

CREATING TOOLS TO EDUCATE AND ENGAGE:
HOW INTERACTIVE MEDIA CAN AID
IN SCIENTIFIC UNDERSTANDING

by

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ABSTRACT

A well-educated citizenry, armed with an awareness of science and technological principles, is vital to the success of our society. In order to keep the public interested in scientific topics, it is important that students become engaged with science in their younger years. Interactive media technology provides a means to achieving this goal by developing students' investigative abilities. Creation and use of interactive media technology is an essential step toward bridging these two imperatives: the need to connect students with science topics in order to pique and maintain interest in these areas, while also maintaining a relevance and engagement with current modes of information exchange.

INTRODUCTION

The importance of formal education in our society cannot be overstated. A well-educated populace serves as the foundation for an informed, democratic society. Moreover, keeping a citizenry informed about scientific principles and advancements is essentially important in our technologically-oriented culture. Since aspects of science affect every person on earth, from health concerns to food safety issues to energy crises to nuclear disarmament, keeping the populace engaged with science topics is of the utmost importance.

If it can be agreed upon that educating the general public is a universal value upheld by most cultures, then finding appropriate and effective means to this end should, likewise, be a universal goal. One might start to determine the most effective ways to educate by examining how the target population currently communicates and disseminates information, for both formal and information purposes.

In a new technological era, where virtual environments and social networks redefine how students interact with each other and exchange information, alternative and complementary approaches to the traditional hands-on laboratory are emerging (Arango, 2008). These information exchange portals, such as internet websites, and social networks like Facebook.com, seem to skew the mode of modern-day information exchange to a highly individualized experience. Users can customize their path in order to best suit their own curiosities.

In order to uncover a particular piece of information, a user of these new technological tools need not have navigated to a given end in the same manner as a prior user. The search can start by choosing one of a number of popular search engines (Google.com, Yahoo.com) from one of a number of commonly used web browsers (Firefox, Internet Explorer, Safari) which have previously been customized with a user's preferences. In the meantime, the user can happily hum along to a favorite playlist created and loaded by his or her own hand on to the ubiquitous mp3 player, the iPod, which he or she is likely to own. This is assuming that the customized ring tone of his or her cellular telephone does not interrupt before the search for the desired information has been completed.

Individualized technological experiences are *de rigueur*, and as more generations are brought up with the familiar presence of technology, there is no reason to expect that this trend toward individualization should stop, or even that it should ebb. Rather, it will likely grow. This inevitability requires that the technologies used to instruct future generations keep in step with other current technologies. In this way, a more tailored educational tool can better address the need for students to drive their own investigative impulse. Opportunities to merge the individualized experience with science education should not be overlooked.

Another important point to keep in mind is that interest in science topics is normally met with enthusiasm in the elementary years, with declining interest, attitudes and achievement among all learners in the middle school years (O'Neill and Barton,

300). It would seem, then, that maintaining an interest in science during the middle school years is critical to keeping students engaged in science topics.

The reasons that students' interest in science wavers should be identified, so that strategies may be developed to combat them. O'Neill and Barton identify, "...the assumption that if students owned the science they were expected to learn, either by connecting science to their lives or helping students feel a part of the culture of science, then they would be more motivated to learn science" (293). A technologically-geared educational tool that moves to address these issues could very much help keep students interested in science in those critical years. Brownlow, Jacobi, and Rogers found that, "social and academic factors varied among people differing in levels of science anxiety. Students with high levels of science anxiety reported that they had ineffective high school science teachers, avoided science in college, and had lower SAT-Q scores" (127).

O'Neill and Barton also state that when, "learners have some choice and control over what and how they learn, leading to the likelihood that they will become more emotionally and intellectually connected to the science explored" (293). If students are finding much of their information from web-oriented sources, then it makes sense to find ways to exploit relationships between a web-type organization of the material and their content areas. The potential for more effective learning abounds as these two aspects dovetail. Therefore, the creation of educational tools that can

re-engage students with science will likely be successful if said tools can exploit the familiarity of individualized technology, while simultaneously breaking down the real or imagined barriers to accessing the body of scientific knowledge.

MEDIA IN SOCIETY

Old Media and New Media

In order to begin to discuss the presence of media in society, it would be wise to first identify what, in fact, qualifies. The word “media” derives from the Latin word “medius,” meaning “middle.” Communication media are made up of technological processes that facilitate communication between the sender and receiver of a message (Croteau and Hoynes, 6-7). The most familiar media incarnations include radio, television, print media and motion pictures. These methods of communication have been around for many years; in the case of print media, it has existed for many hundreds of years.

At a basic level, media serve to disseminate information to a broad audience. With technological shifts have come new modes of communication that can be labeled as “the new media.” These new media include web sites, computer multimedia, computer games, CD-ROMs, DVDs and virtual reality (Manovich, 5). The aspect that these new media have in common is that they rely on computer technology in order for them to be disseminated to an audience.

In this way, these new media can be differentiated from “old” media, but also from media which may utilize computer technology at some other point in the production process. For example, using a digital non-linear editing software program for the postproduction phase of a video tape does not necessarily deem it a “new media” project, since that tape can be converted to a VHS format and be played in an analog VCR. The

distribution of that tape need not rely on computer technology, despite a computer's previous role in its production. The distinction is this: though new and old media can both utilize computer technology to come into fruition, only Manovich's new media require computer technology for the viewer to experience that media.

Linearity and Nonlinearity

Just as a user watching a videotape must abide by the limits of that medium, the user of new media must abide by the "rules" set as a result of that particular medium's nature. For example, a videotape must be experienced in a distinct order with the options to fast forward, rewind, pause and at the user's discretion (Roberts-Breslin, 261).

As compared to the linear format of videotape, computer-based media allow for a web-like organizational structure. The computer-based nature allows for a much less rigid experience for the user. When clicking through a website or utilizing a DVD-ROM, the user may watch a segment again immediately after it has finished, revisit a segment from the start at the end, and skip over much material if he or she chooses to not watch it at that given time. This quality is called random access, meaning the ability to navigate quickly and easily from one piece of data to another (Roberts-Breslin, 354). Often, such media that allow for this facilitated navigation, DVD-ROMs for example, are marked by the compression of a large amount of data into a small physical space. As a result of the random accessibility, this large store of data can be sorted through in a timely fashion, as directed by the user.

As such, the control of the experience shifts; instead of the author solely determining how the media will be viewed by others, the viewer retains influence as well. In “old” media, the information is sent to the viewer, as envisioned by the director, to be experienced as a predetermined arrangement. However, in new media the viewer must engage with the media to progress through the piece. The viewer is bound to feel more connected to a media project in which they have an influence. Tasking the viewer to have a role in the outcome of the media experience empowers the viewer.

The increase in navigational possibilities of new media becomes its largest distinction from old media. Of the most familiar older media, print media is the only type which escapes the dictatorial style set forth in the other modes; the user has control over which articles they are exposed to and in what order they are exposed to them. However, print materials lack the capability to store immense quantities of information in a reasonably discrete space. This diminishes the facility of randomly accessing one given article after another.

Another rule regarding the nature of new media is that the limits on its content are greatly expanded. Printed matter, for instance, may contain text and illustrations, but does not have the capability to display motion media or graphics or any type of sonic information. On the other hand, a DVD may contain video, audio, graphical and textual information combined in any number of ways.

Additionally, it is possible for virtually any real-life setting or scenario to be addressed in a nonlinear fashion, in order to allow the viewer to navigate a new

educational topic. He or she can work through the topic, and the new media object, simultaneously.

New media offers unprecedented flexibility and freedom in accessing information. Not only can a viewer decide to skip around the media's structure, viewing parts in myriad different orders of multiple viewings, but the viewer also has the freedom to supplement an "ordinary" media experience with multimedia content. Instead of simply reading a passage describing the fertilization of a human egg, the viewer could choose to click a link to watch a video taken under the microscope of that very process. A motion picture clip can capture the poetry of such a moment with more depth than one can expect by solely reading dry jargon and seeing still images. As such, the viewer may be more apt to engage with the topic matter at hand. Such applications have the ability to change the very nature of how material is learned and retained, based on how that material impacts a student in the first place.

EMPOWERMENT IN EDUCATION

Brave New Technological World

Why the need to decrease the number of people reticent to learn about scientific subject matter? In individual terms, those interested in science are bestowed with many rewards, including "...access to multiple resources in society, including advanced coursework, higher education opportunities, and prestigious careers" (Elmesky, 335). In more broad terms, "For participatory democracy to succeed, for voters to make informed decisions about their lives and their environments, for choice to be logical, citizens—including students, teachers, and administrators—must become familiar both with fundamental scientific principles and with their impact on society through technology" (Fort).

It is difficult to find a current news program that does not mention some technological or scientific report. Topics such as global climate change, capabilities of the next wave of cellular telephones, the best foods to eat and still lose weight and breakthroughs in disease research are commonly covered in news reports as they are rightfully deemed newsworthy. If these topics are of the utmost concern to many people, then it would only be proper for these topics to be well understood. As such, citizens can act appropriately, according to their educated opinions, when questions arise on a variety of science-oriented topics: funding for research on a particular disease, the choice to build a nuclear reactor in a given city and whether to restrict recreational use of lands to

preserve wildlife habitats, to name a few. In other words, a scientifically literate citizenry is a necessity in order for our society to progress and flourish.

Researchers have even found it necessary to reaffirm confidence in the subject matter with students in higher education, students who have already selected science-oriented majors. In an example from organic chemistry, Thomas Hoye and Christopher Jeffrey found that by exposing students at an early stage in their chemical careers to the act of complex molecule synthesis, the students would gain much experience and confidence with the procedure and be better prepared to repeat the work at a later date. In the late stages of complex molecule synthesis, materials utilized in laboratory settings become limited in quantity and, as a result, very precious. Their key was to use materials with little inherent value, so the students could gain confidence in themselves while the stakes were relatively low. They also found that those students who were able to successfully complete the laboratory tasks on a small scale also had strong experimental skills across a wide range of preparative organic chemistry techniques (Hoye and Jeffrey, 919-920). In this example, the early exposure to the concept and successful outcome in the experiment are the keys to building confidence and empowering students.

Multimedia and Educational Applications

“New technologies open opportunities for student empowerment learning. New technologies facilitate more democratic and student-centered learning environments and can be powerful tools to support students to explore learning in broader social contexts” (Wang, 319). This shift in control can have hopeful consequences, as in O’Neill and

Barton's scenario of, "a learning environment that supports students in building a sense of ownership in science—a sense of control and mastery within the domain of science" (300).

"Multimedia is a learning tool that allows learners to organize, represent and construct knowledge in multiple modalities that include text, audios, graphics, animations and videos" (Wang, 316). New media appears to be inherently suited toward educational purposes, then, if information can be organized and displayed in various ways for those who prefer to learn in different ways.

For instance, if information is presented as video footage, the nature of multimedia makes it possible for aural or textual reinforcement of that information to appear simultaneously. It may even appear only when the user of such media wishes to see it, thus enabling him or her to take in the information at a pace appropriate to that individual. By allowing the individual to have control over the experience, it is possible to instill a sense of empowerment in the user. Empowerment is an extremely important topic in all aspects of education, science education included. "When learners feel a sense of empowerment, the learning is the most profound" (Wang, 316).

Kelly and her colleagues (2008) developed a "virtual laboratory" tool to be used as part of a college-level engineering class. Instead of performing a chemical vapor deposition on actual laboratory equipment, the students ran a virtual experiment using a software interface to simulate the conditions involved in such an experiment. The purpose of the virtual laboratory was to encourage students not to focus on the acquisition of technical skills and knowledge bound to the performance of a particular experiment.

Rather, they hoped to promote more general problem-solving skills beyond the immediate context of the laboratory. In this way, the learning taking place could focus on more global benefits rather than those benefits tied to the experiment at hand.

If students can focus on the bigger picture rather than on precision laboratory tasks, perhaps the take-home concepts will be better absorbed by the students. Kelly's research seems to indicate this. If this is true, then perhaps as students' control increases, their confidence with the material will also increase.

THE VIRTUAL FIELD TRIP

Many educational settings simply do not have the resources to support investment in highly sophisticated equipment or in equipment dedicated to one single laboratory activity. By constructing educational tools which feature such virtual systems, educators can ensure that students are exposed to a wider range of topic areas than their laboratory set-ups currently allow. This benefit has the potential to provide the most impact to underprivileged districts, small districts, small colleges and even to home-schooled students.

A similar concept to the virtual laboratory is the virtual field trip. Field trips are a treasured school tradition, as students have the chance to escape the confines of the normal classroom setting to experience an environment firsthand rather than learn about it from either a book or other research. However, drawbacks to this type of learning include scheduling conflicts, large class sizes, liability issues, lack of funding, and lack of transportation (Tuthill & Klemm). Gail Tuthill & Barbara Klemm report that benefits associated with virtual field trips include an increase in learner-centeredness, flexibility and efficiency in teaching the material, temporal independence, spatial independence, safety and practicality.

Certainly, this virtual alternative should not substitute for a real-world educational experience when resources allow. Taking a virtual field trip, though results in both reduced liability and cost, including time spent traveling and money associated with organizing transportation, for the classroom teacher and school administration. Parents,

who may have been expected to pay entrance fees to an exhibit, can save money and gain peace of mind that the relative safety of the school campus will shelter their children. Students may control the pace of the presentation and complete it at a time that is convenient. Most of these benefits speak to an overall pragmatism regarding the business of accomplishing effective classroom instruction. However, the increase in learner-centeredness is perhaps the most significant benefit of the virtual field trip when one considers the problem of science anxiety.

“The latest trend of education is based on the constructivism in which the learners can participate in the learning in a self-leading way and compose their knowledge in their own meaningful way” (Shin, 63). Shin also states that the number of educators who are moving away from lecture-based modes and toward learner-centered models in which students are engaged in problem solving and inquiry is currently increasing (62).

Shin notes the following benefits of such learner-based modes: senses of immersion, interest, and motivation, and they can focus a learner’s attention by completely absorbing them into a new realm (74). Therefore, when learner-based modes are employed, these modes are more apt to combat science anxiety than to cause it, since these modes tend to engage and hold learners’ interest. These modes appear to be an important step toward ensuring that students feel like the material at hand is theirs to be mastered, rather than there to oppress them. In this way, learner-based modes can be considered empowering.

RELATING TO INTERACTIVE MEDIA

Perhaps the reason for this empowerment is that the relationship between the user and the media has lost a measure of formality. If the user can relate to the media in a less formal way, the user may let his or her guard down and be more willing to take in the material that the media are presenting. When not “held captive” by the media experience, the user may allow him or herself to be captivated by the subject. Ironically, then, the user is liberated to delve into the subject matter on his or her own terms. Rather than overload the user with material, a decrease in formality enables the student to ponder before moving on to the next topic. To lessen the formality of the media experience is to encourage students to consider rather than to regurgitate. This is an important step in molding a thinking populace, rather than a reactionary one.

The Inquiry-Based Approach

The National Science Education Standards report that:

Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations (23).

In their book Inquiry-Based Learning: Using Everyday Objects, Amy Edmonds Alvarado and Patricia R. Herr seek to, “promote the notion of inquiry as a process, initiated by either teacher or students” (xiii). The notion of student-initiated inquiry meshes well with the framework of interactive media or with that of the virtual experiences already described. If a student were to use an interactive media tool, he or she would likely engage in any or all of the facets which the National Science Education Standards outlines in order to navigate through it. Choices cannot be made without assumptions, critical thinking, and considerations for future consequences of a decision. The similarities between the stages of inquiry and making choices in an interactive educational tool are striking.

The benefit of using an interactive educational tool is that there exists time to linger over decisions when collecting and weighing evidence before proceeding to the next step. The tool cannot continue on without input from the user. Conversely, in a real world laboratory, a student may need to perform particular tasks at precise intervals, whether he or she is ready to move to that next step, in order to appreciate the lesson being presented. Therefore, the student is granted the proper time to engage in an inquiry-based approach to the subject by using the interactive tool. As Sean Cubitt muses, “Perhaps we should not be looking forward to faster and faster connections, but to slower and slower contemplation of what we have already downloaded” (186). An inquiry-based approach, articulated as an interactive media tool, may therefore enrich students’ educational experiences.

Interactivity and Cognitive Ability

Peter Vorderer, Silvia Knobloch and Holger Schramm conducted a study comparing cognitive ability and engagement with interactive media. They utilized measures of suspense, empathy and experience of entertainment as their variables to study how subjects felt after viewing an interactive movie. The results showed that, in general, those with higher cognitive ability felt more entertained by movies with a higher degree of interactivity, and that those with lower cognitive ability felt more entertained when they watched movies without any interactivity (352-356). Developing an interactive media tool may, therefore, aid the harried classroom teacher with the precocious student. Anecdotal evidence supports that fact that bored children can become disruptive children, and therefore infringe on the educational experience of his or her fellow classmates. The child may not normally act out, but once he or she has finished the class assignment, well before his or her peers, that child may be desperate for another activity and need something to stimulate his or her young mind. While the teacher tends to the needs of the other students, he or she may be able to rely on the help from a classroom aide or student teacher to engage the child in question in another activity. For those teachers who do not have access to such resources, a workable solution must be found.

Assuming access to the proper hardware, if a teacher is able to give an interactive tool to that precocious child, perhaps it would have multiple benefits; not only could it help to keep the peace, but it could also enable the teacher to focus on those students who

need more assistance without leaving the needs of the advanced child out of the equation. In this way, the teacher's attentions can be split to supervise and guide the children who require more attention while trusting that the precocious child is engaged in a measure of learning enrichment. Everyone's time, from teacher to students, can be utilized more efficiently and effectively. As such, the teacher's attentions are allowed to be focused on educating, rather than on discipline and keeping order.

The die for this model has been cast for years in pull-out enrichment classes for advanced elementary school children. In districts where such opportunities do not exist, the ability to provide enrichment to the standard curriculum can still come in the form of an interactive educational tool.

Gaming and Interactive Media

The similarities between interactive media and certain genres modern-day gaming are striking. The types of games categorized as "simulation" or "role-playing" games rely heavily upon users' interaction with the material presented on the screen. Simulation games include such rhythm-based titles as *Guitar Hero*, *Rock Band* and *Dance Dance Revolution*, and intend for a group of players to take turns using specialized controllers to strike a sensor (commonly with a hand or foot) coordinated with a graphic on the screen. Role-playing games include such titles as *The Legend of Zelda* and *Final Fantasy* franchises, and allow players to take on the role of a hero on a quest. They are typically played from a third person perspective, as if looking down upon the game's characters.

These games are marked by the player's need to stop at points to make decisions about how to interact with characters on the screen (Sellers, 11).

If gaming and interactive media share so much in common regarding how users contend with them both, it is easy to make the claim that the educational possibilities associated with interactive media can also be translated to video games. Take, for example, the matter of Paxton Galvanek, who helped to rescue two victims in a motor vehicle accident in North Carolina. He was first on the scene, and was able to use his medical background to move the victims away from their vehicle and assess and treat their injuries, including bruises, scrapes, head trauma and the loss of two fingers. His medical background consisted solely of the skills he learned playing a computer game entitled *America's Army* ("*America's Army* Medic Training Helps Save a Life").

The purpose of a game need not be solely to kill the most enemies or rack up the most points. In *America's Army*, a game developed and distributed by the United States Army, users must experience extensive medical training tutorials in order to play as a Medic-class character. This was Galvanek's player class of choice. Due to his experience with the tutorials, he was able to provide aid for the accident victims until a medical professional appeared on the scene ("*America's Army* Medic Training Helps Save a Life"). Galvanek's actions serve as evidence that there is a space for education to pair with computer or video gaming.

It would not be proper to expect a gamer such as Galvanek to have been able to provide more extensive medical help at the accident site. Likewise, it would also not be proper to expect that the doctors at the hospital who treated the victims once they arrived

were originally trained solely on computer models of human beings. There are certain experiences that would not translate well to a computer game model. In addition, the computer game model should not be the sole teaching tool employed when training a person for any real world based task. To expect someone to translate flawlessly a computer-based experience to a real world problem would be folly. To say that video games are a definitive way to train all persons for every sort of life experience would be absurd. But, the Galvanek case adds weight to the argument that gaming can expose people to new subjects and new information in an effective way.

In Great Britain, the English Learning and Skills Development Agency published a policy review regarding the place of gaming in education. The report determined that frequent gaming could have a negative impact on schoolwork, but that, in general, “computer games are seen to have a range of educational benefits” (McDougall, 123).

Perhaps these educational benefits are a result of the sense of accomplishment associated with game-playing. Jeff Bell, the former Corporate Vice President of Global Marketing of Interactive Entertainment Business for Microsoft, states that, “You’re going to see gaming grow because games tend to have a progressive function. People build self-esteem as they accomplish a task. Games have a built-in component that’s not technology; they give the player a sense of achievement” (Hill). If a student can experience a sense of achievement from the framework of a videogame, then it makes sense to engineer some of their lessons in a similar structure, in order to pair learning with a sense of achievement. In this way, learning can become another attractive goal in a realm usually populated by princesses saved and gold coins collected.

All game playing is not created equally. The benefits of the reactionary nature of the first-person-shooter genre (popular titles include *Doom*, *Bioshock* and *Halo: Combat Evolved*) or the puzzle games (*Solitaire*, *Bejeweled*) that mark the trend of “casual gaming” are dubious. Joshua Ostroff states that role-playing video games, marked by interaction with the game’s storyline, tend to make the best use of plot, and further states that the Choose-Your-Own-Adventure style of storytelling, called a branching storyline, offers better “replayability” for the user. (30) The educational benefits of revisiting the same gaming interface is simple: research shows that the longer a visitor interacts with an exhibit, the greater the possibility that learning has been facilitated (Pasek, 2008). Therefore, the ability to change the outcome of a narrative has potential for pedagogical benefits. If a student’s desire to see a different ending of the branching storyline drives him or her to repeatedly view the material, the multiple iterations can work to facilitate learning of the given information.

PRODUCING AN EDUCATIONAL INTERACTIVE MEDIA TOOL

Having researched the topics of science education and interactive media, I desired to strike a balance among these various points: reducing science anxiety, engaging students in a topic matter that they may not normally have access to study close-up and exploiting a branching structure to allow for students to feel that the mode was more learner-centered than didactic.

I worked to create a basic DVD project that would merge these objectives. I wished to choose a timely topic that would be sure to be interesting to a wide range of students.

Finding a Method

Throughout the planning and preproduction portions of this project, I aimed to construct an interactive narrative experience, so that the users would have a chance to influence the outcome of the narrative being presented to them. As such, I hoped to acquaint the users with a science topic to compel them to delve deeper into the story. By placing them in the “driver’s seat,” I hoped their attitudes toward the scientific subject matter would be improved, since the material was not simply foisted upon them. My hope was that by giving them a measure of control over the narrative, they would be more drawn to the lessons contained therein.

I wanted the viewer to experience maximum engagement with the material. I made a conscious decision to employ a subjective shot design in the project. I utilized a

direct-address approach, in which the talent oriented completely toward camera. As such, I hoped to achieve the sense that talent was speaking directly to the user. In this way, I hoped to keep the user invested in the outcome of the narrative. This decision also seems to have pedagogical benefits, as Stoney and McMahon report that learning through direct experience has been demonstrated, in many contexts, to be more effective and enjoyable than learning through information communicated as fact (4). The use of first person has the potential to alleviate problems with gender, cultural and age bias. However, in the case of this project, the viewer does see my white, female, twenty-something hands.

My survey of available interactive stories on DVD left me disappointed. The majority of discs available are more game-oriented, though there are a few adventures marketed as strictly narrative. Scourge of Worlds is an example of the purely narrative interactive experience, set in a “Dungeons and Dragons”-based world, marked by elves, wizards and spells. Among the game-oriented discs, there appear to be two camps: the games tend to be quite slow and boring, as in the Harry Potter Interactive DVD Game: Hogwarts Challenge, or very fast-paced and leaving little time for the user to contemplate their environment, as in Don Bluth’s, Dragon’s Lair. I aimed to strike a balance somewhere between these modes, so as to make an interactive experience that would not bore the users with its slow pace but also not introduce material so fast as to make learning the material an impossibility. In order for any absorption of the content to take place, there must be the ability to reflect and contemplate the content of such an educational tool. Therefore, it was an obvious choice for me to not make any decisions in

the game time-sensitive. The key to making the structure work, I found, was to keep the pace as up to the discretion of the user as possible. As long as the influence from the user could be maintained, then their control over the intake of the content could be maintained. This was an essential element in my hopes to keep users drawn to the content.

Finding a Focus

I chose to focus the content of the DVD project on home-based biodiesel production for several reasons. Firstly, given the current energy crisis our society faces, familiarized to the average citizen by rocketing prices of gasoline, the topic matter seemed very timely. The average citizen, even a school-aged child, is well aware of this situation. This factored heavily into my choice of topic matter.

I called on local contacts with which I had previously done research on the topic of home-based biodiesel production. After inquiring with them about the equipment used in their facility, I decided that this topic would be very suitable for the parameters I decided to cover. The set-up necessary for a home-based biodiesel outfit is decidedly more involved than the average school's laboratory setting. This is not to say that it is extremely expensive or sophisticated; rather, the equipment simply takes up more space than other laboratory materials, and lacks the versatility to be suitable for other demonstrations. It is unlikely that a school would devote its resources to such a laboratory set-up.

After I decided on a topic, I designed a basic outline for the layout of the DVD. I identified the various points in the biodiesel “brewing” process that would make for appropriate points of divergence in the narrative flow. It became obvious that I would need to plan a story structure more involved than a typical linear storyline. I transferred my story segments to index cards and created a webbed structure so that I could better see how all of the story elements would interact with one another. Afterward, I transferred this webbed structure to paper; thus, the project’s flowchart was born.

This chart proved to be very useful in finalizing the DVD’s structure, since the project’s structure was much easier to visualize as a chart than in index card form. The chart also proved extremely useful during the postproduction phase, since it served as a nearly exact blueprint for the DVD authoring process. Each segment was labeled with what would eventually become a chapter number in order to keep the segments well-organized.

Research has shown that, “less expertise, less spatial ability and limited reading skills can impede the process of holding large chunks [of information], processing them quickly, and continuing on in the multimedia presentation to develop complete and workable situation models or mental models” (Iding). These are important points to keep in mind during the design or preproduction phases of an educational tool in order to maximize the effectiveness of such an instrument. As such, the project I developed was intentionally designed to be marketed toward a middle school demographic. Reviewing the standards set forth by Montana’s Office of Public Instruction for grade level expectations in science, I felt that the material was appropriately crafted to the knowledge

base of those between the ages of ten and thirteen. For example, Montana students are expected to identify interactions among technology, science and society by grade 4, observe and discuss how scientific information is related to current events and local problems by grade 5, and to describe connections and interactions among technology, science, and society by apply scientific inquiry by grades 7 and 8 (Grade Level Expectations). If the intended audience for this project had been younger, I would have had to design my project with more basic information to help explain the concepts differently. For example, I would have avoided the use of the definition of a term (“cloud point”) scrolling along the bottom of the screen, as weaker readers at lower grade levels might not have the ability to keep up with the text while the narration presented other information about how cloud point relates to biodiesel performance.

Production on the project was quite conventional, with the established chapter numbers also serving as scene numbers. Postproduction involved taking those scenes and organizing them, with the help of the flowchart, in a DVD authoring program, DVD Studio Pro. This authoring program allowed for much flexibility and control in how the various chapter segments ultimately interact with one another. My vision for an interactive experience for the user would not have been possible without a tool such as this authoring software. It should be noted, however, that my use of this program does result in some peculiarities with the finished disc which do not appear in DVDs normally marketed to a broad audience. For instance, one may not simply skip over an entire track to advance from stopping point to stopping point. Attempting such a move will result in the disc shifting from, say, the first scene in the kitchen to the track in which the host

appears blackened with soot. After this scene is finished, the disc moves back to the main menu (Brew-It-Yourself Biodiesel). A viewer wishing to move away from the very beginning by choosing the “next” track feature on the remote will inadvertently find him or herself right back at the very beginning of the disc.

A user who wishes to skip through material in a quicker manner must employ the fast forward feature on his or her remote. The fast forward function will cease once the next menu point has been reached; the disc will wait to advance until the user inputs his or her next choice. On mass-marketed DVD discs, authored on much more highly sophisticated machinery and software, it would be possible to skip ahead by using either the next track button or the fast forward button.

Finding Feedback

During the postproduction phase of my work, I screened this project for three small groups of people. As this project is intended as an educational tool, I was happy to be able to include two schoolteachers in my focus groups. The feedback was quite useful in fine-tuning the project, especially in regards to the educational potential I could include in the content. As a result of the feedback I obtained, there appear two dummy links (“Quizzes” and “Critical Thinking”) off the project’s main menu. In the future, I feel it would be worthwhile to expand my project to include such features, so as to maximize its flexibility and educational benefits. These areas can be customized to fit the needs of different grade levels, thus making one disc useful to a wide range of students and educators. While it may not be effective to expect fourth-graders to hash out

issues regarding international politics and crude oil, it could be appropriate for older students. As such, the students could access the “Critical Thinking” on orders from their instructor and complete the assignments found there. I could include quizzes geared for several grades in the “Quizzes” button, with pre-tests and post-tests to measure changes in understanding before and after experiencing the DVD. Through a more expanded course of focus groups, I am certain that more topic areas could be conceived of, and further content could be devised in order to create a series of engaging and informative educational tools.

Given the nature of the project’s branching structure, increased replayability is an educational benefit. Since a user can make choices which result in a dead end or an untimely failure of the objective, he or she does not simply go through the motions of the narrative to ultimately end up at the same outcome. This means that each time the user plays the DVD, he or she can influence the outcome any number of ways. Instead of a static, linear progression, the user can aim to discover a different path than the one before. The user’s repeated paths are ultimately determined by the individual; the aim here is that a learner-centered design should ease problems associated with students’ feelings of disengagement or lack of control over the material at hand. Repetitive exposure to the presented information works to reinforce it; thus, the branching structure promotes learning.

In a practical sense, the savings of time and money associated with this virtual laboratory of sorts cannot be denied. A teacher is able to cover the entire process from beginning to end in a much more discrete time frame than it would take to actually run it.

In a global sense, it enables a teacher to help his or her students explore possible solutions to our energy crisis. Moreover, the student is learning and reinforcing important science concepts in a global context to which he or she can personally relate. The benefits of this media tool range from the small scale to the large scale.

CONCLUSION

As Pasek's research states, the longer one interacts with a museum exhibit, the greater the possibility that the exhibit facilitated learning. It is not a great leap to assume that the same could be true for an interactive educational tool experienced elsewhere.

Ultimately, the greater goal is to educate and inspire students to be interested in science. The student need not decide to pursue a career in a science-oriented field; rather, he or she must be educated in order to navigate well through society, as it becomes increasingly technologically-based.

A priority of our society should be to develop the most useful tools to reach this goal. Conventional classroom education serves a purpose, but is fraught with limited resources: budget, staff, classroom materials and field trip opportunities, to name a few. Where normal classroom instruction ends, students can utilize other tools that offer entree into more exotic worlds than the typical classroom setting may allow.

An interactive educational DVD is a viable solution as the varied concerns of budget, safety, flexibility and independence combine with the desire to empower students that might normally be shy about scientific subject matter.

Learner-centered models of education must be employed in order to connect students who may or may not be enthusiastic about science topics with valuable science information. Through this process, the chance exists for those students to grow from passive students to active scholars. To combine this process with branching forms of

storytelling, to let the viewer decide which choices to make, works to move this prospect of growth from possibility to reality.

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APPENDIX A

DVD FLOWCHART









