Understanding the Nature of Self-Regulation Behavior of Learners Using Variable Speed Playback in Digital Video-Based Instruction

Qualitative Research Prospectus—Grounded Theory

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December, 2003

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Statement of the Problem

I am interested in investigating the nature of self-regulation behavior of learners who use variable speed playback functionality in a digital video-based course. My interest in this topic springs from personal experiences and observations described below.

I have long held that learning can be both inhibited and promoted with the use of technology. Some of this is due to features of the technology itself, with other variables being dependant on the learner, the environment and how the technology is used. One technological innovation that I have worked with in the last few years is, Variable Speed Playback (VSP). Today's VSP technology gives one the ability is to speed up and slow down audio and video presentations without pitch distortions. It has recently experienced a resurgence in both availability and popularity.

My years as a non-linear video editor I learned the value of being able to swiftly navigate and preview--"speed read"--vast amounts of media at high speeds while still being able to comprehend the content. In my later years as an instructional media designer/developer I integrated such technology into a video-based course. Student response was overwhelmingly positive.

As the designer, I hoped that comprehension would increase with VSP, and that students would use acceleration responsibly. I feared, however, that the positive response might have been simply due to the fact that they could "whip through" the material faster than before. I was left with questions as to when, where, how and why students might use

VSP technologies to support their learning. What motivates their VSP usage and how conscious are they of their usage patterns? This study aims at exploring these questions.

Description of the Problem

At the time of this original study (2001), VSP functionality was only available through specialized hardware or software. Today, however, the ability to control the playback speed of digitized audio and video is available to learners on the two largest media players on the market—Microsoft Windows Media Player, and RealMedia Player. Learners can now listen to audio/video-based instruction at their desired speed, regardless of whether the instructor or developers ever intended the materials to be accelerated.

Research has shown (Galbraith & Spencer, 2001) that given VSP functionality, students report regularly accelerating through instructional presentations up to 2.5 times the normal playback speed over the course of a semester. At the same time, a few students choose to use no, or very little, acceleration. Their motivations varied widely from the individual's prior knowledge of the content, to needing to catch a bus. In light of this information, and the rather high average speed reportedly used by students, the researcher grew concerned about whether students were sufficiently capable of self-monitoring and self-regulation in terms of learning. Or, was the allure of "getting through" the material at a faster rate, even at the expense of learning, just too enticing?

The answers to such questions are critical for Instructional technology designers, but are not easily obtained through course evaluation surveys, focus groups and other common methods for gathering feedback in instructional development contexts. Such methods fail to describe learner behavior and usage patterns adequately. Many college learners are not skilled at self monitoring. They are not accustomed to thinking aloud, and analyzing their highly routinized behaviors and learning strategies for resaerchers. In addition, so much behavior is motivated by covert cognitive and affective processes that even with close researcher observation, the data generated may be inadequate for a deep understanding of student behaviors and any associated product improvement needs. Additional methods of obtaining data are required--methods that help learners be more self-aware and better equipped to describe and critique the instructional products they use, such as VSP. This qualitative study proposes a combination of research techniques (some quantitative) to help participants more fully explore and describe their VSP use experiences.

The implications for VSP functionality in learning environments are only now being reevaluated as the amount of downloadable streaming media-based instruction continues to grow in terms of both volume and accessibility (Arlen, 2003). Scores of inexpensive products and services are coming on the market today that facilitate the simple and even fully automatic creation and distribution of rich streaming media and video presentations for education and training purposes. Both individual learners and instructional technologists should proceed knowledgeably when deciding how to begin using VSP functionality.

Different Perspectives on the Problem

Generally, there are four main research domains relevant to this study that will be explored in the review of literature.

1. Use and comprehension of accelerated (VSP) audio/video
2. Electrodermal activity (EDA) as an indicator of attention, stress and arousal
3. User testing and formative evaluation of instruction media products

4. Self monitoring and self-regulation in learning.

Over just the last few years, higher education and distance education institutions and programs have incorporated audio- and video-based streaming media into their instruction (Galbraith, 2000). This use of streaming media has largely taken the form of online lecture archives and presentations as a primary means of instruction or in support of other modes of instruction.

In normal conversation, people speak and hear between 120 and 180 words per minute (Williams, 1998; Silverstone, 1974). Moderately accelerated presentations have been shown to benefit learning as long as intelligibility can be maintained (Harrigan, 2000; Short, 1977). When this normal speech rate is technologically increased to 210 words per minute or up to 2.0x normal speed, there is still no loss in comprehension (Omoigui, He, Gupta, Grudin, & Sanocki, 1999). With ear training and practice, many can even achieve higher speeds (~400 wpm) notably the visually impaired, for example. (Orr et al, 1965; Voor, 1965; Aarons, 1992; Silverstone, 1974). For most people, however, speeds above 2.5 times normal speed, correlate with rapidly declining comprehension (King & Behnke, 1989). Outside of the potential time-savings benefits, little is written about how learners interact with accelerated presentations, particularly when given control over the rate of acceleration.

"This creates a speaking/listening discrepancy since a listener can comprehend spoken material up to four times (4x) faster than the speaker can send the message" writes Olson (1985), "the result is a listener [or learner] who becomes bored or whose attention begins to wander." (p.3) Students themselves have reported anecdotally that accelerated presentations help them speed through boring or redundant material. They say it helps them stay more focused and attentive, learn more, and get higher grades (Galbraith & Spencer, 2001). Some research appears to bear out the aforementioned student comments under certain conditions (Harrigan 1995, 2000; Gutenko, 1995). VSP differs from fixed rate acceleration in that users can dynamically adjust video presentation speed to individually comfortable rates. The general superiority of VSP over fixed rate acceleration is substantiated by multiple reports (Cohen, Amir, Ponceleon, Blanchard, Petkovic & Srinivasan, 2000; Harrigan, 2000; Omoigui et al., 1999; Short, 1977; Zemlin, Daniloff & Shriner, 1968), and this study will seek to further refine such findings as they relate to the usage habits of learners.

In Information Processing (IP) theory, Limited Capacity models describe the allocation of cognitive resources (both voluntary and automatic) to given stimuli (Lang, 2000). Lang describes numerous conditions affecting orienting response and cognitive resource allocation relevant to video presentations, and how they are affected by the goals and needs of the individual—whether they are viewing for pleasure/relaxation or for learning. The highly attentive learner/viewer, for example, would likely to run into a cognitive resource ceiling (Lang 2000) when viewing accelerated presentations, but due to conscious increases in applied attentional and cognitive resources, the learner will still likely fully process the message.

As early as 1907, Carl Jung claimed that “verbal responses do not tell all” and that EDA “revealed the secrets of mental life.” (Stern et al, 2001 p.206). EDA is anything but clearly interpreted. Nevertheless, it has had a relatively long, stable history and is a good measure of emotional response and cognitive activity—more specifically, attention, arousal and stress levels (Stern et al, 2001; Clariana, 1990,1992; Reeves et al., 1989; Prokasy &

Raskin, 1973; Schwartz & Shapiro, 1973). For the purposes of this study, any electrodermal reactivity measured will only serve to generate reflection and discussion during interviews about a particular reaction, its motivation and the learner's self-monitoring.

The supportive EDA component of this study is also important due to a long-held belief that cognitive performance and learning is best facilitated by some *optimal* level of stress or arousal state, above or below which learning potential falls away (Hebb, 1955; Tiegen, 1994; Mendl, 1999). Most technologies, including ones adopted for learning purposes, undergo some form of user testing, but learner stress and its relation to self-regulated learning behavior is seldom explored. That is, insufficient knowledge exists on how learners' technology usage patterns and their attention and stress reactivity, might reciprocally influence one another.

Although the research in some of the identified domains has not yet been thoroughly examined, little previous work has been found to guide our thinking. It is beginning to be clear that few researchers are actively exploring how these four domains intersect.

The Void & Research Purposes

As discussed, most of the time-compression research conducted has looked at identifying the limits of comprehension, and optimal acceleration rates. Very little is available that addresses how user-controlled VSP might be used by students to regulate their attention and learning.

This study proposes to meticulously explore the relationships among learner usage patterns of VSP, their self monitoring abilities and the self regulated learning strategies employed by learners. The findings of this study could serve to optimize the learning experience for the individuals, as well as provide useful information to instructional designers. To achieve these purposes, the following questions will guide the research:

1. What are the nature and patterns of student VSP usage for a given presentation?
2. How do students explain (self-report) their acceleration/deceleration patterns?
3. How does their self-monitoring or awareness influence their usage patterns and motivations for acceleration?
4. What is the relationship among student self-reporting, researcher observations and psycho-physiological (EDA) data?

Commensurate with established methodological norms in grounded theory (GT) research, once observations, interviews and data analyses get under way, other questions and themes will undoubtedly arise. Answering these new questions may necessitate finding additional participants with different sets of attributes to observe and interview or possibly looking at alternate sources of data not anticipated at this point.

Anticipated Outcomes

The outcomes of this study will be on the one hand, a detailed description of learner VSP usage patterns in one accounting course. On the other hand, the study will present any emerging themes and hypotheses surrounding self-regulated learning strategies that students might employ while using VSP technology. Furthermore, we hope to hypothesize on the role of self-monitoring and awareness in our findings and what the role physiological measurements (EDA) might play in the interview and reflection process.

Finally, additional outcomes may include suggested self-monitoring and self-regulation strategies to help promote optimal attentiveness and learning when using VSP technology. Students, instructors and courseware developers may find the information and suggestions useful as they decide how to effectively integrate and use VSP functionality.

The Research Design

Research Methods

In order to investigate the research questions, one must first consider his epistemic purpose as it helps guide methodological choices (Baptiste, 2003). The epistemological stance (Creswell, 1998, 2003) that this researcher favors supports the existence of some level of objective "reality", but also maintains a belief in the "realities" of subjectivity, interpretation and social construction. The epistemic purpose is generally therefore to explore (both objectively and subjectively) how individuals use a particular technology to support their learning and how aware they are of their behavior.

Field research methods are the most appropriate way to achieve the aforementioned research purposes as they attempt to explore and deeply understand phenomena by observing them in their naturally occurring states (Baptiste, 2003)--also known as ecological validity in some circles. More specifically, the grounded theory approach seems most appropriate in attempting to explore the nature of student VSP use in a video-based course while rendering hypotheses on what relationships such use has on self-regulated learning practices and on what motivations and awarenesses lay behind observed and reported usage patterns.

Time-stamped electrodermal activity (EDA) data, will serve to identify potentially relevant instances of high, low or changing attention, arousal and stress levels as students interact with the instructional materials. Such data will not be the basis nor focus of the interviews, but rather help gauge the self-monitoring abilities of the learners, and trigger the researcher to explore in more depth any interesting arousal patterns vis-à-vis student speed adjustments. Instructional materials will be synchronized with the time-stamped physiological data output, allowing the parties to replay the instruction to help trigger student recall of experiences during specific moments of the instruction.

A key aspect of gathering data in this study will be individual student reflection interviews following their observed instruction. Responding to researcher observations and questions, the student will reflect back on the instruction and describe their general VSP usage patterns. A second, less complex follow up interview will be conducted with participants no earlier than one week following the post observation interviews. This interview will simply revolve around any participant-noted changes in self monitoring or VSP usage during the intervening time period. The researcher may probe into new areas with participants that have emerged through a review of existing data.

It is believed that this combination of methodology and strategies will yield the types of necessary data to provide valuable insight into the nature of and motivations behind different VSP usage patterns in learners, and shed light on the potential value of physiological measures in understanding how learners interact with this technology.

Critical Dimensions of the Phenomenon

It is important to focus on the critical dimensions of the central phenomena of this study. Provided that the nature of grounded theory requires that the researcher remain flexible, it is important to be open to relevant data types that may arise in the course of the investigation, and perhaps pay less heed to some that become less relevant. That being said, some level of initial, albeit broad, planning is still appropriate and will include gathering the following types of data:

- Participants' demographics (age, gender, ethnicity, English proficiency)
- Participant schedules (planners, class schedules, homework/assignment due dates, exam schedules)
- Participants' academic info (GPA, major, yr in school, prior subject knowledge, retaking course, test scores)
- Pre-reflective description of participants' motivation to adjust acceleration rate.
- Participants' VSP usage patterns (self-reported, researcher-observed, informant-observed)
- Participants' reflective descriptions of behaviors and motivations
- Participants' arousal and stress reactivity levels. (Self-report and EDA)
- Participant Study Environments (computer labs, dorm rooms, workplace, library)

Further descriptions on the particulars of sites, units of analysis and observations will be detailed below.

Cases and Units of Analysis

In order to gather the types of data identified as the critical definitions of the phenomena, some very purposeful participant, site and activity selections will need to be made. Perhaps the most critical of these are the participants. Potential participants will need to volunteers, be enrolled in a course employing asynchronous video-based instruction, have VSP technology available to them and feel some pressure to perform at the high level that is commonly associated with a college course.

The potential participants that use VSP should already be acclimated to accelerated listening/viewing. The volunteers will be asked questions about their study habits and their use of the VSP functionality to help determine the most appropriate participants. Other criteria may arise, but the purpose is to select a diverse group of real users that will help the researcher gain insight into a broad range of use scenarios.

Sites and Units of Observation

Brigham Young University is the largest private university in the United States. It is a church-sponsored institution whose 30,000 resident students in Provo, Utah, are high-achieving, and predominantly native English speaking Caucasians. All study participants will come from an introductory accounting course at Brigham Young University (Accounting 200). It is expected that students in the course generally reflect the university student profile.

Ecological validity is critical in such studies. It is therefore important that observations take place in locations where students commonly study. This will likely include campus computer lab settings, the library and places of residence. A unique situation may arise at this site if selected female participants live in on-campus housing. Under most circumstances, male visitors are not allowed in the rooms of female students. If such situations arise, special permissions may be required or alternative (but plausibly equivalent) study arrangements may have to be made to permit observation.

This site and group was selected because they currently use VSP technology in an existing video-based course. The researcher has general access to the students through the instructor, but will solicit a candidate pool of volunteers from which he will select approximately 20 diverse participants who will help generate, to the fullest extent, as many properties of the categories as possible." (Glaser & Strauss, 1967 p.49)

To this end, a number of criteria have been identified: Participant attention, arousal and stress levels, participant interest in the subject matter, prior knowledge of material, year in school, major vs. non-major, gender, computer competence, psychological conditions (dyslexia, ADD), time pressures, specific academic pressures, reviewing material vs. first viewing, computer hardware capabilities, awareness of VSP tool, environmental conditions, and possibly others yet to be determined. In summary, the main units of observation will be:

1. Participants (~20 students viewing instructional materials with VSP technology)
2. Inanimate sources of data (Researcher observation notes, EDA data, test scores, participant schedules, videotaped interviews and observations)
3. Informants (teaching assistants and lab attendants, room mates)

The researcher will work with both universities' (PSU, BYU) human subjects review boards for all proper approvals.

Data Collection Strategies

Most of the data will be collected through three main activities: 1) Direct observation, 2) post observation interview and 3) follow up interview. The researcher will take notes during direct observations and both interview sessions (post observation and follow up). All sessions will be videotaped to allow for more careful coding, review and analysis. During the observation videotaping, the camera will be directed primarily toward the computer screen, and not toward or within sight of the participant.

The EDA capture device is a small, lightweight, wireless armband worn on the upper arm. The physiological data (electrodermal activity) will be recorded and analyzed electronically. The EDA data will be analyzed, along with the videotaped student observations as needed. Lastly, the participants' test scores may be acquired in electronic form from the instructor or department.

Total participation time for each learner should not exceed approximately 150 minutes (2.5 hrs), although if studying occurs late at night, individuals may be interviewed the following day. General participant observation may exceed the 1-hour, direct observation session that is recorded and tracked. Interview time following the direct observation session will average 40 minutes for each of the two interview sessions.

- 10 minutes for introduction and to apply EDA armband
- Up to 60 minutes to view primary study materials (direct observation)
- Up to 50 minutes to be interviewed
- Up to 30 minutes to be interviewed

The interviewer/observer (data collector) tasks will include 1) observing and take notes on participant behavior, 2) interview the participants and 3) analyzing and marking EDA data for points of interest.

Direct observations of particular interest to the researcher include: whether participants use the VSP functionality; when do they adjust speeds, faster? When do they slow down?; Do they leave settings consistently fast, but stop and replay sections for better comprehension?; If so, are certain types of sections repeated more than others?; Do the beginnings and ends of lessons get played slower or get repeated?; Do summary statements made by the instructor get played slower, faster or replayed? How are the instructor's examples and review segments viewed? The semi-structured interview questions will address observations along these lines, but will not be limited to the above.

Enhancing the Study Quality

A number of steps will be taken to help the research study fulfill its purposes. In an educational research atmosphere quite devoid now of behavioral work, this study proposes to revisit some of the field's behavioral roots--looking as much at what learners *say* as at what they *do*. No statement is being made as to where research in the field should be headed, it is simply an attempt to employ the approaches and strategies that will help generate the needed data for analysis.

The ability to self-monitor and report one's attentiveness and level of stress is a critical characteristic of any self-regulating learner (Zimmerman & Schunk, 2001). But since much research suggests that subjective reports of arousal, stress or anxiety seldom correspond with physiological measures (Glynn, Christenfeld & Gerin, 1999). The joint review of learner EDA data during the interviews will be used as a form of member check--passive corroboration or triangulation

As discussed earlier in the proposal, non-random purposeful sampling will also be conducted to facilitate generating the broadest number of categories relevant to this exploration during open coding. Participants will be sought with diverse characteristics (majors, ages, gender, year in school, computer savvy-ness, etc.)

Of particular interest will be individuals that might exhibit significantly different VSP usage patterns than the others. These individuals may provide a source of disconfirming evidence that will effect any hypothesis generation during coding and analysis. Previous research has already identified two groups with potentially unique VSP usage patterns: non-native English speakers and prospective accounting majors who are retaking the course for a higher score before applying for official entrance into the accounting program.

Throughout the largely concurrent data gathering and analysis phases, the practice of memoing (Glaser & Strauss, 1967) will be followed to help capture researcher thoughts, and aid in identifying unique, non-overlapping categories and properties while coding.

Finally, despite the desire to uncover and more deeply understand the forces and motivations at play here, the researcher hopes to avoid over-analysis and remain open and prepared for simple, common sense answers such as “I go fast because I wasn’t aware I could slow it down,” or “I don’t accelerate because my computer “chokes” at the higher speeds.”

Data Analysis

Unlike other research methods, from the very outset, grounded theory relies heavily on data analysis. That is, one does not wait until all the data has been collected before one begins the analysis process. Analysis and constant comparison of data (Glaser & Strauss, 1967) is in fact such a core function throughout the whole research process that it can be difficult to know when to stop. Strauss and Corbin (1998) lay out a systematic process for encoding the data, while Glaser advocates a more flexible, less structured approach. This study will favor the more structured approach set forth by Strauss and Corbin.

Electronic qualitative analysis software such as Nvivo or HyperResearch will be used to support the efficient coding and analysis of the data. Ideally, the EDA data will also be accessible through the software in some form. Interviews will be transcribed to text and entered into the system, observation videos will be digitized and entered on a regular basis. For obvious reasons, the data will initially not be available electronically for analysis, so the post-observation interviews will rely heavily on researcher notes and recall.

Operationally speaking, analysis is accomplished by means of constantly comparing one's data through three non-sequential stages of coding:

1. Open coding, to find and label categories in data
2. Axial coding, to find relationships and links among categories.
3. Selective coding, to find core categories and explain/account for the relationships.

During Open Coding, the direct observation and interview data will be "fractured" or taken apart to identify as many categories and their properties as possible. Each discrete concept, incident, idea, event or relevant learner behavior will be named and labeled. New concepts and instances will be constantly compared with existing ones to determine similarities and uniqueness. Similar comments and incidents will labeled and grouped to form categories. To facilitate this labeling and category-building, questions will be asked of the data such as:

- "What is this action or comment an example of?"
- "How often does this occur, and for how long?"
- "What motivation is at play here?"
- "When and why does this behavior change?" etc.

In the Axial Coding stage, procedures are used to put the "fractured" data back together in new ways (Strauss & Corbin, 1998). It provides a strategy for purposely tracking down relationships rather than waiting to stumble upon them.

This will be done by looking for logical connections and links between the categories identified through open coding. Categories (or phenomena) will be looked at in terms of the conditions and motivations that brought them about and the context in which they are embedded—a process of refining, linking, splitting and merging categories. The researcher will deductively make statements of relationships or suggests possible properties and then work to verify what he has deduced against the data by comparing multiple incidents. This process may necessitate seeking additional study participants and may lead to the identification of new categories altogether—a process that continues until a "saturation" point is reached. When engaged in analysis, the researcher will alternate between open and axial coding as needed.

The last stage, Selective Coding, serves to find the core categories and begin to explain and account for the observed relationships. Links between categories will be established, and will be related back to the central themes and core categories that have emerged. This is where the researcher will begin to render grounded hypotheses on the phenomena under study.

A procedure for memoing will be established. This capture of the researcher's thought trails, decisions, rationale, hunches etc. is another important part of the analysis phase. Its aim is, in part, to make this phase more visible to readers.

Numerous questions and a myriad of hypotheses are already in the mind of the researcher--and are not easily purged. Exceptional care will need to be taken to listen to the "local" data to avoid imposing or forcing hypotheses and insights—to avoid a process of simple verification and validation of preconceived notions.

Limitations of the Study

As with any study, a number of limitations present themselves with this study. The various participants will likely behave significantly different at home than they do at work or at school with regard to their study habits. It will simply not be feasible to address the diversity of study habits and study environments. In addition study patterns will likely vary on weekends, toward exams, and around midterms and finals.

This study will explore how traditional college-age students use time-compressed media. It is noteworthy that older adults (55+ yrs) exhibit decreased abilities to comprehend accelerated speech. Thus, doing the same study with aging adults would predictably result in very different data.

Without doubt, an additional observer/researcher would be an added benefit. This would facilitate valuable peer review processes in coding, analysis and interpretation of the data. Lastly, the capability employed in much user-testing work to capture, track and log individual computer keystrokes and mouse clicks (trace evidence) would be valuable--specifically in looking at what portions of videos were viewed repeatedly, and at what speeds, for how long etc. These luxuries require resources currently beyond those of the researcher, but will be actively sought out.

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