VIRTUAL FIELD TRIPS:
SYNTHETIC EXPERIENCES AND LEARNING

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Founded on the principles of experiential learning and anchored instruction, Virtual Field Trips utilize state-of-the art technologies to create immersive, multi-sensory, interactive experiences with real world environments. Virtual Field Trips are designed to be an integral part of a technology-enabled educational system to teach targeted material and motivate students.

SYNTHETIC EXPERIENCE ENHANCED EDUCATIONAL SYSTEMS

This demonstration involves discussion on, and interaction with, the outcome of a recent project headed by Dr. Janis Cannon-Bowers at the University of Central Florida. We will demonstrate our “Virtual Field Trip” interactive software that was designed to provide exposure to, and experience with, real-world contexts for grade school students. This effort focused on developing innovative teaching approaches and methods both to address the problems faced by Florida’s educational system, and also as a means to leverage Central Florida’s unique talents in the MS&T and entertainment industries. This project sought to utilize advanced, interactive dynamic media approaches in classroom-based settings to produce a technology-enhanced classroom environment that is more effective in teaching targeted material and also more motivating to students. While there are any number of subjects or domains that could benefit from interactive teaching approaches, we opted to focus initially on reading skills for reasons described below.

Our goal with this demonstration is to share with the Human Factors and Ergonomic Society community a means of more fully expanding their research and development base into K-12 education research. Recent advances in the use of technology to build environments that are psychologically valid (e.g., virtual environments, high fidelity motion, environmental and visual models, high-end graphics) have dramatically increased designers’ ability to create learning environments centered around the principles of experiential learning and anchored instruction. We use the term synthetic experience to describe the outcome of such efforts; that is, synthetic experience is created deliberately and artificially in learners to replace, augment, accelerate, or broaden their actual experience in the world. For example, the fields of modeling, simulation and training and digital media both seek to exploit simulation technology to create a human experience through the presentation of a story or scenario. These stories or scenarios are typically delivered using advanced digital media to create a rich multi-modal (e.g., auditory, visual) experience that is not possible in a uni-directional presentation mode. This demonstration will show how we have leveraged the skills and technologies emerging from the military training communities to create “proof-of-concept” learning tool for use in grade school reading curricula. We first describe the specific problem being addressed and then briefly describe the pedagogy and development behind our Virtual Field Trip project.

Problem Being Addressed

Public School representatives express concern that their students, particularly poor, minority children, lacked the real world experiences (and hence, vocabulary) necessary to understand the content of grade-level reading material, often resulting in failing scores on state-wide standardized tests of reading comprehension. For example, how is a life-long Floridian child to understand dog sledding in Alaska? Unfortunately, most school systems currently lack the financial resources to take their students on the field trips that would allow them to build this basic knowledge. Moreover, as in the case of Alaskan sledding dogs, children in many areas would never have the chance to be exposed to such an environment. Yet without this essential knowledge base, many of these children will struggle to understand reading material, continue to perform poorly on measures of reading comprehension, and remain at-risk. Synthetic experiences provide an opportunity to address this challenge. With the help of well-designed technology, it is now possible to bring the world into the classroom and expose our children to experiences that would otherwise be impossible.

Our country’s public education system has garnered much attention in recent years, both at the national and state level. For example, the No Child Left Behind Act represents a federal program focused on utilizing proven instructional methods to ensure that every child learns to read by the third grade. The goal is to support learning (e.g., language skills and reading skills) in the early years in order to prevent reading problems faced later by adolescents and adults (Snow, Burns, & Griffin 1998). At the state level, Florida has similarly enacted the Just Read Florida program. This comprehensive, coordinated reading initiative is aimed at helping every student become a successful, independent reader. The goal is to ensure that every student read at or above grade level by providing teachers with improved access to innovative, creative, and effective strategies to help children learn to read proficiently.
Yet, according to a recent report by the Florida Department of Education (2001), much work remains to be done before these goals will be achieved. The stark reality is that only about half of Florida's fourth graders read at or above grade level. Only four in ten of our middle school students read at or above grade level. And fewer than four in ten of our high school students read at or above grade level. These statistics are alarming considering that failure to read proficiently has been cited as the most compelling reason that children are retained in the same grade, are assigned to special education, or given long-term remedial services. Furthermore, while the number of failing schools in Florida has dropped by more than half since 1999, this year there were still 176 ‘D’ and ‘F’ schools. Enrollment in many of these failing schools is comprised by large percentages (as high as 96%) of poor, minority students – children who typically struggle in class and who lack the ‘world knowledge’ necessary to understand the content of grade level reading material. Clearly there is a need for effective instructional strategies in the classroom to overcome these challenges.

ENHANCING CURRICULUM WITH DYNAMIC MEDIA

The focus of this project was to develop a dynamic-media based (audio visual) interactive presentation, designed to increase students’ word knowledge through a rich, synthetic experience of different environments (e.g., farm, ranch, fire station). This system is designed to complement the standard reading curriculum (e.g., Houghton-Mifflin Reading Series; Harcourt Marketplace), and is intended to serve as an advance organizer by providing necessary background and preparatory information to enhance students' subsequent reading experience. It is expected that our system will help students make better meaningful connections between the vocabulary and text of the reading material, leading to improved reading comprehension skills.

SELECTION OF INSTRUCTIONAL STRATEGY

To select the most appropriate instructional strategy for our project, we first reviewed several key sources from the educational and training literature, focusing on the use of technology in learning. Our review identified several theoretically-driven, empirically-validated principles for enhancing learning via technology. To begin, many lines of research into the science of learning and human performance converge on the conclusion that experiential learning (i.e., learning through experience) is a fundamental human process (e.g., Kolb, 1984; Kolb, Boyatzis, & Mainemelis, 2001). Rather than view learning in terms of outcomes, this perspective conceptualizes learning as a process, whereby concepts are drawn from, and constantly modified by, experience (Jonassen & Grabowski, 1993). In other words, learning is conceived as the process of creating knowledge, based on the transactions between the individual and the environment (Kolb, 1984; Jonassen & Grabowski, 1993). By exploiting recent technological advances in the MS&T and entertainment industry, we seek to provide students with a rich multi-sensory, authentic experience in the classroom that can effectively augment or serve as a proxy for real world experiences, and scaffold their acquisition of meaningful knowledge via an experiential learning process.

Similarly, anchored instruction or situated learning (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990; CGTV, 1992; 1997; 2000) refers to an instructional strategy based on the pedagogical principle that for learning to be effective, it must be anchored in a meaningful context for learners. In other words, learning is enhanced when learners can relate to the subject matter via past knowledge or experience. According to the Cognition and Technology Group at Vanderbilt (CTGV, 2000), anchored (situated) learning environments: enable learners to understand how concepts are applied and why they are important and useful; allow learners to understand how new information is connected to what they already know; allow new learning to be more easily integrated into existing knowledge and mental models; and, help students integrate their knowledge by employing multiple perspectives on the same problem.

Our dynamic media-enhanced educational system seeks to capitalize on the beneficial effects of actively learning through experience (i.e., follow an experiential learning approach to instruction). Furthermore, our system is designed to ensure that the technology-enhanced curriculum is grounded in a meaningful context to facilitate learning (i.e., utilize an anchored instructional strategy).

DETAILED DEVELOPMENT PLANS

A systematic development plan was undertaken involving the following activities. Curriculum development began by first reviewing the targeted Sunshine State Standards (as identified previously) with a reading specialist from the UCF College of Education and identifying the instructional objectives for the selected curriculum at the targeted grade level. We also developed preliminary specifications for a measurement plan to evaluate the effectiveness of our technology-enhanced system at the targeted grade level.

Learning gains will be measured using several metrics, including measurement of the program’s instructional efficiency in terms of the ‘time-to-complete’ reading of grade level books, relative to current levels. Next, we will modify, as needed, and employ standard classroom testing procedures to assess students’ performance on reading comprehension and vocabulary at the targeted grade level. Third, we will evaluate the level of motivation and engagement elicited by the system. Finally, we will develop additional metrics for future investigation, including: 1) tasks assessing organization of students’ knowledge (e.g., card sorts, concept maps); and, 2) problem-solving tasks assessing students’ ability to apply their new knowledge to novel situations. As such,
our proposed measurement plan involves not only utilizing current testing procedures, but also identifying areas where the development of additional metrics for assessing learning gains and student motivation are warranted.

Our development plan also included specifying and addressing our project’s materials and equipment requirements. This included purchasing the necessary reading books to provide the overall theme and relevant content for the VFT and also procuring additional equipment, such as a digital camera and editing workstation, with the supporting software. Additionally, we investigated the possibility of leveraging existing media and techniques. For example, relevant features of the U.S. Navy’s VISIT (Virtual Submarine Introduction Tour) training program were adapted for use in the prototype VFT.

**VFT PROTOTYPE DEVELOPMENT**

Having established a better understanding of our target population’s needs and limitations and having assembled the highly-skilled personnel required for this project, we outlined and carried out several critical tasks to proceed with the development of the VFT prototype. These included: delineating the story generation process; conducting initial field testing and establishing a production schedule; and, designing scenarios and constructing a virtual world. Each of these will be described in more detail next.

![Figure 1. Preliminary Storyboard for Virtual Field Trip](image)

**Field Testing and Production Schedule**

Decisions were made as to which platform (e.g., Apple) and supporting software (e.g., QuickTime VR) optimally meet our VFT prototype development needs, and we subsequently procured the appropriate hardware/software equipment as well as any additional equipment (e.g., digital camera, 360-degree lens) that was deemed necessary. A trained cinematographer was brought on board, camera equipment was field tested, and trial images were generated for software testing. The standard terminology for identifying VFT components (e.g., node, hot spot) was also established. The production schedule for filming of the introduction for the VFT prototype was finalized and executed, under the direction of our cinematographer. Local students were recruited through a local Girl Scout Troop to participate in the filming of the introductory film clip and response to the project was very favorable.

![Figure 2. Collection of materials for virtual world](image)

**Scenario Design and Construction of Virtual World**

We created a rich synthetic environment by ‘stitching’ together different scenario-based frames, which would allow students to navigate in virtual world (see Figures 2 & 3). Within this synthetic environment, scenarios were designed that illustrated important concepts and included the targeted vocabulary. To construct this virtual world, we gathered and produced an exhaustive library of media, from a variety of different settings and objects. Interface media was produced and interactive elements were generated and incorporated into the VFT.

![Figure 3. “Stitching” media](image)

**Story Generation Process**

This effort included extraction and categorization of target vocabulary words from standard reading curriculum. Relevant narrative material was also extracted to serve as basis for themed ‘activities’ or ‘events’ in the prototype VFT, ‘Nature Walk’. The story generation process was specified and a target date was set for completion of the ‘narrative’ that would serve as the organizing framework for VFT prototype. See Figure 1 for an example of the storyboards generated during this design process. This conceptual design demonstrates the principle components of the VFT program.
VFT PROTOTYPE – INITIAL TESTING

Initial user testing of the various components of the VFT prototype was conducted with a small sample of 5-10 year old children. The children were observed as they interacted with the interface and feedback was solicited from the children regarding the ease of use and enjoyment of the different features (e.g., navigation, pedagogical agent, activities). The results of this initial testing highlighted important issues to be addressed in the next iteration of the prototype, such as including instructions in the introduction on how to use the mouse to navigate in the VFT, enhancing the learning activities with both audio and text presentation of the targeted vocabulary words, and introducing elements to make the activities more interesting (e.g., reward, challenge).

VFT CLASSROOM IMPLEMENTATION PLAN

The prototype VFT program is designed to both help second grade students improve their overall reading comprehension skills as well as assist teachers in implementing the reading curriculum more efficiently than through traditional instructional methods. Using captivating and relevant computer-based learning activities, the VFT increases students’ exposure to targeted vocabulary words prior to beginning a new story. Such preparatory activities would be expected to assist students in more easily reading and comprehending these stories. To enable teachers to effectively incorporate the VFT program into their lesson plans, an important part of our project also involved specifying a practical VFT classroom implementation plan.

Figure 4. User interface of Virtual Field Trip including Scooter

USER TESTING AND REFINEMENT OF PROTOTYPE SPECIFICATIONS

We will continue user testing of the VFT prototype, soliciting feedback and input from representative samples of teachers and students. Responses from these users will be fed into our iterative design process to further refine the product specifications of the VFT prototype. We will also enlist the expertise of additional educational representatives in further developing a valid measurement plan to assess the effectiveness of this new educational system. Once the VFT prototype is completely tested and evaluated for functional readiness, the next step is to empirically evaluate its effectiveness in achieving the targeted learning objectives, as described next.

EMPIRICAL EVALUATION OF PROTOTYPE

The main hypothesis of this project is that our technology-enhanced educational system will help second grade students improve their overall reading comprehension skills and assist teachers in implementing the reading curriculum more efficiently than through traditional instructional methods. We will work closely with local administrators to select at least three participating elementary schools to empirically test this hypothesis within the context of regular education classrooms. The instructional effectiveness of the VFT computer program will be evaluated on the following four levels: 1) building of students’ vocabulary and word recognition; 2) time spent on completing reading curriculum; 3) students’ self-reported evaluation of system; and, 4) teachers’ self-reported evaluation of system. This research study will use sound scientific methods to systematically investigate the effectiveness of our dynamic-media enhanced educational system. Our long-term objective is to establish a comprehensive research agenda where issues involving technology-enabled educational environments may be systematically explored and investigated. Ultimately, the goal is to identify guidelines for optimizing the design of virtual field trips and other dynamic-media enhanced systems to promote learning across a variety of domains. Figure 4 shows the user interface including a pedagogical agent named “Scooter”.

FUTURE VFTs PLANNED

Ideally, once the theoretical and technological issues surrounding the development of these educational systems have been addressed, the possibilities for extending these findings to other domains are endless. For example, collaborating with partners in Alaska will enable us to explore the possibility of developing an ‘Iditarod VFT’ on this famous race and familiarize Florida students with a real world environment that is in stark contrast to their own. Similarly, a ‘Chinatown VFT’ would be an excellent venue to enhance students’ awareness of cultural diversity. Our vision is to create a web site that allows groups around the world to post VFTs from their area that can then be accessed by teachers for use in the classroom. The details of such a site are under investigation. We believe that VFTs can provide students with the real world experiences they will need to ensure their continued success in today’s knowledge-rich, global society.
REFERENCES


