

**Variable Speed Playback of Digitally Recorded Lectures:
Evaluating Learner Feedback**

By

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Abstract

This paper describes the deployment of variable speed playback (VSP) capability for use with a media player application on a personal computer, and an evaluation of the utility of VSP to students watching recorded lectures. Variable speed playback was made available to undergraduate students taking a university accounting course. An analysis of responses to a class survey indicates that students generally found VSP to be quite valuable. Many students reported that accelerated viewing rates kept their attention longer, and provided significant timesavings. Most users preferred an accelerated speed of at least 1.5 times normal, and several users reported watching the lecture material comfortably at speeds of twice normal and higher.

Introduction

In recent years a convergence of technologies has made the production and distribution of digitally recorded learning material increasingly convenient and inexpensive. Universities and other educational institutions have taken advantage of these technologies to offer innovative “distributed learning” opportunities, including recorded lectures. The combination of streaming media technologies, high-speed networks, and media players running on standard computers have made lectures available to students far beyond the doors of the lecture hall, and on a schedule that reflects those students’ preferences rather than the lecturer’s timetable.

These digital and streaming video technologies allow the student viewers of this material to choose when and where they watch lectures as well as the order in which they view material. They can pause, “rewind”, and replay portions of the lecture at their whim or as they deem necessary or desirable. Beyond these fundamental options, however, video remains an essentially linear medium, and viewers have little control over the finer elements of content playback. Variable speed playback represents a significant increase in user control over this linear medium. VSP, also known as Time-Scale Modification ([TSM](#)), is the dynamic adjustment, at the moment of playback, of the rate at which audio-visual content is presented. Students can use VSP to speed through boring or redundant material, and to slow down in order to carefully monitor interesting or challenging segments.

Brigham Young University ([BYU](#)) has deployed VSP technology (in the form of the **2xAV™ Plug-In** by [Enounce, Incorporated](#)) as an enhancement to a pre-existing lecture distribution project. An evaluation of the use and perceived value of VSP technology was conducted by surveying students who viewed the digitally recorded lectures. This paper describes the deployment process and reports on the results of the student survey.

Background

In the Spring of 2000, the BYU School of Accountancy and Information Systems ([SOAIS](#)), in conjunction with the Center for Instructional Design ([CID](#)), released an online introductory accounting course entitled “Introduction To Accounting: The Language of Business”, This course currently serves 2,500 major and non-majors a year at the university. It is a hybrid course combining 50 hours of highly-indexed video lectures ([Microsoft Windows Media](#)) synchronized with rich media slides and animations ([Macromedia Flash](#)). The course was designed to give learners a high degree of control over the interface and instructional content through a number of navigational tools: detailed lesson indices, custom player controls, and bookmarks.

Though this course had generally been highly rated by students, earlier course evaluation results indicated a strong desire to dynamically control the pace of the lectures. Students expressed the desire to accelerate through repetitive sections of the lectures, and skip past content areas in which they already felt confident, *without the danger of missing important material altogether*—i.e. they wanted to be able to quickly skim through material or scan pages much like they might do with a traditional textbook.

At the same time, SOAIS and CID content creators identified course material that needed reworking. However, re-editing large volumes of video (to accommodate the great variance of accounting expertise in the class) could be a daunting and cost-prohibitive task. Lecture segments found to be excessively lengthy and/or repetitive would be adjusted in subsequent course revisions—but that was down the road. A solution was needed in the mean time that addressed the students' desire to control their own learning and the pace of the lectures.

It was decided that the addition of a variable speed playback feature would significantly enhance the students' experience while at the same time allowing BYU to realize a greater return on their initial investment in this course. The Enounce 2xAV Plug-In provided exactly this functionality, and could be purchased and installed on any personal Windows™-based computer. The 2xAV Plug-In works with the most popular Windows media players, and enables those players to speed up (or slow down) audio-video presentations from 1/3 to 2.5 times the recorded (real time or normal) speed. Significantly, both speeding up and slowing down the audio is accomplished without pitch distortion (i.e., voices do not sound like “chipmunks” when accelerated, nor like Darth Vader when slowed down.) Other course modifications planned at the same time included an enhanced table of contents, help menus, and support for Microsoft Internet Explorer.

Deployment of the Enounce 2xAV Plug-In

Once the solution had been identified, a way was needed to fund the solution. University policy prohibits the levying of unapproved fees on students. Software such as the 2xAV Plug-In was not an expense for which students could be charged an additional fee. If the department were to fund the necessary licenses, two issues would arise: providing the software free-of-charge in open computer labs was not seen as equitable to students who might not use campus labs; and providing the plug-in for all accounting students was not financially feasible. An arrangement would have to be made that served students equitably, and would be affordable within departmental budgets.

Finally, technical support and training issues for the new plug-in would need to be addressed, and face-to-face time with students was very limited and valuable.

In the summer of 2001, VSP tests began at BYU of the 2xAV Plug-In.

Workable solutions were found to the funding and training problems. A special arrangement was negotiated with Enounce to allow students to purchase an inexpensive timed license for the plug-in, lasting for the duration of the semester. Time would be taken in a face-to-face session with students to very briefly introduce and demonstrate the plug-in.

VSP abilities were made available for the first time to the 1,300 students enrolled in the video-based entry-level accounting course at BYU midway through fall semester, 2001. These students

attend one classroom (guest) lecture every two weeks with the remaining time spent viewing and studying the video-based lectures either in a computer lab, or using a computer at home or work.

The 2xAV Plug-In was initially available only through individual purchase to be used at home, or in on-campus “wired” locations. (BYU was rated the “41st most wired University in the US” by Yahoo! Internet Life magazine, 2001. There are numerous ports and wireless options across campus and in the university library that allow for learners to connect and view lessons with their own personal computers and laptops.)

Initially, due to unresolved lab and licensing issues, the 2xAV Plug-In could not be installed on university lab computers. By the publishing date of this paper, over 4,200 students had been through the accounting course, and arrangements had been made to install the plug-in on 500 computer machines in 4 campus computer labs. The lab installations were funded by a trial course “technology fee”.

Students appeared very excited about the product, and the bookstore had soon sold approximately 250 of the timed licenses. Many students discovered they could now view lectures at up to twice the normal speed and still understand all of the information presented by the lecturer. They received the instruction they needed at an accelerated rate, with the ability to skim through a video presentation without “skipping over material”.

Importantly for the institution, the decision to support the 2xAV plug-in did not require the re-writing of any programming code or re-editing of any video material. The plug-in was an add-on for the existing Windows Media Player already required to view lesson material. No server configuration or installs were necessary either—it was purely a client solution.

Evaluation of Variable Speed Playback

An evaluation of the use and utility of the 2xAV plug-in was conducted by taking a survey of students in the accounting course. The survey is presented in Appendix A. The survey was made available to the students via the web-based component of the course ([Blackboard](#)) between 10/15/2001 and 10/24/2001.

Survey Results

Response Rate

The number of results (sample size) retained for analysis totaled 625 (approximately 50% of course enrollees).

Use of the 2xAV Plug-In

Of the 625 results that were analyzed, 256 students, or 41%, reported using the 2xAV plug-in. These students had voluntarily purchased the plug-in from the University bookstore, for use on their individual computers, as described above.

Locations Where Recorded Lectures Were Viewed

Students were asked where they spent time viewing the recorded lectures. This question is relevant because the 2xAV plug-in was initially not installed in computer labs on campus. Thus if students used campus labs, the variable speed playback option was not available. As shown in **Figure 1**, 65% of lecture viewing time took place on a computer at home, and 29% took place in campus computer labs (no plug-in). Only 5% of lecture viewing time was spent on “other” computers on campus (personal laptops), with the remaining 2% (within an insignificant rounding error) taking place on a computer in the students’ workplace. Most students viewed the lectures at one primary location. Very few reported spending equal amounts of study time at two or more locations.

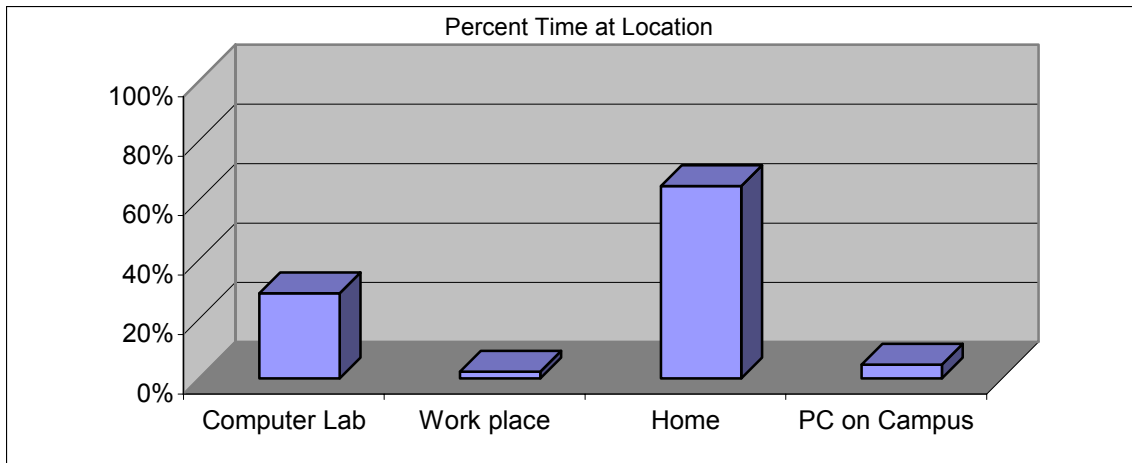


Figure 1: Locations where recorded lectures were viewed. Percentages are out of total hours spent viewing recorded lectures by all students responding to the survey.

Utility of the 2xAV Plug-in

The usefulness of VSP for the 256 students who reported using the plug-in is shown in **Figure 2**. The students were asked to rate usefulness on a scale from 1 (not useful) to 7 (very useful). The average reported usefulness measured 6.2. Only 4% of students (11) indicated that the plug-in was only moderately useful or less (by selecting a rating below 5). On the other hand, 61% of students (156) rated the usefulness at the top of the scale at 7 (very useful). The remaining 35% (89 students) rated the plug-in’s usefulness highly at 5 and 6 on the scale.

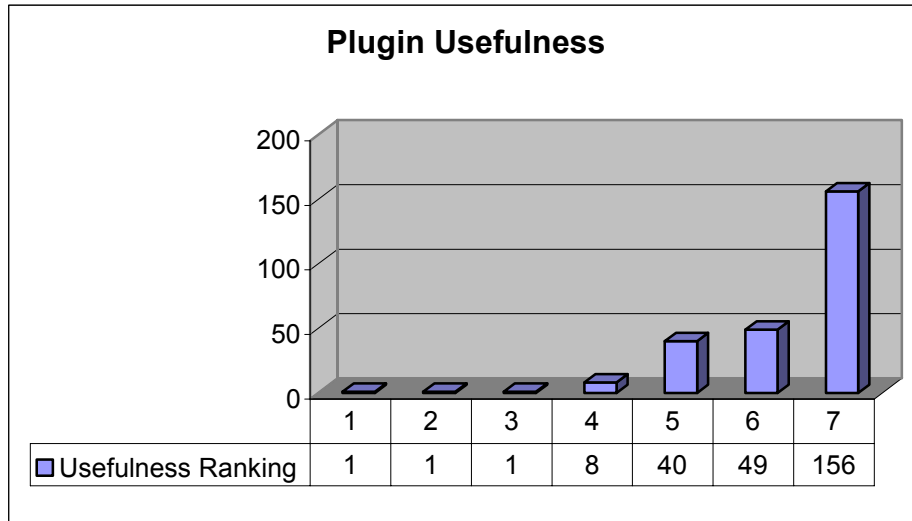


Figure 2: Utility of the 2xAV plug-in on a scale between 1 (not useful) and 7 (very useful).

Segments Commonly Skimmed

The students were asked to describe the type of segment they were most likely to accelerate through. Most students reported using the plug-in and VSP all the time. Of the students who did not use the plug-in for the entire lecture, most reported using it mainly during explanations or examples they felt irrelevant or redundant. Some of the specific video segment types commonly “skimmed” included the numerous “extra” examples provided by the instructor to help increase understanding on specific topics; and the step-by-step problem solutions or “walkthroughs”.

Playback Speeds Employed

The students were asked what playback speed they used most frequently. Speeds of up to 1.8 times real time shortened lecture time without diminishing comprehension. As shown in **Figure 3**, most of the students who used the plug-in reported using speeds between 1.3 to 1.8 most often. The average response to the question of the most frequently used speed was 1.6 times normal speed.

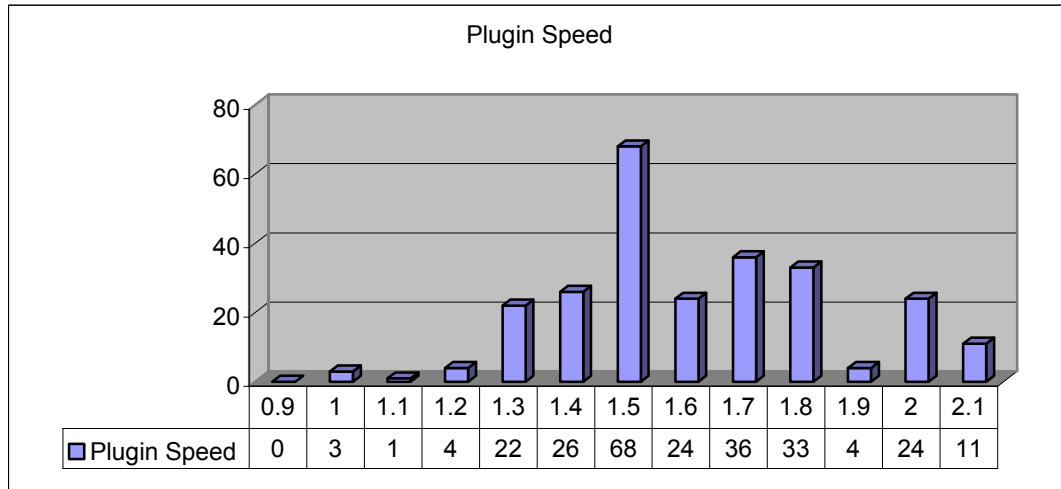


Figure 3: Histogram of most frequently used speed.

Why Students do *NOT* use the 2xAV Plug-in

The final question was intended to assess why students did *not* use the Enounce plug-in. Students were to answer this question only if they had previously stated that they did not use the 2xAV plug-in (question 3).

Of the responses for those who did not use the plug-in, the majority reported using the computer labs on campus where the plug-in is not installed. The rest reported difficulties when attempting to install the software on their home computers. Very few of the responses indicated that the normal speed was fine for them (i.e., that they did not find variable speed playback useful). In this regard it should be noted that since the completion of this survey, the 2xAV Plug-In has been installed in a number of campus labs. Use of these labs by accounting students is now high.

Practical Considerations Of Using the 2xAV Plug-In

Many new video indexing products provide methods for “browsing” or scanning video visually. They provide thumbnails sequences, text transcriptions of the audio and search capabilities. Searching on individual keywords or topics returns a list of relevant material. While important, this type of indexing, browsing and searching should not be confused with the needs of learners viewing linear instructional content. Once content has been located, the 2xAV plug-in allows one to quickly skim over selections to *hear* if they are indeed relevant. The tools are complementary, not competitive in the least.

Streaming video can be more accurately, and often more rapidly, scanned for needed content with the 2xAV plug-in than by the traditional fast forward or “spot checking” methods. This is

partially due to the lengthy buffering times frequently required by media servers and clients each time a new point in a video file is requested. If enabled at all, the fast forward features of the RealNetworks and Microsoft Windows Media players to not allow the user to monitor the audio. Only intermittent video images are displayed. Some other players and video formats do support variable speed playback, but at the cost of significant spectral distortion of the audio content, and a consequent loss of naturalness and intelligibility.

As a practical note, when deploying the 2xAV Plug-In on multi-user computers, such as in a lab, it is important to be mindful of the range of uses of the media player. Players are commonly used to listen to music. VSP features are not generally desired for casual music listening. As the 2xAV Plug-In by default “remembers” its most recent speed settings, a subsequent user may be unpleasantly surprised that their Brandenburg concerto is playing at twice the normal speed. This may also cause an unnecessary burden on technical support personnel. One can contact Enounce for a custom version of their plug-in that resets the playback speed to normal speed each time the player is opened.

As with many computing advances, some problems may be experienced when installing and operating the plug-in on older, slower computers. Be sure to follow the manufacturer’s minimum system requirements, and close as many applications competing for processor cycles and RAM as possible.

There are many different university applications for the 2xAV Plug-In. In addition to being well suited for all lecture-based content, the use of VSP would help students involved with audio e-books, language instruction, listening comprehension exercises, English as a second language, and general browsing/skimming of any CD-ROM or online audio and video collections where speech is a key component.

Conclusion

The survey results clearly show the high value of the 2xAV plug-in and VSP to the students in our course at BYU. Notably, a number of users appear to be comfortable viewing the lecture material at 2x and higher. This represents huge timesavings for them. A full 29% of students reported using computers campus labs and therefore did not have access to the VSP feature at the time of this survey. Currently, the 2xAV plug-in is installed on 500 lab computers across campus. If all of these previously-unsupported students were to use the plug-in, in addition to the 41% already using the plug-in, a full 70% of students would be benefiting from VSP. A post-course survey will also be conducted to gather current data.

A very exciting and unintended outcome related to the use of VSP is the number of comments received from students to the effect that accelerating the lectures forced them to pay greater attention to the lesson content. They reported being less distracted by their surroundings, and more interested in the lesson material. This improved attentiveness and interest is critical as such characteristics are directly tied to retention in learning.

The ability to *individually and dynamically* control playback rate also appears to be very valuable. It would have been possible to encode or process the audio and video for all users at a predetermined (fixed) accelerated rate—perhaps at the 1.5x mean speed. Doing this might have disenfranchised the 74% of students who used preferred speeds other than 1.5x, and the ability to *dynamically* control the rate of lecture segments as the need arose, would be lost.

Furthermore, the ability to continually (or intermittently) decelerate or accelerate lectures according to individual comprehension level and interest fundamentally changes the nature of video from a traditionally “lean back” passive medium, to a “lean forward” active delivery medium. These findings are preliminary, and the excitement of a new tool may cloud results somewhat, but the implications are nevertheless not trivial. Unquestionably this observation merits further research.

It is arguable whether this quantity of lecture format material (52 hrs) represents sound instructional design in any setting or course. While the “less-is-more” approach may be preferable in some circumstances, there are a number of good reasons to incorporate additional material in many courses. Regardless of one’s philosophy or preference on this matter, if the lecture format is to be used, no learner should be without the power of variable speed playback control.

Appendix A: Survey Instrument

The following questionnaire is being conducted by the Center for Instructional Design and faculty members in the Accounting department. We are collecting this data so we can systematically analyze and improve the online course offerings at Brigham Young University. In addition, this data will be used for research and publication purposes. We ask for the last four digits of your social security number for tracking purposes only. Your participation is optional and will remain confidential and anonymous. **Your grade and status with the accounting department will in no way be affected by your participation in this survey.**

Last four digits of your social security number: _____ (For tracking purposes only.)

The percentage of time spent viewing the lectures are on a computer at:

- ___ % A computer lab on campus
- ___ % My workplace
- ___ % My home or apartment
- ___ % A personal computer on campus

Do you use the 2XAV plugin from Enounce to accelerate through certain lecture segments?

- Yes
- No

If Yes, present the following 3 questions:

On a scale from 1 to 7, rate the usefulness of the plugin (1 being useless, and 7 being very useful).

Scale: 1 2 3 4 5 6 7

Which segments are you most likely to accelerate through? (If not a particular segment, when are you most likely to use the plugin?)

What speed do you use the most often?

Drop-down menu from 1.0 to 2.5 in .1 increments

Why *DO* you use the plugin?

If No, present the following:

Why *DON'T* you use the plugin?