Adaptive Learning via Social Cognitive Theory and Digital Cultural Ecosystems

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Abstract. This paper will look at the human predisposition to oral tradition and its effectiveness as a learning tool to convey mission-critical information. After exploring the effectiveness of the conveyance of information, the paper will examine current adaptive learning research and develop a system that will marry the strengths of oral tradition with those of an optimal adaptive learning environment. Emphasis will be made in the area of military service personnel stationed in contested cultures, the aiding of their arrival and once established their continual improvement processes. This paper will then illustrate a digital cultural ecosystem that leverages the strengths of current industry thinking in digital community development and social architecture combining the adaptive learning models discussed earlier to create a dynamic digital social ecology that could significantly improve the transition process by exposing service personnel to the collective learning of all of the personnel currently and previously deployed to a particular region. It will illustrate tools and techniques that can be used to filter the quality of the collective intelligence, the dynamic categorization of new narrative and the selective recommendation of content as an adaptive learning technique. This system will incorporate a virtual environment to test the quality of learning before the military personnel are deployed and a capture and debrief system that will enable the continual improvement of service personnel as they complete missions during their deployment.

Introduction

Military personnel are required to transition to and from assignments in contested cultures many times during their careers of service. This transition usually takes the form of a six-month cycle at the beginning and end of their tour-of-duty. During the transition into an assignment the service person must train on equipment, procedures, communications protocols, and more to become prepared to perform effectively. In addition to their training, they are required to understand the culture they are about to enter in order to effectively communicate, and ultimately survive.

During recent informal interviews with service personnel returning from an assignment overseas, the author also found a significant number of responses indicating that the most effective method for transferring domain and situational knowledge occurred through oral tradition. Individuals reported that team members sharing stories of their experiences with them as they arrived made their transition experience significantly smoother. While some reported that the information conveyed by their predecessor was mistaken, outdated, or misinformed, none reported issues with regards to retaining the lessons conveyed during the transition. In contrast, when queried about current knowledge management systems, service personnel reported many difficulties navigating the often raw and meaningless volumes of content. One service person told the author, “I could either read tons of boring documentation or talk to the guy I was replacing.” It is clear that oral tradition, as a fallback knowledge transition tool is more effective and more popular than current document based knowledge management systems. Unfortunately in its current form it lacks the ability to capture and distribute cumulative knowledge, to provide any record of knowledge transition, and to provide an understanding of the extent of the knowledge has been successfully absorbed. Those relying on oral tradition as an information source are not rewarded by and therefore not concerned about the benefits of capture, distribution, and measurement.

Through the design of a novel system that explores the tenants of social cognitive theory, storytelling, digital systems, and adaptive learning, this paper will attempt to explain not only why oral tradition could be a superior knowledge transition tool, but also how a digital community could be developed that passively capture and adaptively filter community knowledge in a manner that would streamline transitions into a culture and significantly improve situational awareness and continuous learning for individuals currently stationed within contested cultures.

Social Cognitive Theory

Social cognitive theory looks to fundamental human behavior as the key to effective learning practices. Human beings, being social creatures, have relied on storytelling techniques for thousands of years as their key to survival. Transferred in

the form of "wives' tales," tradition, legends, stories, etc., these social cultural norms have served to convey key information in a memorable and applicable manner.

Social cognitive theory began as a body of work that evolved from thinking in the area of social learning proposed by N.E. Miller and J. Dollard in 1941. Miller and Dollard believed that if humans were motivated to learn a particular behavior that particular behavior would be learned through clear observations. By imitating these observed actions the individual observer would solidify that learned action and would be rewarded with positive reinforcement (Miller & Dollard, 1941).

Social cognitive theory explains psychosocial functioning in terms of triadic reciprocal causation (Bandura 1986). The theoretical triad illustrates the causal relationship between behavior, cognitive factors, and environmental events as having bidirectional influence on each other. Behavior as an agent is both a stimuli and a response. Traditional Skinnerian behaviorism posits that all behavior is a result of environmental stimuli. Social cognitive theory differs in that it does not claim an originator but instead accepts behavior as a product of other behaviors, environment and cognitive determinism.

Bandura (1988) defines social cognitive theory as having three aspects that are particularly relevant to cultural learning and organizational improvement. They are: developing competencies through mastery modeling, strengthening people's beliefs in their capabilities so they make better use of their talents, and enhancing self-motivation through goal systems.

Mastery Modeling

Modeling is being widely used with good results to develop intellectual, social and behavioral competencies (Bandura 1986). The purest definition of modeling is the internalization of concepts through the observation and practice of their demonstrated actions and results. It is the process of internalization that creates strong and memorable associations and hence successful learning.

Systems that utilize exposure to behaviors, environments, and cognitive determinants and then provide reinforcing manners in which to respond and shape personal meaning can provide a development framework that is in alignment with social cognitive theory's mastery modeling. It is, however, important to recognize the difference in observable value between a text-based document and a time-based illustration like a video. Actions illustrated natively, as with a video capture, are easier for the individual to observe and internalize. While observing videos of oneself is common practice, caution should be exercised. Simply being shown replays of one's own behavior usually does not produce much improvement (Hun and Rosenthal 1981). Observing flawed performances can weaken trainees' beliefs in their capabilities (Bandura 1988).

In addition, successful internalization relies on more than just observation. A successful system must introduce and maintain a social element that provides a framework for individuals to share and practice learning. Social cognitive theory calls this activity "guided skill perfection." At its core, guided skills perfection utilizes social interaction and validation to positively reinforce self-confidence while introducing incremental improvement ideas.

Finally for learning to complete the transition to successful internalization it must be practiced. Much like a second language, level of skill is greatly affected by application and repetition. Social cognitive theory calls this a transfer program. Transfer programs not only provide a "safe" environment to test newly formed skills but also promote advancement by encouraging the undertaking of more and more complex (and difficult) variations of the learned skill as success increases.

Storytelling and Oral Tradition

Research showing the positive benefits of storytelling in the field of learning is robust. Cross-culturally, storytelling is a fundamental method of learning even at an early age. Children learn storytelling many years before they master logic, persuasion, writing, and other forms of information delivery. Story is an essential precursor to mastery of expository and logical forms (Engle 1995). Humans are, in essence, hard-wired at an early age to transfer learning in the form of stories. Shank reports that storytelling has demonstrable, measurable, positive, and irreplaceable value in teaching (Shank 1990). In addition, telling stories is one of the most influential techniques because you give the information, ground the meaning in structure, provide for emotion, and make the content meaningful. Our brain loves storytelling (Shank 1990). Narrative details create mental images, making possible both understanding and memory (Tannen 1999). "Stories enhanced recall, retention, application of concepts into new situations, understanding, learner enthusiasm for the subject matter." and "Stories enhanced and accelerated virtually every measurable aspect of learning" (Coles 1989).

Storytelling as the presentation form for mastery modeling as part of a social cognitive theory driven approach makes sense and will likely create a vehicle to effectively convey learning, but the question still exists as to how to incorporate guided skill perfection and a transfer program.

Designing the Digital Cultural Ecosystem

To begin the design of our novel system, we look to the future of digital community development or specifically the digital cultural ecosystem (DCE). A digital cultural ecosystem is any system that is designed to connect individuals of common purpose and strengthen their shared understanding of key topics, processes, group dynamics, and each other. In short it is a culture that centers on a shared area of

interest (SAOI). The SAOI could be meeting people (online dating) or as in the case of our system gathering better understanding about the community in which our troops have been stationed through the eyes of the community that is our troops. DCEs, implemented properly will successfully replace today's knowledge management and intranet systems with relevant, timely, and community validated content feeds.

Goals for the DCE

As mentioned above, the primary goal of this novel DCE will be to connect our service personnel sharing assignment in contested cultures. It will also:

- Strive to provide participants a better understanding of the culture they inhabit and each other.
- Capture, tag, and filter real-time multimedia information feeds for distribution and storage for further review.
- Be built using adaptive learning principles that work collaboratively with expertise tagging techniques to identify areas of strength for participants and insure they get a well rounded and continuously evolving training program before and during their time on station.
- All opportunities will be taken to minimize the intrusiveness of this system on the daily duties of participants.
- Use emerging technology to measure group interests, activities and areas of focus. Providing administrators the tools to continuously improved the communities cultural dynamic both online and offline.

Target Culture

The demographic statistics for our target participants will collectively define stationed service personnel:

- Active duty enlisted and officer personnel
- Ages 18 to 40
- Males and Females
- Computer literate with more than 1 year of experience using the Internet.
- Access to a computer terminal or mobile device.

When developing a culture of individuals defined above, care needs to be exercised to insure that participation is not taken for granted. As with most military initiatives there tends to be a "They'll do what their told" mentality when designing systems. While this may or may not be true, the level of quality provided by participation will significantly improved if the participants are excited and rewarded for their behaviors. Part of this reward will need to include entertainment. Much like America's current fixation with reality television, our DCE will use personal accounts and individual personalities to convey cultural learning as perceived.

Everybody is a Celebrity

Recent news stories of photo sharing sensitive media by military personnel actually help us understand our target audience a little better in that we can see that they are eager to participate and be validated by their peers in the same way they can on FaceBook or like public community sites. Several publications of recent have begun to discuss the shifting of values among our demographic with regards to privacy and celebrity. In the new world, everyone is a celebrity and shares openly even their most personal details. Systems like Twitter allow others to feel connected to friends or other celebrities as they post glimpses into their current mental state as micro transactions on Twitter.com. The proliferation of digital community systems is a testament to their value as an entertainment, knowledge management, and goals achievement medium. Community systems like FaceBook and LinkedIn have proven valuable tools to connect individuals on personal and professional levels. It's not hard to envision the convergence between emerging technologies and digital community systems.

Technology Architecture

Instead of text and photos as the primary communication medium our DCE will be built to use stereoscopic video recordings of events and then the narration of the individuals that experienced the events. Additional commentary will be provided by teammates who may further enhance the value of the narrative. The technology stack will include five key components:

1. Helmet or chest armor mounted stereoscopic video recorders (similar to those in today's mountain biker cams). Cameras will be activated during primary activities like patrolling a region or other assignments. Because of the overhead imposed by wireless data transmission, these systems will not transmit video live but instead record and upload wirelessly before debrief sessions.
2. Bio/environmental flagging systems – While the cameras will capture the entire event (up to 16 hours) bio/environmental sensing technology will be used to flag points (time code) on the video that are of interest. Flags will be captured when the wearer feels stress, experiences an elevated heart rate or even is exposed to a loud noise.
3. Debrief stations consisting of:
    a. Wireless downloading facilities
    b. Group presentation and review terminals
    c. Individual and group narrative capture cameras
4. Information distribution and rating systems
    a. Web portal that displays issues geographically and temporally for review by the collective culture.
    b. Measurement systems designed to capture responses from the culture on a specific narrative. This includes direct commentary as well as sharing and blocking activity.

   c. Intelligent tagging architecture that dynamically captures tags from the original narrative (voice-to-text) and the following cultural responses to the narrative.
5. Virtual modeling facility that, by using video capture to derive three-dimensional models, will dynamically build a virtual environment that will allow the replay of events and review from multiple angles.

A Sample Use Case

Soldier X is about to go on patrol in a contested region. After picking up her gear from the storage locker (uses closed coil technology to charge digital units). She mounts up with her team and begins her assignment. Three hours into the patrol an IED explodes causing no damage to soldier X but injuring one of her teammates. Biosensors tag video as she experiences the explosion and the chaos. Environmental sensors also trigger flags as explosions and shocks are logged as significant events.

As soon as the returning patrol members are within range of the base's wireless network, the camera recording software begins downloading the recorded events. Video footage is compared against teammate footage for correlating events (signifying more importance) and prepared for the debriefing session. When the team is ready for debriefing they enter a debrief circle that consists of a circle of chairs around a display device with screens and cameras for each participant. The debrief unit begins playing back flagged footage and inquires to each team member as to their thoughts and comments about the events that had been flagged. Team members are allowed to add comments to other members' stories further enriching the narrative. Some events are discarded as irrelevant including one when soldier x stubbed her toe while on foot.

When debriefing is complete the remaining aggregated narratives are uploaded to the team portal where they are displayed as new events. The portal displays events as they arrive in real-time in a linear timeline presentation format with the most recent at the top. New events are also geo-tagged with the location of their occurrence and displayed on a map within the portal. Cultural participants download the most recent events and rate those of relevance to their understanding as well as provide feedback, and support for the original narrators. Their responses are captured and used to generate tags that further identify the categorization of the event/narrative. Narratives with more cultural interest receive higher relevance scores using adaptive collaborative filtering (ACF) techniques. Narratives with the greatest volume are pushed to others as items of interest and maintain higher ranking in the collective knowledge pool.

Adaptive Learning

The use case above references intelligent narrative tagging several times but fails to illustrate the value and purpose of the tagging technology used. To enable

intelligent adaptive learning our DCE will capture tags relevant to personal experiences and responses the experiences of others and build a digital "experience" fingerprint of each participant. The fingerprint will infer areas of interest and expertise based on the actions of the participant in the system and the number of tags associated with each topic area. With this fingerprint we can begin to understand areas that need improvement and recommend content that is relevant to those areas as needed. One approach might be to display narratives that are loosely related to the experiences of the participant providing them with insights presented by others having similar experiences. Another might be to look for opposites or deficits in each participant's digital fingerprint and present that material to attempt to fill the gaps. Our design will use both approaches.

Temporal Dimensional Modeling Repository

Further analysis is often needed for incidents. Video feeds of events and rankings will be converted to a three-dimensional environment using technology very similar to Microsoft's Photosynth technology. Currently Microsoft's Photosynth technology can be connected to still-photo feeds (i.e. Flickr.com) and from them can render dimensional navigable experiences. Figures 1, 2 and 3 illustrate a three-dimensional model of Notre Dame Cathedral derived entirely from an image search done on Flickr.com.

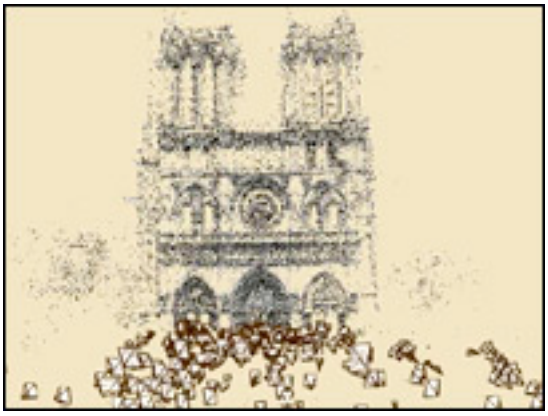

Fig. 1. Photosynth derived Notre Dame model

Fig. 2. Image library used to create Photosynth model.

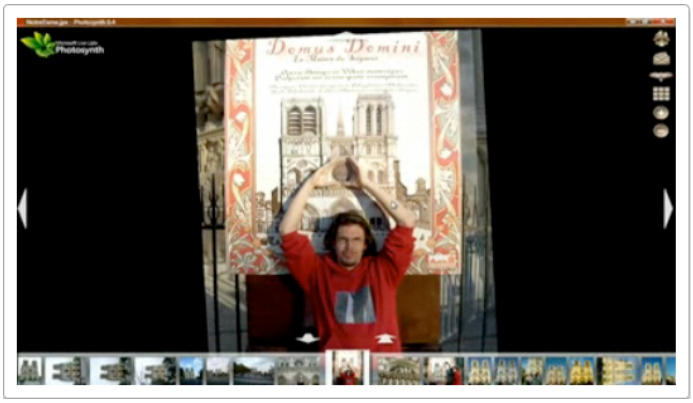

Fig. 3. Notre Dame poster that became an entry point for the Photosynth model.

This model is fully navigable and presents the viewer with more than a view of the object in a virtual world. It presents a collective memory of the object. Figure 3 illustrates a man standing in front of a poster of Notre Dame that the model accepted as part of its framework and because of it viewers can navigate into the model through the poster as a portal. By grouping photos by date, one can present an accurate history of an object over time. Scaffolding, for instance may only exist for a few weeks and therefore be present in photos dating within those weeks. If one starts to imagine video as thousands of images then the value of the collective memory begins to materialize. Stereoscopic video presents us the ability to create images of individuals that can be navigated around. Viewers in our collective memory will be able to walk around slow moving or still images of individuals as they experience events creating opportunities for analysis and even training/teaching/learning.

Summary

The possibilities are exciting when one starts to think of the possibilities presented by a real-time capture and modeling system that uses the eyes and experiences of every single participant as input. Rich and robust knowledge and even wisdom can be generated by just one modeling session. It is important to remember that all digital systems must provide insights into the activity they host. These insights are as valuable, if not more so, than the original data that is captured.

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