Report
on
Instructional Design using Rich Media and Multiple Delivery Systems for Online Self-Study.

submitted to
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This paper chronicles a capstone project for the development of an online self-study distance learning course on the topic of Attention Deficit Hyperactive Disorder (ADHD). Course content is from a chapter in the Project EXCEPTIONAL curriculum "Children and Challenging Behavior: Making Inclusion Work" edited by Cindy Croft and Deborah Hewitt (2004). The project is examined from planning through development, usability testing, adjustments, and final deployment.

Background

Online special needs training in Minnesota includes three primary tiers: two already exist and the third was developed for this project. At the top is a web platform for instructor lead training known as *Eager-to-Learn*. The technology interface was developed by myself and deployed in 2003 through the Minnesota Childcare Resource and Referral Network website (CCR&R) for the purpose of providing in-depth instruction to Project EXCEPTIONAL trainers (and others). Short introductory *Info Modules* designed for the lay person represent an entry level tier and are offered on related topics at the Center for Inclusive Child Care (CICC): *www.inclusivechildcare.org.* Missing was an intermediate tier, something that would serve as a primer for *Eager-to-Learn's* in-depth instruction, targeting professionals and those who would like to enter the field as special needs trainers or consultants. Filling this gap with new self-study courses based on the recently published Project EXCEPTIONAL curriculum entitled "Children and Challenging Behavior: Making Inclusion Work" was the perfect choice: overhead using this format is minimal and learning potential is significant. Hence, the genesis of this project.

My initial thought for deployment was the creation of a typical e-learning platform featuring an html *frameset* with links in a left column that would open documents in a *main frame.* The idea is that users would read documents, review worksheets, and then finish with an online competency test: not very exciting, questionable in usefulness, and requiring a high degree of motivation. After all, some users may have limited technical skills, and although credit options are being explored,

there currently isn't a big payoff for course completion. Thus, built in motivation is limited, rendering this approach ineffective for meeting learner needs.

Our objective is to engage learners, provide them with resources they can take into the community, and spur them on to the advanced training offered by Eager-to-Learn. Accomplishing this requires a special approach.

Initial Development

The decision was made by CICC director Cindy Croft to develop the first self-study course using the chapter "ADHD: Seeing the Disability Behind the Behavior" written by Dea Anderson and Colleen Pachal. At the same time, my discovery of new text-to-speech (TTL) technologies with AT&T natural voices lead to the investigation of using this technology in a multiple delivery platform. Proliferation of iPods and similar devices provide new opportunities for a "book-on-tape" approach: listening while driving, walking, or jogging, and then bringing the audio version with you into the community for others to hear—great potential, but what does the research indicate?

1. Multitasking with audio seems to work well, but why?
2. Is it pushing the envelope to employ this technology in a serious distance learning environment?

Answers to these questions are revealed in research. A particularly insightful angle is noted in the article *When Auditory Presentations Should and Should not be a Component of Multimedia Instruction* by Leahy, Chandler, and Sweller. "The hypotheses were generated by cognitive load theory…". This theory splits cognitive load into long-

term memory and working memory. “Long term memory is limitless,” whereas working memory, that which can be perceived and retained at any given moment, is very limited (Leahy et al 401). In this context, working memory is split into perceptual channels: audio and visual. The cognitive relationship between these channels is referred to as “The Modality Effect.” Detailed quantitative research by the authors clearly indicates, “…the amount of information that can be processed using both auditory and visual channels [simultaneously] is larger than that of a single channel. (Leahy et al 404)

I suggest this supports the reasoning behind why one can effectively listen to a book while driving (as an example). Listening represents the auditory cognitive channel, driving is primarily visual, and thus represents the visual cognitive channel. Together they combine for the total cognitive working load. Increasing the cognitive working load via a simultaneous blending of auditory and visual channels has tremendous implications; not just for books on tape while driving, but for an entire range of applications, including *rich media* which will be discussed later. Adding portable, mass storage, and asynchronous features to a wide range of audio material extends potential and has tremendous implications in a world where demands on our cognitive load continually increase, but where working memory capabilities remain the same.

In preparing the text for audio deployment, I broke down the written chapter into three essentially equal parts or units with listening lengths of about 20 minutes. Text was arranged in a linear sequential order. Anecdotal sidebars were placed in-line with primary content. Aural cues and narration text were added so listeners could retain context and order, and have a sense of placement within the text: e.g. main headings preceded each sub-head to compensate for the lack of visual anchors. AT&T natural voice technology

was used for the text-to-speech (TTS) application. For variety, voices were rotated between a female with a British accent and an American male. The files were posted for testing as follows:

1. An Audio stream using M3U files for universal compatibility: opens with any computer's default audio player. Encoding resolution retains quality while allowing for uninterrupted streaming even with dial-up connections.
2. MP3 files for download and delayed listening on a computer, or for easy transfer to a portable audio player like an iPod.

Only unit one (of three) was posted for testing.

Audio Component Usability Results

Usability testing was conducted using two approaches. The first was a carefully crafted online 16 question survey designed to determine the effectiveness of using audio in a distance learning environment. Considered were the effectiveness of construct (voices, audio cues, added narration), and effectiveness in terms of comprehension. The second approach was anecdotal: informal critiques gleaned from work colleagues and Metropolitan State University (MSU) Technical Communication graduate student colleagues, the latter are documented on a messageboard thread regarding the study.

There were 13 completed survey responses: five from MSU graduate students and eight from professionals in special needs related fields. Survey highlights are as follows:

- Most respondents had a moderate technology comfort level and listened online via high speed connections.
- Everyone found that the technology worked well: no difficulties.
- Most listened to the entire segment though this was not required.

- Comprehension was good with 46% saying they seemed to recall basic points while 23% claimed detailed recall.
- Most found the voices interesting and easy to understand: pacing seemed to be just right and voice rotation was refreshing.
- 84% viewed this technology as favorable to very favorable.

Downside comments included references to personal learning styles; some learners are not predisposed to learning via audio. There were also comments pertaining to choppiness due to ill-placed pauses and a third voice used to introduce sub-topics. Changes implemented as a result of usability testing are as follows:

- The third voice associated with subtopics or section markers was eliminated. Now, the voice used to narrate a section also introduces that section.
- Aural cues are now limited to heading—sub-heading announcements. Numerical cues like “unit 2 section 1” seemed confusing and have been eliminated to enhance clarity and simplicity.
- Voices are now rotated less frequently for greater consistency.
- Pauses have been adjusted. They are now in the right places but never too long (primarily .25 seconds, and .5 seconds between main sections).

This usability study confirms the strength of using audio as a supplemental delivery system. Learners like it. The technology is adaptive to a variety of lifestyles because it is portable, audio can address learners who are less predisposed to visual learning, and audio has an edge in being able to grab a piece of the cognitive pie not available via typical screen reading based approaches to distance education.

Unforeseen or "escaped" benefits of audio delivery include the ease with which critical knowledge on topics such as ADHD and Autism can easily be deployed for community outreach once course learning is complete. The spoken word has great impact potential for community gatherings or overwhelmed parents of limited resources who may be more inclined to listen to a segment on Autism at their convenience versus reading a flyer or printed page. This could also address literacy issues, and topics could be offered in a variety of languages.

Visual Component Development

My research into audio including cognitive research and the previously mentioned modality effect pointed me in the direction of rich media design: an interactive approach incorporating user interactions plus audio and visual elements. A noteworthy argument for this approach is found in the article *Context and content visuals and performance on listening stimuli* by April Ginther. The author looks at computer-based testing (CBT) for the Test of English as a Foreign Language (TOEFL) amongst low and high-proficiency groups using dialogues/short conversations, academic discussions, and mini-talks as stimulus types (Ginther p 133). Her conclusions are varied but they essentially note that "when content visuals accompanied Mini-talks, the effect was slightly facilitative; when context visuals accompanied Mini-talks, the effect was slightly debilitating" (Ginther p 157). Content visuals refer to information that supplements audio content such as "a photo, graph or drawing that is related to the content of the verbal stimulus (Ginther p 134). Context visuals might be a photo of a situation or author that serve as visual cues for audio content. Arguments for content versus context visuals are extrapolated. For

example, as noted "all of the participants, regardless of level of proficiency, were apparently able to use the information presented in the content visual to help create a mental representation of the text" (Ginther p 158). Nevertheless, context visuals are useful in certain circumstances, particularly as transition markers. Both visual types have "…potential to ameliorate the effects of increased difficulty that may occur with the use of longer audio stimuli…" (Ginther p 163).

Not only does audio have much to offer as a secondary delivery system, but audio interacting with visual elements in a rich media environment makes perfect sense for dynamic learning. Another advantage of rich media as deployed for this course was the ability to create sequential linear presentations. A common thread through many of the *works consulted* for this project are references to confusion or cognitive overload due to daunting and cluttered interface designs. Having too many links, repeated links, and a confusing array of choices can cause learner anxiety and greatly reduce cognitive capacity before the learning process even begins. A linear slide based rich media approach addresses this problem as relates to content presentation (more on overall interface design later).

In this project, once the visual presentation loads into the learner's browser, content is presented step-by-step starting with a brief technology-benefits-course structure orientation. This is followed by course content which includes built in parent stories presented as text with optional audio to provide a break from reading. Interspersed throughout are "learning reinforcements" or quiz questions with detailed feedback for correct and incorrect responses. Pictures are also included as context cues and text is easy to read – no scrolling required. Learner's have the opportunity to review "learning

reinforcement" responses after the final question and a floating navigation bar in the ADHD course enables quick navigation to any point in the course.

Visual Component Usability Results

Usability testing was conducted using two approaches. The first was a carefully crafted online 22 question survey designed to determine the effectiveness of this particular rich media approach in a distance learning environment. Considered were the effectiveness of construct (orientation, benefits, unit outline, and content), effectiveness when compared to static reading, and effectiveness concerning quiz questions or "learning reinforcements." The second approach was anecdotal: informal critiques gleaned from work colleagues and MSU Technical Communication graduate student colleagues, the latter are documented on a messageboard thread regarding the study.

There were 13 completed survey responses: Six from Metropolitan State University Technical Communication grad students and eight from professionals in special needs related fields. Survey highlights are as follows:

- Most respondents considered themselves "…comfortable with technology but no expert." Their internet connections were primarily high speed, they were not bothered by download times, and for all but one person, the presentation "…loaded and started playing: no error messages". The remaining individual had to go through a self-guided *Flash player* update.
- 73% of respondents liked the format and indicated that it "…was easy to follow and understand." Most did not skip the navigation explanation and consequently had no navigation difficulty.

- Over 60% strongly favored reading from within this format and felt comprehension was higher than straight text reading.
- 91% chose not to mute the audio narration of *parent stories*, and most thought this feature provided a refreshing break from reading.
- "Learning reinforcements" were very positively received by 75% of respondents.
- Most found these quiz questions easy to navigate and 68% used the quiz review feature.
- 78% favorably rated the interface design as being professional in appearance.

Comments from the survey and graduate student messageboard precipitated the following changes:

- Text was reworked and chunked for better screen reading; paragraphs were broken down into smaller segments, subheads and bulleted lists were added.
- "Learning Reinforcement" button order was changed. The default order was not intuitive and caused confusion.

As in the case with audio, usability results for the visual component were positive and indicative of the enhanced learning potential embodied in a rich media approach.

Rich media components can easily be deployed offline in community settings, as dynamic learning components complete with audio, video, and learning reinforcements. The potential for audience engagement far exceeds that which is available via the PowerPoint presentation.

Bringing It Together: Classroom Interface Design

Once the primary audio and visual components were complete, the final step was deployment in a seamless online classroom setting. One with a simple, clear, minimal, and directive approach that was consistent with primary course components. This translates as follows:

- A clean interface that provides brief but clear instruction on what to do upon entering the online classroom.
- A small number of primary links in an always visible page-top frame. The preferred order in which users access information is reflected in the left to right order of the links.
    - *MAIN:* this initial page uses bulleted lists to note *core competencies* met, *course objectives*, course structure and how to proceed, and technology requirements.
    - *VISUAL:* This short page begins with a Flash Player test link to insure technical compatibility. It is followed by links to the rich media course units and finally a link to the competency exam which is taken by the learner upon course completion.
    - *AUDIO:* The first set of links are for listening to course content as real-time streaming audio. The second set of links are for downloading content as mp3 files.
    - *SUPPLEMENTAL:* This page contains handouts and worksheets. The documents are embedded as FlashPaper with optional PDF links below.

Through ongoing use on the CICC website, we have found FlashPaper to be a preferred and more user-friendly online document format than PDF.

- *GLOSSARY:* This resource is an indexed comprehensive glossary of special education terminology. It provides definitions related to the entire special needs sector.

Usability testing of the interface as a whole is forthcoming. Based on initial positive feedback from likely users, and previously discussed research on the benefits of a clear and simple design, the prevailing sense is that this design is on the right track. Tweaks will be implemented based on final usability test results.

Future Versions

At this point, the instructional design approach used for these CICC self-study courses will remain intact for future offerings, but key components will be enhanced. Advanced *Flash* design procedures will be implemented in future versions. Additional audio, including audio based interactions will be deployed as will video clips. The goal is to increase the *media richness* factor. New Flash video compression technology (FLV format) will enable streaming video, even with dial-up connections. And a linking approach to audio and video content will allow for nearly immediate loading of *FLASH* modules since additional content does not need to load with the rest of the *movie.*

Interactive artificially intelligent animated characters will also be deployed as a help tool and as a comprehensive terminology resource. Using the XML based Artificial Intelligence Mark-up Language (AIML) a custom terminology database can easily be constructed. Although deployment of this technology will be subject to rigorous testing, this has the potential to dramatically elevate the level of media rich interactivity.

The design of these CICC self-study courses elevates the standard for this type of online training. And the future holds in store great promise for learners, and offers additional benefits and opportunities for community outreach.

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