Designing Blended Learning Environments within Automotive Technology for Secondary Education Students

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***Abstract*— With advancement in computer technologies, new opportunities for highly interactive blended learning environments within K-12 environments are now possible. These learning environments help teachers increase the level of academic rigor and make classroom and eLearning instruction more relevant and engaging for students.**

In this study, a blended learning environment was presented to students by integrating eLearning training programs within a face-to-face automotive technology course. This strategy is to enhance content, introduce interactive eLearning modules, and initiate a comparative analysis of *Argo* and *CDX*, leading automotive eLearning training programs.

***Argo*, an eLearning program, is an educational database which, through the use of eLearning modules, allows students to learn about automotive technologies as well as how to maintain and repair vehicles by using interactive animations and simulations.**

***CDX* Automotive Training Program is an online interactive resource to assist students to develop technical understanding and psychomotor skills that are concrete and visual, rather than abstract and descriptive.**

This paper will report how the blended learning environment facilitates learning and training for real world application. By providing students with a genuine shift from conventional instructional design, the program uses game-simulation and mixed and virtual reality technologies, all resulting in students taking eLearning and training into real world applications.

Moreover, preliminary analysis of data and field notes also indicates student confidence, engagement, and learning has increased in technical understanding and psychomotor skills both in automotive and eLearning technologies. Student feedback indicates that Argo is much more interactive than *CDX* and thus students in general prefer *Argo* over *CDX*.

***Keywords*— game-simulation, interactivity, learning environment blended, psycho-motor, rigor/relevance framework**

I. INTRODUCTION

In the 1990s, many educators prepared students to become “knowledge workers”, and often closed high school shop as a source of funding for computer literacy programs. In California, three-quarters of high school shop programs have disappeared since the early 1980s. Although there are efforts in some states to revive shop, competent people to teach are hard to find.[1]

Meanwhile, employers in trade and industry complain about their inability to find
workers. According to Jim Aschwanden, executive director of the California Agricultural Teachers Association, "We have a generation of students that can answer questions on standardized tests, know factoids, but they can't do anything."[2]

Not surprisingly, one of the fastest-growing segments of student body at community colleges is people who already have a four-year degree. They are enrolling in Career and Technical Education (CTE) programs to develop marketable trade skills for jobs that are rewarding and not easily offshorable.

With this new demand for 21st century CTE programs, how do educators design learning environments for the next generation learner?

Many educators are implementing blended learning environments. eLearning has evolved from overcoming classroom barriers of time and distance to becoming a digital resource that enhances the traditional classroom setting. These blended learning environments offer access to virtual tours of historic sites, online experts, and social network dialogues. Furthermore, with the advent of mobile devices, instructors can teach and students can learn from anywhere.[3]

Moreover, just as earlier generations embraced voice recording, radio, television, and video to their educational resource kit, instructional designers and educators using mixed reality, video games, and simulations have an unprecedented opportunity to create blended learning environments that are highly interactive, meaningful and learner-centered.[4]

As with any new innovation, prototype learning systems must be designed, developed and tested to their effectiveness in creating next generation learning environments. There are a variety of theoretical to practical frameworks to consider when designing a blended learning environment.

This paper evolves from a paper I wrote in December of 2009, a *Study on Blended Instruction in Automotive Technology for Secondary Education.*

In this particular study, I instigated a prototype blended learning environment for a new unit of automotive technology instruction that included strategies to help students develop eLearning skills and at the same time acquire basic knowledge of automotive technology systems and psychomotor skills.[5]

I integrated within my face to face classroom, *CDX*, an eLearning automotive training program that promotes itself as an online interactive resource to assist students to develop technical understanding and psychomotor skills that are concrete and visual, rather than abstract and descriptive, as a curriculum-based assessment study.[6]

In general, this study found that student motivation and confidence level increased in being successful within a blended online automotive technology course. Moreover, both automotive technology and online skills were attained in this collaborative learning environment.

The study also noted field observations indicated that students were absorbed with the streaming videos and instructor interaction with them, (the instructor used the video player pause button at key points to check for student understanding). Although the instructor lead video method was proven to be pragmatic, it was only effective when employed to a twenty minute maximum, as students soon became restless. As I reflected on this study, I realized that although *CDX* and its valuable resources of over 800 plus instructional videos were relatively effective, next generation students needed more. Student attention span diminished rapidly viewing the videos and needed more interactivity to hold their interest.

In this follow-up paper, *Designing Blended Learning Environments within*

Automotive Technology for Secondary Education Students, I introduce many of the same students that used *CDX* in last year's study within this year's study using *Electude's, Argo***,** an automotive eLearning training program. This resource uses interactive animations and simulations as a way for students to learn and apply automotive technology.[7]

As with the first study, this blended learning environment assessment study takes place in a small rural public Hawaii high school within a geographic area that contains a widely diverse population with an overall socioeconomic status below state averages. Twenty nine percent of families with children in this school are living in poverty.

Student pre/post test and instructor field notes are discussed to evaluate this curriculum-based assessment study.

II. REVIEW OF RELEVANT LITERATURE

A. Blended learning environments

As with any design endeavor, basic design principles should be considered when designing learning environments.

In Sonny E. Kirkley and Jamie R. Kirkley's, article, *Creating Next Generation Blended Learning Environments Using Mixed Reality, Video Games and Simulations*, it considers five key areas when designing learning environments:

"First, the theoretical framework that guides the instructional design and development approach and management of the overall learning environment. Second, the affordances and limitations of specific technologies that will be employed to create the learning environment. Third, the specific instructional methodologies, strategies and tactics used. Fourth, the instructional design processes and support tools necessary to ensure effective use of the technologies, methods, strategies, and tactics within the theoretical framework."[8]

These instructional design considerations emphasize the complexity of the task in designing blended learning environments for today's learner.

More than ever, research is needed in constructivist blended learning environments in eLearning methodologies. Change is needed, especially, in the design and delivery of blended learning environments within the context of mixed and virtual realities.[9]

B. Interactivity

Back in 1997, Rod Sims wrote an article, *Interactivity: a Forgotten Art,* where he argues multimedia in itself is not inherently interactive, unless the value in an instructional resource is a function of the design effort, not the technology.[10]

Interactivity of multimedia becomes important only when the level of interaction is adequate or relevant to facilitate the acquisition of knowledge or the development of new skills and understanding. Thus, educational products will likely require more complex forms of interactivity depending on strategy and application. "It is the use of the products which integrate multimedia elements where interactivity becomes important. These technologies are of value because of the capabilities they provide to learners in being able to interact with and manipulate the real world.[11]

Many of the interactive educational products that Sims hypothesized as needed to facilitate the acquisition of knowledge or the development of new skills and understanding are now available.

Such new interactive products are mixed and virtual reality technologies. Through a blending of senses, more than often using visual displays and auditory devices, a mixed reality evolves into the experience of a blended virtual and real world.

The space between these two extremes is called mixed reality where there is some blending of virtuality with the real world.

Furthermore, augmented virtuality takes on a mostly virtual world and enhances it with some real objects.

These technologies have a broad range of applications in which some elements of the real world can be blended with digital objects depending on learning or training objectives.

In the early 1990s, the Boeing Company developed augmented reality-based systems to support maintenance and assembly for aircraft wiring harnesses. [12]

Also during this time, Feiner and colleagues at Columbia University developed a test bed system for automating the design of augmented realities that explain maintenance.[13]

As we observe the progression of multimedia from voice recording, radio, television, and video to sophisticated mixed reality, video games and simulations, we see that the quality and quantity of interactivity is the chief consideration in the development of these technologies. Interactivity along with its learning objectives ought to direct your technology choices while your technology should never solely drive your learning objectives.

C. Game-simulation

One type of mixed and virtual reality is games and simulation. Simulations have been shown to provide an authentic context to facilitate learning about relationships among realistic contexts, environments, actions and outcomes.[14]

The strength of simulations is that they present interactive opportunities for learners to manipulate an array of interrelated variables within a complex system as a method to better understand how specific actions can influence outcomes. [15]

In real training environments where safety is a dominant concern, simulations can provide novice learners with a safe environment and a place where alternative decisions can be tested in support of learning.[16]

However, not all learners can adapt easily to a simulated learning environment. Learners who lack a foundational understanding of domain-specific concepts, relationships and problem solving strategies may be challenged by the complexity of the target learning environment.[17]

On the other hand, to support the novice learner's development of cognitive and metacognitive skills as well as problem solving strategies within the simulated learning environment, using embedded scaffolding can be integrated within the learning technology.[18]

D. Psychomotor

There are a number of psychomotor/visuo-motor skills that are developed through using interactive animations, simulations, and gaming. These skills are not only useful in automotive technology but in many other fields as well.

For example, capping the Gulf oil spill required pilots who operate the robots from comfortable-looking, La-Z-Boy-type chairs. The pilot is in front of 11 monitors, DVD video recorders, and a sonar screen and through the use of joysticks, maneuvers the machine through the water.

"It's the most fun job in the world," said Jeffrey Harris of Oceaneering International Inc., which is providing about 14 robots to work on the Gulf spill. The joysticks resemble the ones used in fighter jets and, he joked, they're "a little more sophisticated than your Gameboy."[19]

It may be no joke at all. In particular, video game players have been shown to possess decreased reaction times, increased hand-eye coordination, improve spatial skills and augmented manual dexterity.[20]

E. Rigor/relevance framework

The staff at the *International Center for Leadership in Education* developed the *Rigor/Relevance Framework* as a tool to examine curriculum, instruction, and assessment in order to improve student achievement.[21]

The continuum – known as the Application Model– employs five levels of action:

1. Knowledge in one discipline
2. Apply knowledge in discipline
3. Apply knowledge across disciplines
4. Apply knowledge to real-world predictable situations
5. Apply knowledge to real-world unpredictable situations

The Rigor/Relevance Framework uses four quadrants that represent levels of learning. On the Knowledge axis, the framework defines low rigor as Quadrants A (Acquisition) and B (Application) and high rigor as Quadrants C (Assimilation) and D (Adaptation).

In designing blended learning environments, this framework is useful so that learning objectives are interdisciplinary that lead to real life application.

III. STUDY OVERVIEW

This curriculum-based assessment study had three primary objectives: to create a blended learning environment within an automotive technology course to enhance content (more relevant and engaging for students), to introduce and study the effects of interactive game-simulation based eLearning modules, and to initiate a comparative analysis of *Argo* and *CDX*—leading automotive eLearning training programs.

The instructor set up Argo student accounts and lap tops, assigned modules, and circulated among students to provide one-on-one assistance if needed.

IV. METHODOLOGY

This curriculum-based assessment study began in September, 2010 with a pilot trial of *Argo* and ended in December 2010. The Automotive Technology 2 course began with 6 students between the ages of 15 and 17. **A**pproximately 30% students of this study have special education needs.

Students completed a preliminary anonymous 20 questions self-assessment pre-test designed to identify: (1) personal knowledge of eLearning; (2) strengths and weaknesses in using *CDX* and *Argo* ; and (3) each student’s level of confidence in their ability to perform target skills on a scale of 1 to 3: 1=No Confidence, 2=Some Confidence, 3=Total Confidence.

The primary focus of this pre/post student survey was to assess the overall effects of a blended learning environment, not individual student performance. It was collected and assessed as a group to establish general assumptions as one way to evaluate the interactivity of eLearning training programs. This blended learning environment used a constructivist workshop model that was student centered in the classroom environment where students collaborate with each other and work on projects together.

The survey results were tabulated using Microsoft Excel and presented in the form of graphs. Each graph (pre and post test) was compared and contrasted to provide numbers to indicate any change in confidence level in described skills.

V. RESULTS

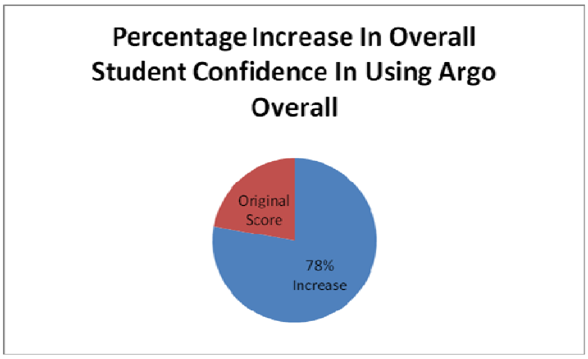
The survey results indicated the overall average student confidence and comfort level increased approximately 78% from the duration of the study.

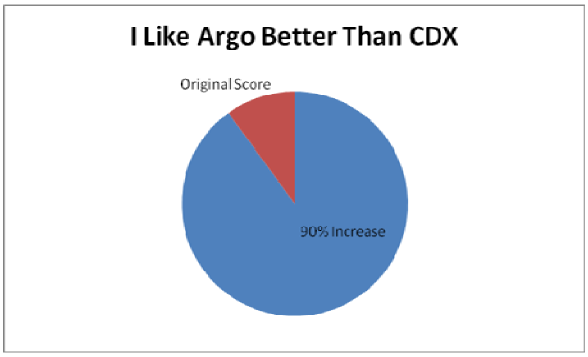
Moreover, three notable student responses within the survey questions correlate with cite studies:

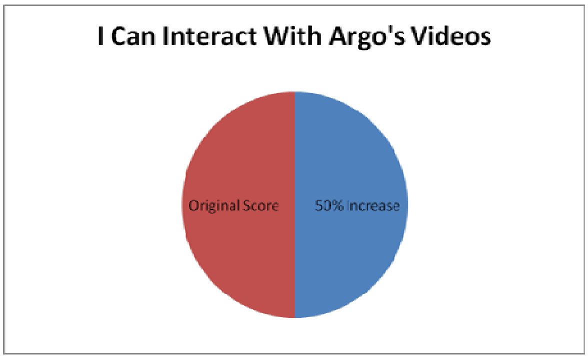
I will like Argo, jumped 73% in student confidence

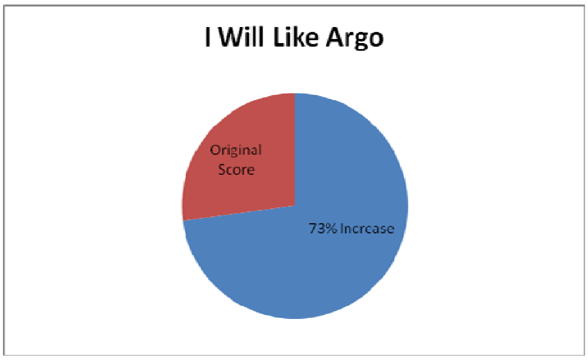
I like Argo better than CDX, jumped *90%* in student confidence

I can interact with Argo’s videos, jumped 50% in student confidence









In addition to stated survey questions, the survey asked students for any comments they wished to share in using *Argo* or *CDX*.

"Argo is better! Because it is more interesting and interactive."

"Argo is very interesting & learning a lot of good modules and visuals."
"It's a quick learning thing. You pick up things faster than book work"
"I like Argo because there are better examples."

VI. CONCLUSIONAND DISCUSSION

This brief study found that students prefer *Argo* over *CDX* primarily because of *Argo's* rigorous interactive animations and simulations which helped them understand complex automotive theories more clearly and at the same time found, *"It's a quick learning thing. You pick up things faster than book work."*

Moreover, in the prior study, students responded to the post test survey question with a score of 27% increase in confidence: *The visuals in CDX will help me better understand automotive technology.*

In this study, students responded to the post test survey question with a score of 50% increase in confidence: *I can interact with Argo's videos*, jumped 50% in student confidence, which is a significant increase when compared with *CDX's* 27%. In my prior study, I noted that student attention span diminished rapidly viewing *CDX* video and thus needed more interactivity to hold their interest. However, with *Argo's* interactive animations and simulations, the students for the most part, were engrossed as if they were playing video games.

This correlates with cited research, *Interactivity: a Forgotten Art?* "It is the use of the products which integrate multimedia elements where interactivity becomes important."

In the design of any new blended learning environment prototype, there are many bugs to work out. And thus to draw broad conclusions from this study on a limited number of student participants and a particular focus on interactivity is premature.

A more comprehensive comparative analysis of *Argo* and *CDX* would require assessment using other criteria for evaluating eLearning training programs. One such program model is Thair M. Hamtini's, *Three stages of eLearning evaluation based on an adaptation of Kirkpatrick's four levels of training evaluation.* Simply put, the three stages are interaction, learning, and results.[22]

A follow up study should include a number of assessments from the theoretical to the practical in learner outcomes. A big question would be: How effective is *Argo* in facilitating student mastery of actual hands performance in real shop/life applications? From my limited use of Argo, I do see promising results in hands-on applications, but more study is needed, too.

The goal of this article has been to discuss designing next generation blended learning environments within automotive technology. Its primary question was if student confidence in using eLearning training programs increased if the level of interactivity increased. The results were clearly yes, and this finding is supported by the literature.

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