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Time-lapse Video as a Self-Reflection Tool for Collaborative Learning Projects

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Abstract: For many disciplines, students are required to learn to work collaboratively in groups and to perform team-based activities such as brainstorming, collaborative problem solving, and cooperative decision-making. To support the learning of such team-based processes, many university courses require students to engage in short "group challenges." These challenges often comprise in-class experiences in which students form small teams and attempt to solve a simulated problem of practice. Upon completion of the challenge, students are usually asked to reflect upon their experiences and to evaluate their group dynamics, their collective time management, and other factors that might have contributed to the success and/or failure of the team effort. A common problem is students, like most people, are generally poor at self-reflection and have a difficult time objectively assessing their personal behavior as well as the behavior of their group. To address this problem, time-lapse video has been employed as a novel pedagogical intervention for enhancing student reflection in group exercises. Under the protocol, groups were video taped using time-lapse technology that visually compresses time, for example compressing a sixty-minute work session into a sixty-second high-speed video. We postulated that by watching the high-speed video of their own collaborative efforts, the students would more readily recognize patterns of behavior they otherwise would have missed: becoming more insightful when assessing group dynamics, division of labor, time management, and the reasons for the success or failure of their collaborative effort. This paper describes our preliminary efforts to develop and test such a time-lapse video intervention for university-level group projects and describes initial observations regarding the effect of this intervention upon student reflections.

Time-lapse Video as a Self-Reflection Tool for Collaborative Learning Projects

Introduction: Time-lapse video is a display methodology by which processes that occur over long periods of time are captured on video and played back at dramatically higher speeds. Common applications of time-lapse video include recording the growth of plants over a period of days or weeks, capturing the motion of clouds over a period of hours, even capturing the motion of stars across the night sky. When such processes are captured over hours, days, or weeks and then played back over a period of seconds, behaviors that are ordinarily too slow for humans to perceive are made perceptually explicit. In this way, time-lapse video is an effective perceptual tool for allowing people to perceive patterns of activity, whether in natural phenomenon or social interactions, that ordinarily would have escaped their senses. The current effort explores a novel application of time-lapse video as an educational intervention intended to enhance student ability to reflect upon group performance in collaborative design tasks. The proposed intervention is motivated by constructivist learning theory that supports the idea that enhanced reflection leads to more meaningful learning outcomes.

Constructivist learning theory states that students learn best through participation in real-world experiences and by reflecting thoughtfully upon those experiences (Bielaczyc, Pirolli, & Brown, 1995; Forman & Pufall, 1988; Maddux, Johnson & Willis, 1997). Empirical work in this area has demonstrated that real-world learning has the greatest impact upon students when performed in small groups such that students can interact socially, sharing their insights and discussing their reflections with peers (Brooks & Brooks, 1993; Driver, 1995; Duffy, & Cunningham, 1996; Lieb, 1991; Schifter, 1996; Schön, 1983). One technique for getting students to reflect more critically upon their own behavior and the behavior of their group is to

have them watch video footage of themselves, thereby encouraging them to assume more objective and self-critical perspectives. Research has demonstrated that learning is enhanced through visual images (Schultz, 2007). Nixon (2001) conducted research on the use of images as well as the use of images in textbooks to assess scientific understanding. This work, along with work by other scholars in this area (Wandersee, 1999) point to the fact that learning is greatly improved through the use of visual experiences. Sadoski & Paivio, (2001) also found a positive relationship in learning and imagery in their work examining the dual coding theory of reading and writing.

Although empirical evidence points to the fact that this type of enhanced instruction is beneficial, unfortunately students generally lack the time and patience to watch lengthy videos of themselves performing a multi-hour group exercise. In addition, it is often difficult for students to watch video of their own group activity and assume a truly objective viewing posture; by watching the video over an extended period, students may easily get caught up in the same emotions and perspectives they held during the experience itself.

The current research effort is thus aimed at developing and testing of an improved video-based educational intervention that supports group learning from a Constructivist perspective, providing students with enhanced ability to reflect critically upon their own behavior and the behavior of their group as a whole. More specifically, the present intervention provides students with the ability to view a multi-hour collaborative experience in a time-lapse video format such that the full group experience can be viewed in just sixty seconds or less as part of a formal reflection process. The premise being explored is that by watching a high-speed video of their own collaborative effort, students will be able to more objectively reflect upon the performance of their group and more insightfully assess group dynamics, division of labor, time management,

stages of design, and the success of their collaborative process. It has been shown that images have played an important role in the area of science education (Schultz, 2007). It is postulated that by observing the behavior of their own group in this high-speed format, students will be more likely to assume an objective stance. It is also postulated that students will be more likely, by virtue of the unique high-speed perspective, to observe patterns of behavior that they would not have perceived during the actual experience or by watching a standard video of the experience. Thus, it is anticipated that time-lapse video will help to foster a learning environment in which more meaningful reflection can take place, enabling students to more quickly and more objectively assess the behavior of their group and to evaluate the reasons for collaborative successes and/or failures.

Method

The time-lapse video intervention has been pilot tested within two different student populations at California Polytechnic State University: (a) an undergraduate design course in the College of Engineering, (N= 18) and (b) a graduate level leadership course in the College of Education (N=25). All students were not required to participate in these projects as part of their respective classes. Prior to this effort, students in both courses had been exposed to exercises where they were required to work collaboratively and to reflect upon their efforts when participating in in-class exercises.

Post-It Design Challenge: The collaborative experience developed for this study required students to work in teams of three to five students and together build a structure composed entirely of *Post-It*® brand self-adhesive notepad paper. Each team was challenged to create a structure using no more than 12 standard-sized (3” x 3”) *Post-Its* that would support a penny as far from the edge of their workbench as possible. The task is highly challenging because the

Post-It notes must act as both structural members and fastening components. At the inception of the group experience, students are generally perplexed by the task, their initial design attempts unable to support a penny more than a few inches from the edge of the table. However over the sixty-minute session, groups of students discover through brainstorming, prototyping, and testing, a variety of techniques for stiffening their structures and increasing the supported distance. For example, by folding, rolling, bending, or otherwise altering the cross-section of the Post-It members, students discover that significantly improved structures can be constructed. Ultimately most groups produce designs that are able to support a penny more than 20" from the edge of their workbench and some groups exceed 30" in support distance.

At the completion of the design experience, each group of students is asked to collaboratively reflect upon the successes and/or failures of their group effort. More specifically, the groups are asked to respond to a set of questions designed to assess how their team performed as a whole and how each of them contributed personally to the effort. They are also asked to consider the number and variety of ideas explored, the design principles discovered, and how well the team managed its time. In addition, students are asked to consider as a group what they would do differently the next time they engage in a collaborative problem-solving task.

Rules of the "*Post-It Design Challenge*": As described above, students were required to work in teams and to build Post-It structures that could suspend a penny as far off the edge of their workbench as possible, each structure using no more than twelve standard-size Post-It sheets. Students were encouraged to work quickly and to test as many ideas as they could during the allotted time. Students were instructed they were allowed to tear, fold, rip, or otherwise alter the Post-It notes in any way they saw fit, but could not use any other materials and could not use more than twelve Post-It notes in any single structure. The challenge was run as a competition

among groups, a small prize being awarded to the winning team. In this way students were motivated to work hard during the sixty minute period and to seek an optimal solution.

The sixty-minute design session was conducted as follows – whenever a group had a design completed and loaded with a penny, they were instructed to call over a faculty member for an official measurement. The distance was measured as the perpendicular distance from the nearest edge of the table to an imaginary vertical line passing through the penny. Students were allowed to request official measurements as many times as they desired during the session. Thus, each time a new design was constructed by a group they could immediately request a new measurement. This encouraged students to explore a variety of ideas during the session, driving them to generate multiple designs of increasing distance. In addition, the current "maximum distance" among all groups in the class was announced by the instructor each time a new record distance was achieved. The leading distance was also posted by the instructor upon the board in the front of the room. In this way students were motivated through friendly competition to push themselves to exceed the distance achieved by the current leading design.

Task Completion and Reflection: At the end of the sixty-minute design challenge, the winning team was honored with a small award. Each team was then required to engage in an in-group reflection session, discussing together how they performed during the challenge. To structure the reflection process, the teams were given a set of written questions to discuss as a group (see questions below). They were then required to draft a formal written response to each question and turn it in before they departed. The discussion and written reflection process was performed immediately after the design challenge to ensure the experience was fresh in the students' minds. Students were provided as much time as they needed to perform the reflection

portion of the collaborative experience. The written instructions provided to each group were as follows:

> *"Having just completed the Post-it Design Challenge, each group is to write about the experience and turn it in before you leave. Your objective is to think critically about the collaborative effort, reflecting upon the performance of your group by answering each questions* [*sic*] *listed below. Please make sure you read each question carefully and address all of the sub-parts. Remember, your goal is to make insightful observations about your team's behavior, both strengths and weaknesses."*
>
> ***1. How well did your group work together in a team?*** *What would you do differently next time you work together on a design team?*
>
> ***2. How well did your group manage its time?*** *How would you use your time differently next time you tackle a collaborative design task?*
>
> ***3. Did everyone participate equally?*** *How would you divide the labor differently next time you work on a collaborative design task?*
>
> ***4. How many ideas did your team conceive and test?*** *Did you do enough brainstorming? Enough prototyping? Enough testing? Enough thinking?*
>
> ***5. What advice would you give*** *to a group of engineers who are about to engage in a collaborative design project?*

Time-Lapse Intervention

During the initial pilot study, the *Post-It Design Challenge* was run with six teams of students in each of the two academic classes, each team consisting of three to five participants. Of the six groups in each class, three were asked to perform the written reflection after experiencing the time-lapse video intervention and three were asked to perform the written reflection without the time-lapse intervention. For those groups that were given the intervention, the time-lapse video of their sixty-minute collaborative effort was shown immediately prior to their reflection process (video – http://www.education.uiowa.edu/jrel/media/). Each video was approximately sixty seconds long and was displayed on a laptop computer at their design table. The groups were required to view the video only once, but were instructed they may view the video additional times at their own discretion.

Findings

Provided this was a small pilot-study, only a modest amount of data was collected. This caveat aside, this investigation did yield interesting results, useful anecdotal observations, and generated very positive feedback from students. A first important observation was that *all six groups* presented with the time-lapse video intervention verbally reported that the high-speed video was interesting to watch and worth the time required to do so. In fact, *all six groups* chose to watch the time-lapse video multiple times even though they were only required to watch it once. In addition, all groups were observed to engage in energetic group conversations while watching the time-lapse video, commenting amongst themselves about various aspects of their group behavior.

Differences in Reflection

There were marked differences between the groups that were exposed to the time-lapse video intervention versus those groups that were not. With respect to the written reflection documents produced by the students, the six groups provided with the time-lapse video intervention generated reflection documents of greater length than the six groups that did not experience the intervention. The average word count among the video-watching groups was 325 words (SD = 39 words) while the average word count among the non video-watching groups was 214 words (SD = 47 words). This represents a 52% increase in document length for the video-watching groups. Thus the length of the written reflection documents, while not conclusive in itself, suggests a more thoughtful reflection effort was performed by each of the video-watching groups as compared to the control groups.

Another observed difference between the video-watching and non-video watching groups was the nature of their written reflections. In general, the written reflections provided by the video-watching groups were observed to be more self-critical than the reflections provided by the control groups. For example, the six groups that watched the time-lapse video each submitted highly critical assessments of their time management skills. This is reflected in the following quotes taken from each of the of the video-watching group's written documents:

- "We didn't feel that our time was managed to the fullest potential…"
- "Time management seemed to be our limiting factor in this group challenge…"
- "We tended to waste time with comments about design instead of collaborating…"
- "Our team was not good at time management..."
- "Our team could have done better with the management of time…"
- "We entered a trial and error mode… and time management went out the window…"

Conversely, the six groups that did not experience the video intervention provided no critical assessments of the time management skills – none. In fact, two of the groups made no qualifying assessment of the time management aspects of their performance despite being explicitly asked to do so in the questions provided. The remaining groups made the following comments:

- "We had excellent time management…"
- "We had excellent time management skills…"
- "Time management wasn't an issue; we worked well from start to finish…"
- "We feel very good about our time management…"

Finally, it should be noted that in one of the classes, the group that won the competition was among the groups that viewed the time-lapse video intervention. Still despite having won the competition by a substantial margin over the over groups, this group still provided a critical assessment of their time-management skills in the document they turned in.

Conclusion

This initial pilot study seems to suggest time-lapse video may be a valuable tool for inspiring thoughtful and critical reflection among collaborative teams of students (Solso, 1994). All six student groups that were exposed to the intervention responded favorably to the time-lapse video presentation, not a single student expressing that the added requirement of watching the video was a burden or a waste of time. Much the opposite, all of these groups chose to watch the video multiple times despite the fact they were only required to do so once. In addition, group members that watched the time-lapse video provided lengthier and more critical written reflections of their collaborative efforts than the groups that were not presented with the video intervention. Although the current pilot study is preliminary in nature, the initial observations as

reported herein indicate that further investigations into the use of time-lapse video as a self-reflection tool for collaborative design projects should be performed.

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