EXAMINING THE DIFFERENCE BETWEEN ASYNCHRONOUS AND SYNCHRONOUS TRAINING

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ABSTRACT
Disasters may occur with either notice and no notice. The goal of this research was to provide a method for reproducible training using asynchronous training methods that could be measured to show fewer errors and resources required train responders using traditional synchronous training methods. The asynchronous training also called “just-in-time” training can save significant resources during a medical emergency event. Our researcher team developed an educational pilot study to demonstrate for government and company application training as a point of distribution exercise. While no statistical differences were found between synchronous or asynchronous training, it is evident that companies and government could use the asynchronous training method as a viable training option, especially in emergency situations where there is time only to provide just-in-time training. Asynchronous training offers more flexibility in times to train volunteers because the training can be offered at varying times when volunteers arrive and there is consistency in the information provided, which can be updated and upgrade after every exercise. Staff can devote their time to the myriad of other duties and responsibilities that occur when emergencies occur and could aid the public by a quicker and more professional response.

Keywords: Synchronous Training, Asynchronous Training, Just-in-time Training, Medical Emergency Response, Point of Distribution, POD

1. INTRODUCTION
Disasters may occur with either notice and no notice. Notice disasters based on scientific modeling of events may include floods and hurricanes that may provide hours to days of prior warning. No notice events include actions such as earthquakes and disease outbreaks. Many disasters and emergencies occur with such routine that training for first responders and the public must be part of learning about their communities. Other training, while needed desperately in an emergency, may have such a slight probability of occurrence that routine training may not be needed. This study was intended to show that asynchronous learning can be a method to conserve resources compared to synchronous training when a community is challenged with a point of distribution (POD) event that is required to quickly deliver emergency medical resources after a disaster or emergency. Sought was not only an inexpensive method to address multiple training needs, but also a possible better way to provide training. If asynchronous learning is shown to have an equal or similar retention rate than traditional synchronous training, it would be possible to develop multiple applications that can train the specific individuals as needed, just-in-time, and when deployed. This would be a significant advantage for responders that could conserve substantial time for more needed daily training needs without allocating time to the many contingency training tasks that might be requested. The ultimate goal was to be able to show that the benefits of the asynchronous training would outweigh the costs to produce such applications. These above statements were shown to be true, so it could change the way that many organizations train their employees. The net result would be fewer volunteers needed, with more retention of essential knowledge using fewer resources to achieve a level of training, and less overall time needed to teach. This study would benefit emergency planners and emergency response volunteers by making them more confident in their knowledge of the required tasks needed to provide for individual safety and provide benefit to their communities. This approach may also improve the skill retention rates as demanded by the situation at hand.
2. PURPOSE OF RESEARCH

The goal was to provide reproducible training that could be measured to be replicated with fewer errors, intensive resources or large well-trained staffs, while reducing costs to train responders and increase retention rates of essential tasks. By researching how well asynchronous learning can help in the workplace, the hope was to be able to design a training process that could eventually help government and companies develop training programs. The research team conducted a pilot study to find out how well asynchronous learning compared to the more traditional methods of learning in the workplace using a POD exercise as the model event requiring a number of trained volunteers to collect information and dispense emergency medical supplies rapidly enough to change the outcome during a disease outbreak. Specifically, the intention was to determine if making just-in-time training videos for emergency response needs would be as beneficial as traditional training. If this proved to be true, or if it shows to be just as effective learning tool as the traditional method, then the study would further an understanding of time and resource needs for responders’ teams.

3. RESEARCH SUMMARY

The questions that were proposed were:

1. How does asynchronous and synchronous training compare in the scope of the time it takes students to complete the task?

2. What are the different accuracy levels students demonstrate based on the two different types of training they received?

Assumptions

The following were assumed in this study:

1. All volunteers completed their assigned tasks to the best of their abilities
2. Each volunteer tested on the material has equal learning capabilities
3. All volunteers were trained with the same material whether it be asynchronous or synchronous
4. The measurements taken accurately reflect the effectiveness of each training method

Limitations

The following are limitations used in this study:

1. The study is limited by how truthful and cooperative the volunteers are
2. The study is limited by the ability of each volunteer’s ability to learn information quickly
3. Statistical significance due to sample may limit generalizability of the findings
4. The study is limited by the accuracy of the data being gathered

Delimitations

1. All volunteers were from Purdue University nursing and pharmacy classes
2. The amount of time the researchers had to conduct the study, which was a three-hour block of time

4. REVIEW OF LITERATURE

Online Synchronous vs. Asynchronous Training through Behavioral Modeling

Since the steady increase in technology, there has been an increased amount of training online. This raises the question pertaining to the most effective method of training. The behavior modeling approach, otherwise defined as observational learning or teaching through demonstration, has been shown as the most effective approach in a face-to-face environment [1]. To answer this question, a quasi-experiment was conducted with 96 undergraduate students all taking a Microsoft SQL Server 2000 course. The behavior modeling approach [1] was then used in three learning environments; face-to-face, online synchronous, and online asynchronous. The results were measured by determining which method produced the best performance [2].

Bandura [1] suggested that behavioral modeling takes place in four sequential steps. The four steps are attention, retention, motor reproduction, and motivation and reinforcement. One issue is how well this approach can be transferred to online training, due to the fact that there isn’t a face-to-face interaction with the asynchronous method. This means it may not be possible to use behavioral modeling in an online environment without the use of other methods [2].

Knowledge transfer is the application of acquired skills and knowledge in different situations, generally having four formats. The first two are positive versus negative transfer, which is learning stimulating learning versus learning hindering learning. Next, is near versus far transfer; this is basically face-to-face or asynchronous training [2]. The two others types of transfer are specific versus general and lateral versus vertical transfer, which were not used or addressed in this study. In this study the researchers focused on near and far transfer measures of learning outcomes for the experiment.

This study lasted for 4 weeks, with 50 training sessions each week for class. The students were given pretests, posttests, and quizzes. All scores were compared to one another. The results were that there were no significant differences among the three methods. The conclusion was that it may be almost as effective to use online training (synchronous or asynchronous) as it is to use a costlier face-to-face training [2].

Discourse Functions/Syntactic Complexity in Synchronous and Asynchronous Communication

Sotillo’s [3] study examined discourse functions and syntactic complexity in computer-mediated synchronous and asynchronous communication among English-as-a-second language (ESL) learners. This study included 2 instructors and
25 students. The two questions addressed were if the discourse function present in ESL learners' synchronous discussion of reading assignments quantitatively and qualitatively differed from those found in asynchronous discussions, and which mode of computer-mediated communication would show more syntactically complex learner output [3]. In this study, the asynchronous training promoted critical thinking and better prepared responses to the questions that they reviewed beforehand. Asynchronous trained students learned more than those who were synchronous trained and were not given time a priori to prepare responses to the prescribed questions.

The Effect of Synchronous and Asynchronous on Oral Performance in German

A study by Abrams [4] included a total of 96 students, divided into three groups to assess the different effects that synchronous and asynchronous learning had on oral performance. The first group was the control group, which had regular classroom exercises. The second participated in 1 hour of synchronous computer-mediated communication (CMC) using a WebCT's chat tool each day before their discussion period, while the third group participated in a week long asynchronous CMC session using the WebCT's bulletin board that began 1 week before the oral discussion day.

This study addressed four hypotheses; the first was whether CMC (synchronous or asynchronous) would result in better oral performance. Also whether CMC would have a positive effect on oral performance, and if so, to see if there was a difference between the effect of asynchronous and synchronous training. The last hypotheses examined if there was a difference in the oral performance of students in the synchronous CMC and asynchronous CMC groups. To determine the effects of these two groups of learners, the oral output of the students was analyzed according to gains in scores between the pretest and the final discussion.

The results of this study showed that those students who participated in CMC produced more language during oral discussions than those who didn’t have the same preparation using CMC. The study did show that the synchronous CMC group performed better than the asynchronous CMC group, but this was thought to be most likely due to the fact that students had to wait to discuss until other students participated in the online discussion. This was considered a hindrance to some students from being able to discuss topics as well as those in the synchronous CMC group. It would be interesting to see if imposing a mandated time to reply to the discussion would dramatically change the results to the point where the results for both groups would be equivalent.

Asynchronous Stream Modeling for Large Vocabulary Audio-Visual Speech Recognition

The study by Luettin, Potamianos, and Neti [5] used audio-visual information fusion to help provide a higher level of speech recognition. These researchers wanted to investigate different methods that help to make different assumptions about the asynchrony and to help propose a technique to help account for stream asynchrony at different levels.

There are three main issues in information integration which are the classes' conditional dependence across streams, the level of integration, and the kind of integration. The experiments addressed each of these issues and compared asynchronous and synchronous methods. The conclusion was that the synchronous integration showed improved performance with the additive speech noise, but also increased the error rate in the clean audio case. Results of the asynchronous condition showed better performance with the added “babble” and also with the audio-visual speech. This study showed that the asynchronous stream models were best for providing a higher level of speech recognition.

Comparison of Asynchronous Online Text-Based Lectures and Synchronous Interactive Web Conferencing Lectures

Skylar [6] compared pre-service general and special education students' performance and satisfaction in a course that used two types of online instruction. The purpose of the study was to see if there were differences in performance between students accessing content presented in a synchronous interactive web conferencing lecture format compared to students that access content in an asynchronous text-based lecture. The author also wanted to see which method the students would preferred whether they would perceive an increase in level of technology skills when taking online courses.

The 44 students were equally divided into two sections, one asynchronous and synchronous section. Students took a 100-item pretest and a survey. There were no significant differences between methods of teaching. The findings indicate that asynchronous learning could be beneficial to students and workplaces as an alternative method of teaching.

Affective Learning Outcomes in Workplace Training


The WebCT group was offered an asynchronous discussion that included text, audio clips, and video clips. The site was available at all times, every day. The synchronous training was only available once per week for 1 hour. This platform had synchronous online presentation that incorporated audio interaction among the participants and the instructor. The key variable in this research was the type of interaction available to each group.

There was no significant difference between presentation methods. This suggests that asynchronous learning in the workplace could be an effective alternative of instruction to more traditional methods. The software of the asynchronous text-based learning can be duplicated each time the course is taught and thereby, reduce costs and time to prepare materials and lectures.

Content Analysis of Student Interaction in Synchronous and Asynchronous Learning

Chou [8] compared learner-to-learner interaction in a distance learning environment. The study addressed three research questions. The first was if there would be a significant difference in social emotional oriented content and task oriented content between asynchronous and synchronous communication modes. The second was if there was a significant association between the instructors and among participants in online discussions. The third question focused on whether there was difference in the
socioemotional (SE) oriented versus task oriented contents between female and male participants [8].

The conclusions were that there was more SE-oriented interaction in the synchronous communication mode. The asynchronous peer review provided collaboration on building knowledge base and sharing information. Though there was still no significant learning difference between the two methods, in this study students showed they spent more time on the synchronous learning method. This suggests that it might have been easier for students to communicate with each other with this method of instruction.

**Surface and Deep Learning Processes in Distance Education**

Offir, Lev, and Bezalel [9] examined differences in the achievement of students who studied the same course using synchronous versus asynchronous teaching methods. Abstract verbal thinking ability as well as the differences between high and low level thinking were examined.

The results of this study showed no significant differences between the two research groups. Students reported that they did not feel as free to ask questions as they would online due to the perception that they would interfere with other classmates. Another common perception was that the students felt like they needed the teachers’ presence when going over lessons to help prepare for the exam more effectively. Though this is not true with all students, the disconnect between students in the online class appears to be greater than those in a traditional classroom.

**Comparison of Two Technologies for Synchronous and Asynchronous Group Communication**

Shirani, Taft, and Affisco [10] examined the interaction between task structure and technology in relation to synchronous and asynchronous group communication. They used two communication technologies consisting of email and a group support system (GSS), with two level of task structure (less and more structured). The objective of the research was to ascertain if there was a difference in the amount of ideas generated using each method.

There 148 students randomly assigned to four or five person groups. The research suggested that using the GSS method, the students produced a far greater amount of ideas than did the email asynchronous group. However, the email groups seemed to have a deeper analysis of the topics than the GSS groups did. This suggests that if the goal is to generate a higher abundance of ideas then you should choose to use the GSS synchronous method. If the goal is to develop a deeper understanding of the topic, then the asynchronous method would be better to use.

**5. FRAMEWORK**

In the present study two teaching methods were examined, asynchronous synchronous. The context for evaluation of the two teaching methods was a functional exercise by the Homeland Security Exercise Evaluation Program.

**Providers and Patients**

Two sets of volunteer providers were used to deliver medical services. Eight nursing students were randomly assigned to either the asynchronous condition where they traditionally trained in a group i or to a an asynchronous. Condition where they were trained individually. There were two stations for each group of 4 nurses, one for data entry and one for dispensing the simulated medicine through empty bottles labeled as various antibiotics.

There was a staging area where participants simulated patients in the exercise and were issued actor cards to simulate a multitude of medical problems and different personalities to make the data entry and dispensing more like an actual disaster. The patients were instructed to proceed to the data entry station, then to the dispensing table, and finally the patient review or exit area. There were 8 nursing students that were evaluated not only on the time it took for a patient to complete their station, but also in terms of the accuracy of the information recorded. There were two phases to the exercise. The first phase would have two students from each of the training groups (control and experimental treatment) screen then dispense the proper medications to roughly 75 total mock patients until finished. Time and accuracy data were collected for each of the roughly 75 mock patients. Once this was completed, the second of four students were exchanged to screen and dispense a second group of roughly 75 mock patients were screened and dispensed medication during the exercise while again observes for time and accuracy to complete tasks were collected.

This design provided not only data for the researcher provided in this paper as a functional exercise but also provided an education benefit. All of the students benefited from participation in the mock exercise as a means of reinforcing the public health principles from classroom discussion. The exercise benefits of this process are described in more detail [11].

**Dependent Measures**

The dependent measures were amount of time at each station and correctness of decision of dispensing the appropriate medication based on the problem presented. Once collected, the observed data was compiled and sorted between synchronous and asynchronous training types and then accessed for accuracy. In Table 1, the four possible decision assessments are outlined.

<table>
<thead>
<tr>
<th>Table 1. Dispensing Possible Decision Outcomes</th>
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<tbody>
<tr>
<td>Mock Patient Gets the Correct Drugs</td>
</tr>
<tr>
<td>Screener and Prescriber Correct Decision</td>
</tr>
<tr>
<td>Screener Incorrect, Prescriber Correct Decision</td>
</tr>
<tr>
<td>Mock Patient Gets Incorrect Drugs</td>
</tr>
<tr>
<td>Screener Correct, Prescriber Incorrect Decision</td>
</tr>
<tr>
<td>Screener and Prescriber Incorrect Decision</td>
</tr>
</tbody>
</table>

In total, there were four decisions possibilities that were scored for medical screening and medical dispensing. The first outcome was if the screener made the correct decision, and the prescriber made the correct decision. This outcome was rated the best of the four, due to the fact that both providers correctly evaluated the patient. The next outcome was whether the screener made the correct decision and the prescriber made the incorrect one. This was label as an incorrect decision due to the prescription being wrong for the patient, but was not the worst of the outcomes. The third decision was when the screener made the incorrect decision and the prescriber make the incorrect decision. This level was labeled as the worst because both providers failed to accurately
assess the patient. The final decision was when the screener made the incorrect choice, but the prescriber noticed and made the correct decision. This outcome was rated under best because even though the patient received the correct medication, it was due to the prescriber catching the error the screener made.

A stopwatch was used to determine how long patients were at each station. Providers also completed a post survey to see how well they had learned and retained the information presented either asynchronously or synchronously.

**Observed Dispensing Times and Accuracy**

There were roughly 150 data points planned to determine time of execution for dispensing. Each data collection included a subject representing an individual or family needing medical distribution. Data collected includes each group/individual demographics for the patient, provider screener, provider dispenser, total time, training type, and medication distribution accuracy. Once the observed data had been compiled and sorted between training types, it was inserted into a separate table to account for varying levels of effectiveness.

Table 2 indicates the average time it took to screen an individual. The medication count is also very important to observe because each patient could be responsible for up to five patients within the family.

<table>
<thead>
<tr>
<th>Training Method</th>
<th>Total Time (seconds)</th>
<th>Average Time (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asynchronous</td>
<td>6302.28</td>
<td>80.33</td>
</tr>
<tr>
<td>Synchronous</td>
<td>6477.43</td>
<td>82.59</td>
</tr>
</tbody>
</table>

Accuracy was determined by comparing the recommended medication dispensed based on a patent demographic and medical information. There were four prescriptions possible that were included in the training. Screeners reviewed the patient information making a recommendation for the dispenser. The dispenser reviewed information, revised medication recommendation, answered questions and provided medication. Table 3 shows the accuracy rates for medication dispensing.

**6. RESULTS AND CONCLUSION**

Scores for the four varying levels of decision were recorded and totaled for each type of training. There were 87 correct decisions for those asynchronous trained and a total of 11 incorrect decisions. The error percentage was 11.22%. For those synchronously trained, there were 91 correct decisions and 11 incorrect decisions, for an error percentage of 10.78%. The differences in error percentages was .44%. There was no significant difference in the effectiveness of the training approaches.

An asynchronous training method maybe a viable training option, especially in emergency situations where there is time only to provide just-in-time training. Government and state training programs for preparedness might consider developing asynchronous as a viable means of instruction as a means to save money and time. Asynchronous training offers more flexibility in times to train volunteers because the training can be offered at varying times when volunteers arrive and there is consistency in the information provided, which can be updated and upgrade after every exercise. Staff can devote their time to the myriad of other duties and responsibilities that occur when emergencies occur and could aid the public by a quicker and more professional response.

**7. REFERENCES**


