by

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Introduction

As the widespread adoption of the Internet changes the way information is distributed and consumed, emergent digital media platforms provide new modes for skill training and education. *Software-Based Learning Systems (SBLS)* provide cost-effective solutions to allow teachers to spend more time with students.

I have implemented several design schemes during my career at Purchase College using free and often open-source platforms. In this paper I will share my work exploring the potential of software for learning and skill-training using examples of designs I have created. Software interface designs for learning I have done for software that relates to learning are:

- Interactive visualizations of mathematical and logical concepts
- Instructional videos presented in a web environment
- **Student Loans**, challenge-based educational application
- Search interface **Bibliofy** with accompanying auto-generated keyword cloud
- User interface design for Moodle-style classroom web software
- Games, ones which include cultural, conceptual, and historical information

The *'Learning'* in *'Software-Based Learning Systems'* is important to define as the intended goal of an educational platform. *Learning* is broadly defined as the ability to acquire new or transform existing knowledge, skills, or behaviors (Pereira). More specifically, *learning* is "a process which leads to the modification of behaviour or the acquisition of new abilities or responses, and which is additional to natural development by growth or maturation" (Oxford-English Dictionary).

'Pedagogy' is "The art, occupation, or practice of teaching. Also: the theory or principles of education; a method of teaching based on such a theory" (OED).

'E-learning' is:

> any form of education or training that uses computer technology as an essential part of the teaching process. The term covers a broad range of goals and methodologies, but two features frequently found are that computerized data and programs substitute partly or completely for the human teacher; and that students engage with all or part of the course remotely, for example over the

> Internet from their homes. (Daintith)

SBLS categorically encompass educational games, electronic learning (*e-learning*), and mobile learning (*m-learning*). One subset of *SBLS* is *'Digital Game-Based Learning'* (Lothian, Ryoo), referred to hereafter by the acronym *DGBL*, which uses fictional narratives to immerse and motivate students (Beserra, Annetta, Malone, Lothian). More broadly, *SBLS* do not necessarily depend on participant immersion in a fictional world to maintain participant engagement and motivation, as do games. Likewise, they are not necessarily used outside of the classroom as is implied by the terms *'e-learning'* and *'m-learning.'*

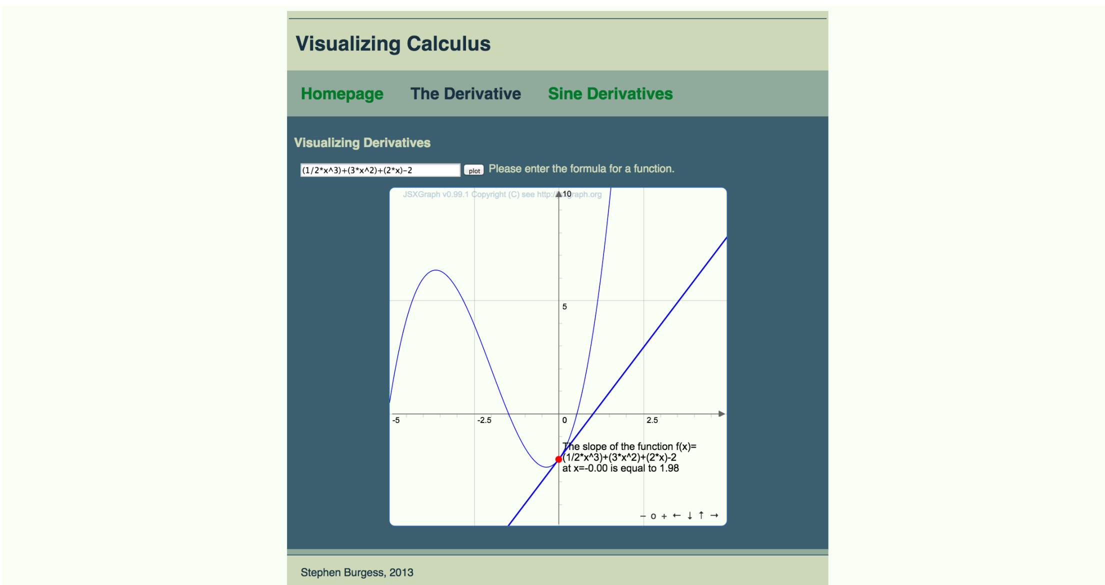

Figure 1: Visualizing Calculus

In the example of **Visualizing Calculus** (Figure 1: Visualizing CalculusFigure 1), I created an interactive graph to help students understand what a derivative is. In this example, students could input any formula that falls in the range of the graph, then can trace along with their input devices the derivative along any point on the line. Being able to see how the derivative changes from point to point in an interactive graph on any inputted formula is just one powerful way that software can aid in learning and subject comprehension.

Software-based learning enjoys a valuable characteristic after the process of design and implementation is complete: immediate individualized feedback. Other benefits include processing and tracking numerous data points about student performance, responsive and flexible frameworks that allow for continual improvement and adaptation, and access asynchronicity providing expanded options for engagement outside the classroom. "Asynchronous mechanisms allow players to freely choose when they play, and they do not have arrange [*sic*] a time before playing." (Chien-Hung) The modularity and capability of randomness inherent in *SBLS* especially lend themselves towards designing learning exercise of rote, such as math homework or French vocabulary training with randomly generated problems. Immediate feedback provides motivation and lets students know right away if they are able to grasp the concept of a topic. With less busy work of grading homework or exercises, teachers can spend more one-on-one time with students already knowing what topics to address.

Survey of Literature

Studies have concluded that games can be an effective pedagogical tool: "The use of computer games favors the development of complex thinking skills related to problem solving, strategic planning, and self-regulated learning" (Beserra). Since "97% of students between the ages of 12 and 17 years old play video games" (Lothian and Ryoo), it is a form with near-universal appeal. However, the use of educational games does not result in higher subject comprehension compared to equivalent non-narrative digital instruction. Digitally-assisted instruction in a physical classroom setting, whether constructed as a game or not, produced higher subject comprehension than typical instruction methods that didn't use software (Beserra). Considering that fact, this paper will discuss software-based learning systems as a whole and not be limited exclusively to software with narratives, or software intended to be accessed outside of the classroom. *SBLS* do not need to have a narrative component, nor must they be used outside of a classroom setting. If the ecosystem of apps intended to be used in a classroom setting grows, this technology would be more available to under-supported school. Therefore, while initial investments are comparable or slightly more than textbook-based instruction, software does not become completely obsolete in two years or less as do some textbooks. This is because software can be changed, whereas books end up in landfills.

Lacking a term to sufficiently encompass all of these software options, I will discuss software-based learning as a whole using the acronym *SBLS*. However I will relate the finds on studies done on *DGBL* game learning to *SBLS*. For instance, Ryoo found that "[digital] games have also been demonstrated as an effective way to close learning gaps among previously underperforming students." Considering that studies did not find significant differences in learning outcomes between the two, besides a higher motivation to play *DGBL* games over other *SBLS* applications, I will hold Ryoo's observations on games to also hold for non-narrative instructional software. Continual development in this field, and expansion upon existing offerings is necessary in order for *SLBS* to be most effective and well understood. "In game-based learning *[DGBL]*, if the same system is used continuously, long time use would result in lowered curiosity or even annoyance at the system, resulting in decreased learning motivation" (Lai). Once systems are developed, they must be continually expanded upon and updated in order to maintain the advantage of student engagement. So while there are many effective offerings already extant, the process of continual investment and development must be emphasized for most effective results.

Though SBLS as a category do encompass *Massive Open Online Courses (MOOCs)*, and though software is often an integral part of *MOOCs*, the fact that they are online and intended to be used massively (in other words, with many users who have minimal to no interaction with a teacher) puts them outside of the scope of what other literature I cite. *MOOCs* have faced serious and increased criticism as their use has grown (Fischer, Parry). The essential separation of teacher and student a serious of this system due do the primary role of guidance that teachers play in students' learning experience. In the use of *interpersonal computers* for instance, engagement with software allows more time for a teacher to give individualized attention to students. In the video "This Will Revolutionize Education" by popular online educational video-maker Veritasium, Muller makes the point that many technologies have offered the potential to revolutionize education without delivering in the end. This is due to the powerful role of teachers in a role of learning guide and diminishing returns of an increased classroom size enabled by technology options. As such my argument is not to increase classroom sizes significantly, but simply to allow teachers to spend more time in a guidance and advisory role to students.

The United States is consistently given scores of average or below average for quality of education and is often ranked around 20th in the world (OECD, Pearson) despite spending the most on post-secondary students ($25,576) in relation to gross-domestic product per capita (NCES). Worldwide, literary rates are around 84% as of 2010. The largest concentrations of the world illiterate are located in India, China, and Pakistan (CIA) and three-quarters are women. In the United States, states spend an average of $10,608 per pupil each year for public elementary-secondary schools (Dixon). Further development of educational regimens is needed in the United States in order to achieve more cost-efficient education as well as universal literacy worldwide. If the cost-efficiency of education improved following the integration of software into the learning process, increased accessibility could only promote educational equality. Beserra found in 2014 that the learning impact of technology-based exercises "was significantly greater among students who were initially in the less knowledgeable half" of the groups in the study. ****On the other hand, in the implementation of *Massive Open Online Classrooms (MOOCs)* showed that the students who succeeded from this form were the same ones who were already motivated to succeed. As such, adoption of *SBLS* depends on situation, and may only be a benefit for students already enrolled in classes. However in a classroom setting, *SBLS* promise to most benefit underperforming students, the same ones who have a greater need for individualized feedback. Overall, adoption would expand educational opportunities and increase the efficacy of educational regimens in struggling and underfunded schools.

One especially cost-effective model is the *interpersonal computer*. In this setup, a group of students all have input to a single computer and a single shared screen.

"With an *interpersonal computer*, multiple users located in the same space share one output device, like a computer screen, but each user has their own input device that they use to interact simultaneously with the virtual world" (Beserra). Having to purchase a set of input devices rather than individual computers for a classroom could provide many of the benefits of software-assisted learning while keeping the cost low per student. Pereira found that "a team-based game can lead to better performance results, a better learning process, and better cognitive development." Attracting and maintaining student engagement through active, social engagement in learning activities could serve to alleviate some of the strain of passive learning experienced in secondary education as outlined by Strauss in her 2014 article "Teacher Spends Two Days as a Student and Is Shocked at What She Learns" in the Washington Post. Of course this would not completely replace traditional chalkboard instruction. Software would be just another tool to use in pedagogical settings, but it would be an important one. If buying a full-set of computers for one classroom is unrealistic then the *interpersonal computer* offers a more cost-effective model.

Existing *SBLS* technologies such as Khan Academy, Lynda, Code Academy, Code School et al. already provide opportunities for subject training for free or at low cost. Khan Academy, the most well known of online learning platforms, enjoys 10 million unique viewers per month as of February 2014 (SRI International). The micro-tutorial videos Salman Khan produces are a low-cost resource for independent learners. Kolås (2012) explores in greater depth the use of *Easy Production Educational (EPE)* videos as a cost-effective pedagogical tool. *EPE* videos only need minimal equipment to produce, using a computer with a microphone and using inexpensive screen capture software can record a short pedagogical video. Filming an instructor at a chalkboard or a white board is another kind of *EPE* video since it requires very little to produce beyond a computer and a camera.

Kolås' study found that "it is more efficient to work with the subjects based on an inquiry-based approach, making the students ask questions and wonder about why different mathematical formulas are defined the way they are." This is in contrast to the traditional format of a chalkboard lecture. In *m-learning (mobile learning),* such as the style of the *flipped classroom*, students can access *EPE* videos remotely, and can watch them on their phones while commuting or at home. Then, when they get to the classroom, students focus on exercises, what would traditional be homework, with the teacher on hand to provide support at the very moment the student is struggling. In this case, the transmission of knowledge takes place when it is most convenient for everyone involved. Then, when students are in class they have access to teachers to provide guidance. The unusual style of the *flipped classroom* is made possible by the use of *EPE* videos. Now imagine if students could also do practice exercises without having to go to another page. Then, more classroom time could be dedicated towards students practicing exercises or more social learning activities generally.

Looking forward, *e-learning* and *m-learning* both offer new possibilities to reshaping the educational experience. *Bring-Your-Own-Device (BYOD)* offers one of the most cost-effective models, but requires strict control of device use in classrooms that would present its own challenges (Bruder). With *BYOD* learning, students navigate to web software with their mobile devices and use them in class. This way, the school does not need to purchase computers for students. However without a healthy and robust ecosystem of existing software platforms for mobile devices, *BYOD* and *m-learning* models will struggle to gain traction.

The relationship between instructional content and its motivational appeal is important in building an effective *SBLS* platform. Motivational appeal can be built through contextual understanding of a subject's importance, but it can also be built through creating engaging experiences. "*Intrinsically motivated learning* [emphasis added] is learning that occurs in a situation in which the most narrowly defined activity from which the learning occurs would be done without any external reward or punishment." (Malone and Lapper). One *SBLS* site, Khan Academy, has 10 million unique visitors a month. This speaks highly of how successfully the platform has created an *intrinsically motivating* learning experience through their videos and challenges. Software that does this most successfully puts students in a state of *flow*.

Csikszentmihalyi (1990) defines *flow* as "the state in which people are so involved in an activity that nothing else seems to matter, the experience is so enjoyable that people will do it even at great cost, for the sheer sake of doing it." *Flow* consists of eight elements (Sweester):

1. a task that can be completed
2. the ability to concentrate on the task
3. that concentration is possible because the task has clear goals
4. that concentration is possible because the task provides immediate feedback
5. the ability to exercise a sense of control over actions
6. a deep but effortless involvement that removes the awareness of the frustrations of everyday life
7. concern for self disappears, but sense of self emerges stronger afterwards
8. the sense of the duration of time is altered

The main types of learning—"auditory, visual, and kinesthetic" (Pereira) should be considered when designing educational software, though the brunt of the work will fall in the visual category. Two important considerations are balancing the cognitive load and providing advice and feedback. Annetta created the six "I"'s of educational game design. The six I's are as follows:

1. *Identity*
2. *Immersion*
3. *Interactivity*
4. *Increasing Complexity*
5. *Informed Teaching*
6. *Instructional*

Identity, as discussed in the last section, can be built through such methods as allowing for choice and customization of in-game personas through avatars, name customization, in-game professions and through many other means. "One of the critical issues in designing educational games is to sustain student motivation over time during gameplay" (Eseryel). Creating a strong in-game *identity* won't lead to better test scores; it will put the reins of education into the students hands. *SBLS* could provide children and learners of all ages with a more active role in their own education. *Identity* is a factor of becoming *immersed* in a virtual world, as are *interactivity and increasing complexity*. Greater *immersion* leads to finding a *flow* state, thus greater engagement in the learning process. Incorporating fictional narratives into a learning module is intended primarily to elicit student *immersion* in the game and student *identification* with their in-game avatar (Chien-Hung, Sweetser). This *immersion* is intended to promote motivation and engagement with the material in game, and to make the learning module intrinsically motivating.

"*Informed Teaching*" and "*Instructional*" are two factors that are applicable outside of the scope of educational software design that feature a narrative element. Utilize strong feedback cycles to tune the learning experience to address specific needs.

Student Loans

In my **Student Loans** application (Figure 2), I set the task to the learner of having a greater understanding of student loans by the end of the experience. I used minimal design elements to encourage concentration on the subject, one that is usually not a part of general curricula. The key concept with which this application engaged was compound interest. The concept of "Annual Percentage Rate" can be misleading to people unfamiliar with loans. Considering compound periods are generally per month instead of yearly, and can be of any variety of time frames, interest gained on loans is usually functionally higher per year than the stated rate. This application aimed to educate students on concepts such as the loan principal, how often interest compounds, and how much interest will be paid over the life of the loan. These numbers should be part and parcel of any loan agreement, and calculations for cumulative student loans should be done every time the principal amount increases through new loans, which for many students happens every semester.

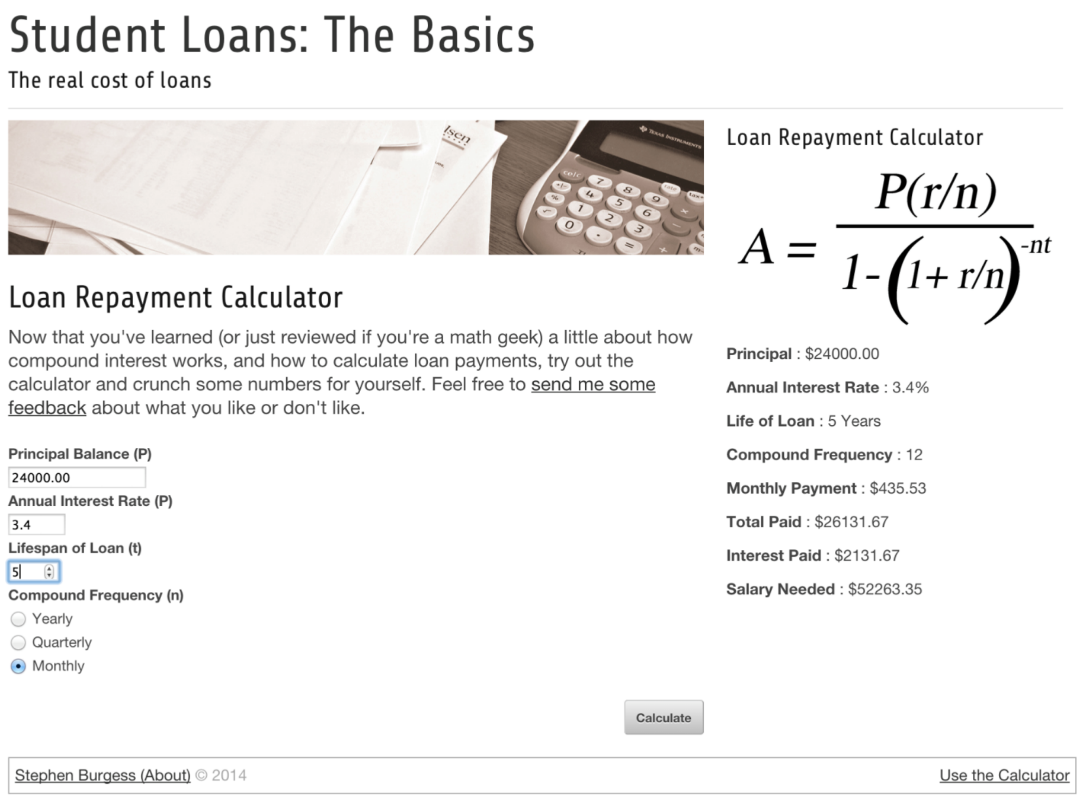

Figure 2: Student Loans

Through the use of three quizzes (Figure 3), I engaged students with the concepts presented in each informational section. According to Leemkuil, "learners need to be prompted for reflection to occur." Without a warning, the pop quiz reinforces the need to do close reading in each section. For those without finance training, I estimate that the entire application would take 20-30 minutes to work through with close reading. One friend who I asked to use the application to learn about student loans commented that the information sections could be rewritten to use clearer and more concise language. While she said the language was grammatically correct and made sense, it could be redone to be less dense. This is a note I've received on other writing that I've done. Having short, clear sentences lets readers move smoothly through material.

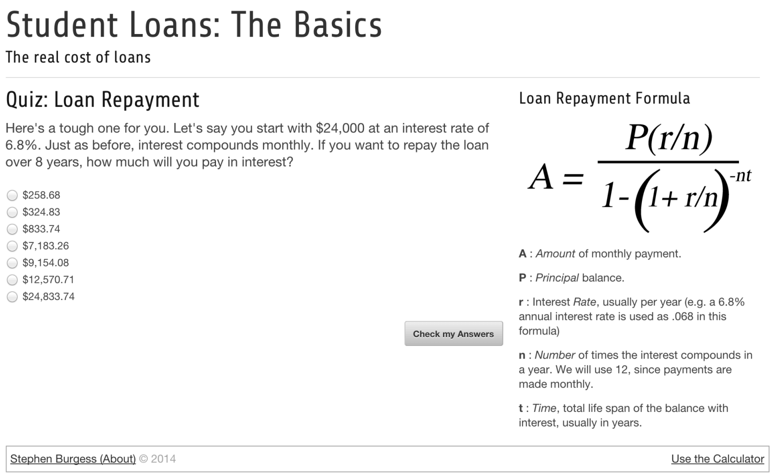

Figure 3: Student Loan Quiz

Design should be as transparent as possible. That is, the design choices of an interface including layout, buttons, typography, color, and so on should not draw attention to themselves. The less cognitive effort put into understanding an interface, the easier interaction with the software will be. Warde (1956) wrote that typography should be like a crystal goblet, allowing the meaning of the content to be read clearly without being obscured. Extending that concept to interface design means following a strategy of simplicity, clarity, and convention. This was a struggle for me as I developed my design aesthetic. In my earlier projects, I liked to break convention and use bold colors or unusual symbology. In feedback I received for my *Student Loan* education application (Figure 3), I never received notes that it was hard to understand, slow, or distracting. I view the lack of negative feedback as positive feedback that the design choices were not distracting or garish.

Other feedback I received from my professor, Irina Shablinsky, was that the loan calculator could have been standardized to existing loan interfaces such as for mortgage repayment calculators. Having a format that fits in with existing conventions is an easy and simple way to create transparent design. Giving monthly repayment values, monthly interest values, and other information couched in conventional language is most often an ideal way to communicate new information to learners. Although most people who are interested in learning about student loans would not have experience with mortgage interfaces, some way. Even if they don't, they most likely will later encounter mortgage calculators, and so my role as an interface designer goes even so far as to prepare learners for those later experiences to minimize cognitive overload.

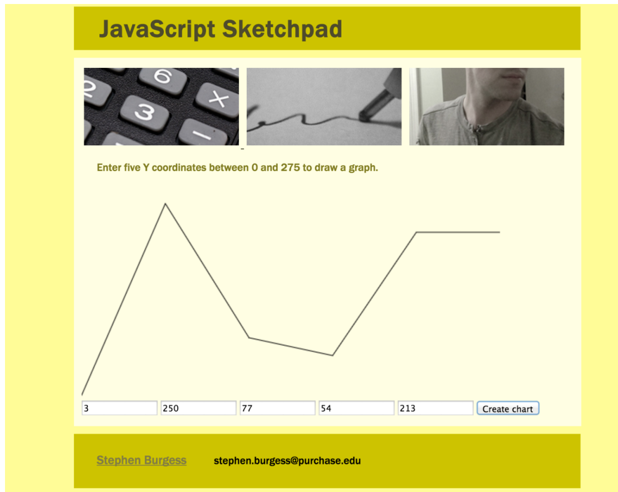

Figure 4: JavaScript Sketchpad

In some of my previous work at Purchase College such as *Bibliofy* (Figure 10: 'Bibliofy' Search Interface, 2013) and the JavaScript grapher (Figure 4: JavaScript Sketchpad), I made bold color choices that feedback showed distracted from the software's purpose. While these colors appeal to me personally and I believed would provide an exciting flare to simple flare, I have come to believe through feedback from professors Hakan Topal and Peter Ohring that opting for cleaner and simpler design schemas is the wiser option for user interfaces.

Astrablade Game

Transparent design is just one component of building player engagement. It prevents confusion and frustration, allowing the content to reach its audience. *Interactivity* (that the student has agency in the learning environment, and that her actions have measurable effect) is another important motivator. *Interactivity* is also one of Annetta's "six I's of educational game design" as explored in the next section.

"Not only has the provision of choice been shown to enhance intrinsic motivation per se, it has also proved a significant variable in a variety of motivational paradigms" (Malone and Lepper). Choice was found to be an effective tool for building student interest even when it only gave the illusion of control to the players without any actual effect in the program. Interestingly, even the false illusion of agency may be more effective at sustaining student interest than when student actions do create change but the effects are imperceptible.

Figure 5: Astrablade Name Generator

The game **Astrablade** was designed around the idea of a non-linear experience for players, one determined by the series of choices they made. One of the first choices players are presented with is the choice of what name they would like to use in the game world. For this I wrote a fantasy name generator in JavaScript (Figure 5). After choosing gender and degree of familiarity, this widget generates a name from options of prefixes and suffixes. In the feedback I received on this, most players generated names that sounded strange and unfamiliar, even when using the familiar option. This is an effect of English names inheriting from Germanic as opposed to Romantic languages. In Latin and languages that have evolved from it, names are more often made of a prefix (Jul-) and a gendered suffix (–ia and -ius) in the case of the names Julia and Julius. I built the widget with this in mind, but the effect was not understood as well as it would be for speakers of Romance languages. One key consideration for me in the creation of the name generator was to allow for third-gendered name endings. This was to encourage thought in players of moving beyond the cultural construct of a gender binary (i.e. only male and female) to be inclusive of options outside that range. In this way, choosing a name and being offered a choice for third gender would lead to engagement with broader cultural issues as an ancillary activity in the game world.

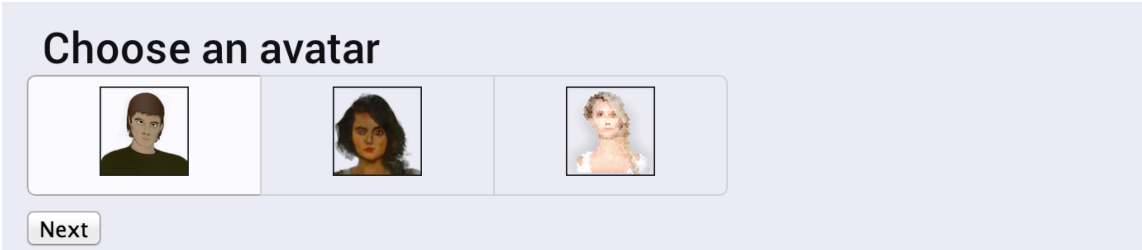

Figure 6: Astrablade Avatars

For the **Astrablade** game demo, I also created three avatars (Figure 6) for players to choose from. Since this game takes place in a fantasy world, I did not include anything I felt would be an obvious marker of time, place, or another potentially anachronistic features. Players start with a default avatar, and are given the option to change it to any of the above three. The system is easily scalable and would be just a matter of adding another avatar element, in other words the game is not limited to three avatars. Avatars represent a similar level of choice as a chosen in-world game. Annetta found that:

> …using avatars increased social presence and built a strong community of practice. During game play, students who had a choice of which avatar they would like to represent them reported greater course satisfaction and felt closer to their classmates and instructor than students who could choose only between a standard male or female avatar.

Avatars serve as a source of identification with a virtual world increasing a sense of a immersion and making easier a state of flow as described by Csikszentmihalyi.

Another feature I explored with **Astrablade** was hidden information. For instance, at the beginning of the game players can choose a profession such as "Merchant Trader" or "Martial Artist." Players can view a description of these professions, but when they select one option it provides different starting conditions for their characters in the game world. This information could not be predetermined by anyone unless they had access to, and could read, the code that I've written. Hidden information provides an element of the unexpected. In complex systems, this can be even more effective through the process of observation and learning behavior. Actions may have an outcome that is impossible to determine beforehand but after observing the effects of an action, strategy can emerge. While **Astrablade** was only a proof of concept demonstration, my concept for the finished product included a complex system of non-player characters (NPCs) with which players could engage (Figure 7). In this concept, becoming friends with a morally ambiguous character such as a thief would lead to decreased favor with authority figures. In other words, mutually exclusive choices would result in unforeseen outcomes with an opportunity to adjust behavior for desired results. Still, it is important to not overload players with data outside the primary scope of the experience as that would result in a less immersive experience. Instead, hidden information can be used to effective create interesting and dynamic experiences in a game setting or in any complex simulated environment.

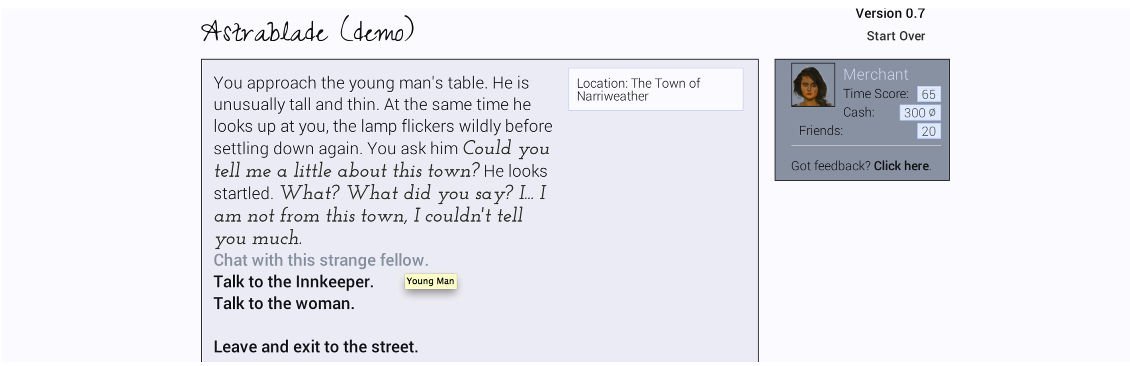

Figure 7: Astrablade Game

There are some features in **Astrablade** for which I laid the groundwork but did not have the opportunity to fully implement. One of these features was a time score (Figure 7, top right). For every second players stayed on the page, their time scores incremented by one. In the concept of the final piece, this time score could serve as a kind of in-game currency. After gaining enough time score points, players would be able to 'spend' them to reveal new locations or meet new NPCs.

Another aspect of the game concept yet to be implemented was to have tiers of goals. Some goals would be small, such as meeting a new character. Other goals would be larger, such as meeting every character in a town. Players could train in different in-game skills, and once a skill was trained could use it to accomplish a task that was previously inaccessible. Malone's observation on the use of tiered goals was that

"Hierarchical goal systems—that simultaneously provide both proximal and distal goals across a wide range of performances—may prove especially effective motivational devices." In addition, "challenge appears to be intrinsically motivating, in large part, because it engages the learner's sense of self-esteem." It seems as though a healthy mix of proximal (e.g. "Get 5 correct in a row," Figure 8) and distal goals will provide the greatest boon to motivation. Increasing complexity is a strategy to ensure that an appropriate degree of challenge is maintained.

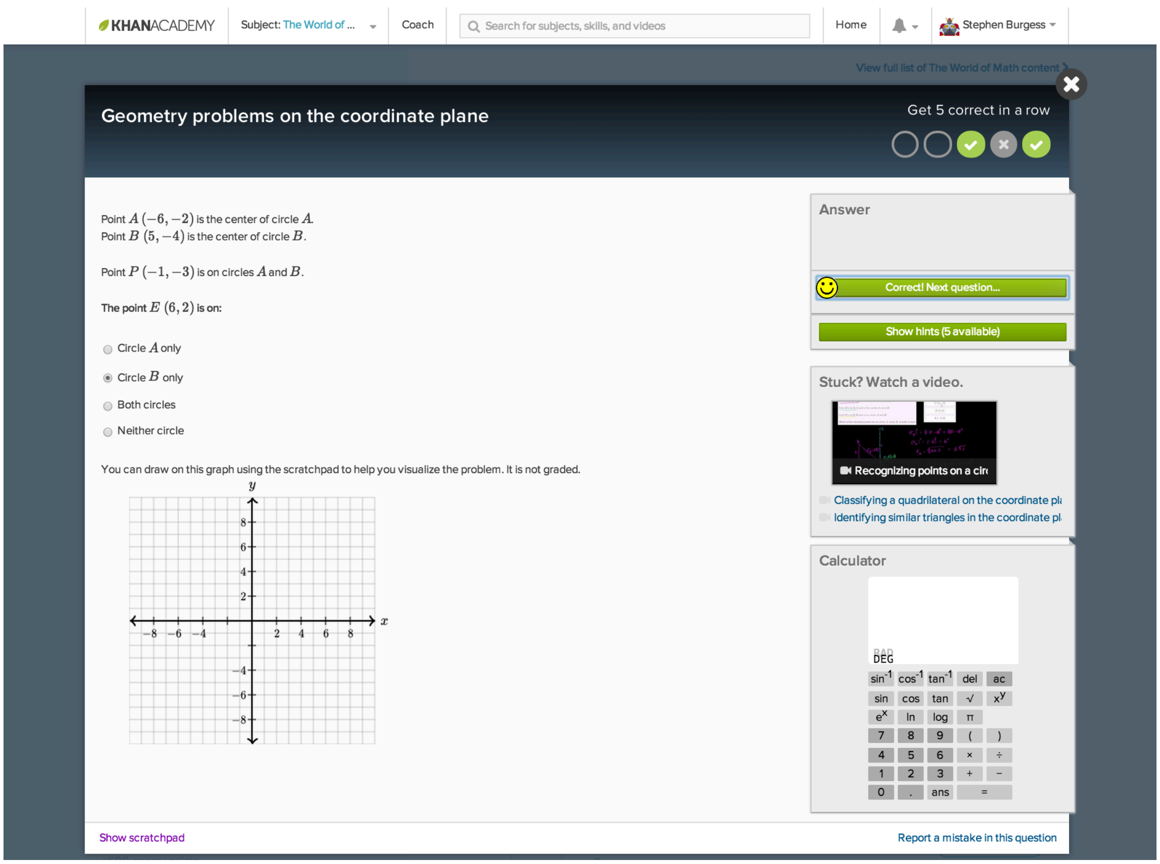

Figure 8: Khan Academy Math Challenge

Astrablade is the most powerful framework of any I developed during my time at Purchase College. Considering the application is contained within a single page from the player's perspective, the many links and state changes in the game do not overload the player's web history. In addition, the use Asynchronous JavaScript and XML (AJAX) allows lightning-fast page returns for short load times and therefore a smoother game experience. Astrablade was built in a way inspired by the representational state transfer

(RESTful) style of web architecture. REST web applications feature modularity, minimal calls to the web server, and scalability among other qualities (Fielding). Like a RESTful application, **Astrablade** is lightning fast, functions well even without a fast web connection, and is inherently scalable. As other demands required my attention during my final year at Purchase College, I was unable to expand upon the original demo. Indeed, much of the most impressive work I did in this application is invisible to players in its current form. However, I have created a framework that could easily be adaptable for a number of purposes beyond this game per se. Within the context of this game, next steps would be to develop the scenes of the narrative story as well as challenges. The modularity of this structure creates a form that lends itself towards “scenes.” Each scene contains narrative information as well as a selection of options of where to go next (Figure 7: Astrablade Game). A combination of third person narration and character dialogue uses conventions of prose fiction, while the Uniform Resource Identifiers (URIs, or links in common speech) (Fielding) brings the power of web architecture to create an interactive narrative experience. The potential for interactive engagement with text is one of the most attractive qualities of web frameworks.

The next step is to put to use the modular framework of **Astrablade**. The concept I have had for that game was to create a series of proximal and distal goals within the game that involve learning skills that may also be applicable within real-world contexts. For instance, the player could choose to work as an “editor” within the game world. After getting a primer on grammar, the player would be presented with text with grammatical errors. Identifying the errors would earn the player in-game achievements and points. After attempting this task enough times, the player would gain a badge indicating their success at editing, opening up new challenge options. In this way, learning about grammar could be an active process and its situation within a challenge environment would provide motivation. While having a page to boast of achievements and badges has not yet been integrated into the game, the framework already exists to implement the challenge of providing a selection of random grammar challenges with UI elements to input answers and client-side scripts to check for correctness.

Pen +ool

In my project **Pen +tool** (**Error! Reference source not found.**), I embedded *EPE* videos on a website to provide some basic instruction on how to trace a raster image in Adobe Illustrator and make a vector image out of it. A raster image is one that it made out of a grid of squares or dots with per-pixel information about color. Digital photographs are stored in raster format. Vector format images on the other hand are created from a set of mathematical instructions given to the computer, which process to draw lines and colors as defined by the image creator. This creates a scalable illustration that is especially useful in printing and digital animation. **Pen +ool** provides *EPE* videos that show how to trace a raster image in order to create a vector representation.

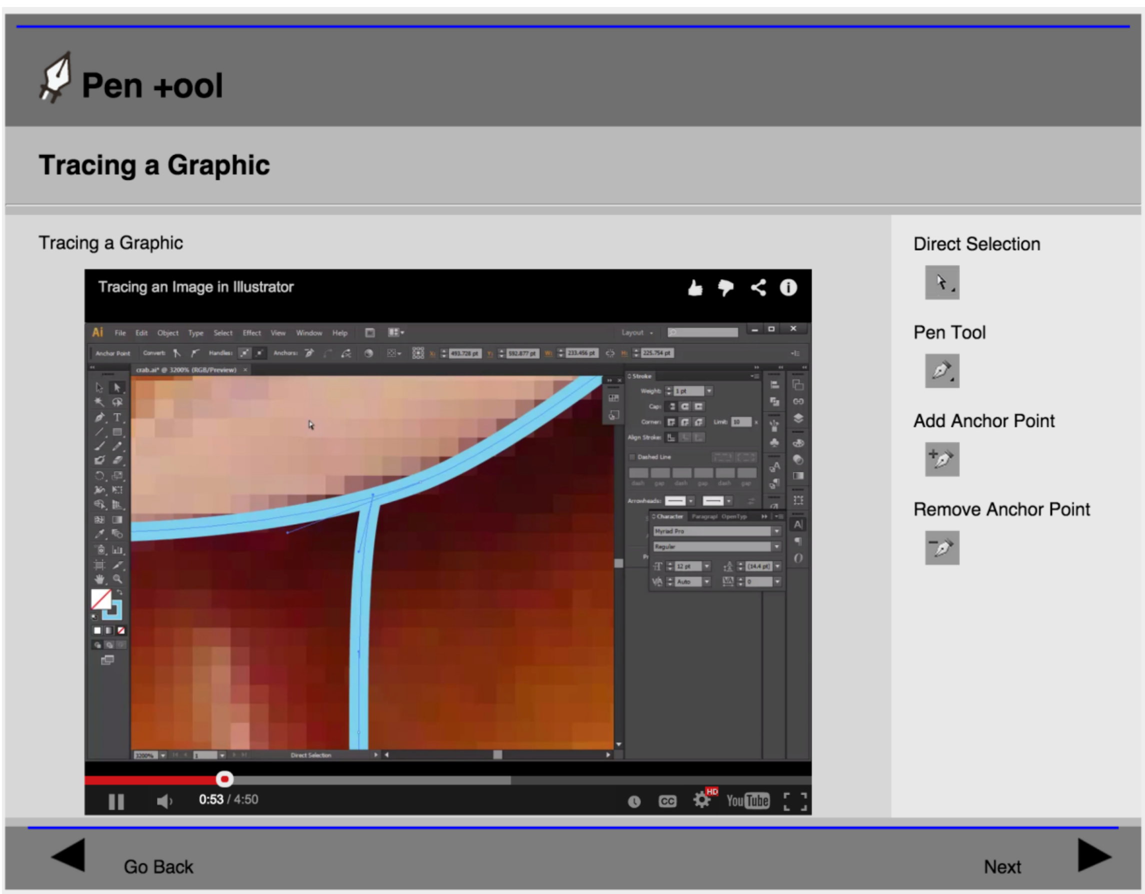

Figure 9: Pen +ool

Coupling *EPE* videos with challenge prompts not only takes the pressure of basic instruction and grading off teachers, it is more efficient and engaging. Interactivity with learning software would give agency to students in becoming active participants in learning and move us away from the poor results of the dominant passive learning model. If I were to implement challenges in **Pen +ool** they would use the HTML5 canvas element, and be a basic simulation of using the pen tool in Adobe Illustrator. Once the student arranged the elements on the canvas to match some certain criteria, the exercise would be complete and the student will have achieved a *proximal goal*. For a *distal goal* in this case, it would be that the student successfully completes three simulations of vector manipulation, thus finishing the section. With both *proximal and distal goals*, students would be motivated to learn this useful skill and be participating actively in kinesthetic learning.

Bibliofy

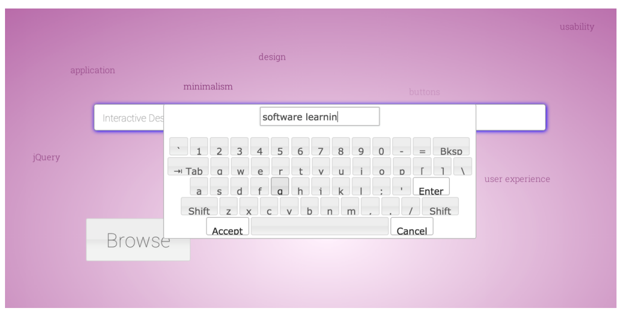

Figure 10: 'Bibliofy' Search Interface, 2013

Bibliofy (Figure 10) was a concept I explored for an integrated application in a library setting. The idea was that students and researchers could approach an integrated touch screen unit that would be constantly cycling through popular search keywords. This would engage those without a clear idea of what interesting topics they wanted to look into. In this way, this library interface could become a more engaging place for casual readers. If a reader did have a clear idea of a topic to research in coming to the search interface, the word cloud would dynamically regenerate based on whatever terms were entered into the field without needing to search. These words clouds would be informed through a dynamically updated database. In other words, as searchers click terms of a word cloud, the words that are clicked would gain priority of association. Likewise, searching related terms in succession would give a stronger relationship between those terms for future users. This algorithm would evolve, and become better as the user base increased. Considering that this interface would be embedded, I felt the keyboard could easily be eliminated utilizing existing jQueryUI keyboard interface elements. Isolating this application from its hardware and providing an keyboard interface not dependent on a tablet or physical keyboard would give it a modularity allowing for use in a variety of settings and with a variety of hardware options. For this semi-functional mockup, feedback from fellow students focused on the distracting and bright color and not understanding the function of the emerging words.

Conclusion

Software has many as-yet unexplored possibilities for integration into learning environments. These possibilities could be cost saving for educational institutions, but that is not the strongest case for increased use. Instead, the possible use of software in freeing up the time of professors to work closely with students has yet to be explored in public education in the United States. With the U.S. trailing behind other developed countries in education despite spending more than any other country, it's clear that decisive action is needed and options should be explored. While *SBLS* have specific limitations and should not be seen as replacing the powerful relationship of student and teacher, it could open up time for teachers to engage individually with students. Following principles of design, powerful and simple software could help transition education from a passive experience that fails to engage restless students. Making education an active experience could serve to address the problems of motivation and attention in U.S. schools. Feedback on my work consistently shows that working within the framework of convention and depending on transparent design are essential to successful interface design.

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