AC 2010-210: EFFECTIVENESS OF VIDEO IN CASTING EDUCATION

Craig Johnson, Central Washington University

Effectiveness of Video in Casting Education

Craig Johnson, Ph.D., P.E.
Central Washington University (CWU)

Abstract

Our traditional casting course features both lecture and laboratory venues. However it is noted that many students have never interacted with foundry equipment, and there is a significant learning curve associated with the ability of a student to execute basic green sand foundry operations. Education methods were sought to reduce this learning curve resulting in a series of short videos with subsequent incorporation into the curricula.

In this study, the use and effectiveness of video in a modified 'traditional' introductory casting course is explored. First, specific video equipment is listed, and the creation and editing processes described. Then the videos were used in casting classes, and the students were allowed access outside of class.

A positive educational impact due to the videos was evidenced by instructor and student feedback. A casting operations metric was presented, with measures including time-on-task analysis. A more rigorous assessment of educational impact was implemented in a spring course.

Introduction

Motivation for this project was to improve both the education experience and the speed at which students would acquire necessary skills and concepts. In a skills intensive course such as MET257 'Casting Processes', many 'millennial' students (1) are ill prepared. Specific skills include operational safety (e.g. use of PPE) and operations (e.g. sand preparation, molding).

The content of MET257 contains basic foundry processes such as 'green sand', and has laboratory exercises in an on-site green sand foundry. A typical foundry process includes management of the sand, as well as many tools (e.g. patterns, flasks) and equipment (e.g. furnaces, crucibles, test equipment). Overlaid on this complex environment are real safety issues. A significant amount of time is allocated to both skill development and related safety concerns.

An idea was developed to create videos that addressed these needed skills, concepts and issues. The videos would be used in the CWU Foundry, to supplement the introductory course (and other courses as needed). There was obviously no such material evident at CWU, but subsequent searches did turn up some similar material such as those from Georgia Tech (Jonathon Colton) on NDSL – National Direct Science Library (2). There appeared to be limited use of external material due to the differences in equipment and procedures.

It is also noted that there was no substantive way to determine the 'effectiveness' of using video, in an education pedagogy sense. To address this a metric was created and planned for use in another course (also using the foundry).

Finally, the process of creating a video is time and equipment intensive. Some ancillary aspects of video production included a momentarily clean foundry, an outstanding archive document, and some of those higher Bloom's Taxonomy (3) scenarios played out on the instructor.

Methodology

This project posits the use of video to accelerate and improve some basic foundry concepts and skills. Since safety is such a prominent constraint, it is covered soon and often. Commercial videos (4) have been used during MET257 in conjunction with lab tours and demos. But commercial scenarios are typically different in scope and application compared to the small foundry at CWU. So the videos we created use CWU facilities.

The first video created was a general foundry process description. The base footage was taken during an outreach event know as the 'Pattern Swap'. The event is intended to foster support and networking for all foundry education entities in our region. It typically has 3-4 dozen attendees from all over the state, with all levels of K-20 represented. An attribute of this venue is that a variety of participants were available.

The next two videos targeted green sand. One video described the use and maintenance of the sand itself. The other video concentrated on how sand is used to make a mold. Managing sand is both a time-consuming and necessary part of foundry operations. Many students are reticent to approach and use the large equipment. There is also a quality issue (the quality of the sand itself) of interest.

The videos were created over the spring and summer of 2009. The first opportunity to use the videos was in a 'Production Technology' (MET345) course in the fall of 2009. The videos were included into the existing curricula.

During MET345 Production Technology (5), the foundry is used to cast metal propellers for toy aircraft. About 500 toys are made each year for the holidays. Each toy is made of donated wood and metal foundry parts. The 'airplane' has wood fuselage, wing, tail and wheels, with a cast metal propeller (advertising CWU and our Industrial and Engineering Technology Department). Major outcomes for this course are oriented toward production (e.g. production processes, process control, quality control). Since the actual wood or metal fabrication processes are secondary, there is reason to quickly gain the necessary fabrication skills. The videos were used for this purpose.

Video Issues

Creating a quality video is certainly becoming more doable. The advent of handheld HD camcorders (e.g. SONY HDR) allowed a team of two to capture the video during the Pattern Swap event. After that a considerable amount of time was spent editing. This excessive editing time (orders of magnitude) may be unappreciated by non-participants. These videos were edited using Adobe CS4 Production software (6). Narration was overlaid later using a digital recorder (OLYMPUS VN-4100PC) and many e-mails.

Other content for the videos included a series of still pictures of the foundry that were shot during off hours. Also, some illustrations were developed to augment the video. These illustrations were done in MicroSoft™ PowerPoint (e.g. mold sequence). Hours went uncounted as the product was pushed forward to meet our deadlines (fall classes).

The video product has many qualities. Like images, there are different storage formats and compaction styles. Adobe™ was used as a master. Vimeo™ was used (www.vimeo.com) as a streaming agent (7). During class, the internet was accessed and Vimeo brought up. The videos were run from the Vimeo website. To view the videos, simple go to Vimeo and search for 'green sand casting', for example.

Many pitfalls exist in the creation of videos, such as the time involved. For the three videos described, there are many types of activities that occurred. For example, we estimate 20 hours of video and a hundred pictures taken. Also, we expended 100 hours of video editing, 30 hours of graphics creation, 40 hours of audio creation and 20 hours of format editing. We did not include overnight computations and processing.

We also did not address the issue of teamwork. It took days for us to coordinate our efforts with regard to uploading new versions to the net, and then accessing it for new audio or video editing. It then took more time for the originator to get the new material or feedback in order to use it for the next version.

Another pitfall is equipment and software. We started with one computer and Adobe™, but another computer was bought to speed the processing up. This can be a never-ending game of system maintenance.

A suggestion for interested parties would be to try to make a short (less than one minute) video as a trial for the process. Checking to make sure the system is in place can reveal significant issues may preclude show-stopping problems.

Assessment: Video vs. Education

The video itself can be assessed, and many rubrics already exist for this purpose. One that stood out was from Joan Vandervelde at UW Stout (8). These rubrics tend to address both the video content and video production qualities.

For our purposes, we chose to concentrate assessment on the educational impact of the videos. The feedback we sought on the video itself came from student surveys and their comments.

Education Assessment

The class formats for both MET345 and MET257 are 3-hour blocks, two days a week (6 quarter contact hours). Typical pedagogy includes a series of activities such as lecture/demo/lecture/activity scenarios. We were able to administer a survey for students that addressed their response to the video material.

Fielding pedagogical assessment is scheduled for spring quarter in 2010. A metric was desired that could compare new pedagogy with old (e.g. with last year's efforts). Also, it would be interesting to compare the effect of the video vs. demos or other activities. An example of a metric assessing the preparation of green sand is offered in Appendix A. This metric includes basic 'time-on-task' methodology, and is intended to evaluate the 'effectiveness' of using these videos.

A disclaimer of what we did not intend to accomplish is appropriate. The short time period precludes validation and longitudinal assessment aspects. Simple correlation was sought for an initial feedback. This applies to both the student surveys and our in-class assessments.

Results

Three casting videos were used in the fall, 2009, Production Technology course. The longer (20 minute) introductory video was shown first. During the same course period (3-hour block) the other two videos were shown as the topics appeared in the lecture. A demo in the foundry was performed after the lecture/video sequence. The following class period had students performing a casting operation for usable parts.

Instructor feedback from the fall 345 course was recorded. For comparison, similar amounts of time were spent (between the previous year and current, both taught by Mr. William Cattin) on the foundry introduction portion of the curricula. There were four lecture segments, three videos and one demonstration. The first lecture segment (introduction to casting processes) was the same for both years. Then the three videos were followed by their appropriate subject discussions (1^{st} video on process with safety, 2^{nd} video on sand management, and the 3^{rd} video on molding). There was no difference noted in the length of discussions related to each discussion, and no difference noted in the amount or quality of questions. There was also no difference in the amount of quality of questions during the demonstration. However, during the following class period students made significant references to the video (e.g. as they were trying to process the sand). As an indicator of the effectiveness of the videos, both the amount and quality of questions and discussion increased during this time.

Student surveys were completed by seven individuals (they did most of the foundry work in the 345 class). The survey only addressed the 'sand preparation' video. The results follow:

Sample: 7 students
1. How many times did you watch the video(s)? 1 (86%) 2 (0%) 3 (14%)
2. Did you watch the video outside of class hours? Y (71%), N (29%)
3. Did you have foundry experience before watching the videos? Y (100%)
4. Was the video helpful in understanding the foundry process? Y (100%)

Student comments included some on their impression of the video itself and its length: "shorten the video", "the video was a good length", and "the video was great". On the video audio: "jazz up the audio", "narration needs to be much more upbeat", and "have the dialogue scripted". On the animation and motion: "watch the whole job in fast motion", and "speed up the animation".

On the content: “it showed how green sand works”, “it show what green sand is”, “very useful and informative”, “maybe showing a finish product after risers and sprues have all been removed”.

Discussion

The initial results were encouraging, in that some students both made reference to the videos in class, and accessed them off-line. The effectiveness of using of the videos during lecture was not as obvious to the instructor. It is easy to consider using the videos in this more traditional fashion, but not as easy to assess its worth.

The student feedback was encouraging in that all the respondents thought it worthwhile. Student comments were ambiguous regarding video length, but very positive with regard to content. The asynchronous access evidence supports further investigation. We plan to upload the videos to BlackBoard™ so that a quantitative feedback on ‘asynchronous use’ can be easily obtained.

To further investigate the effectiveness of the videos, we plan for two professors to teach two tracks of activity in MET257 during spring of 2010. Each professor will use the both the video vs. traditional as a control (for the sand management, for example), and then the professors will switch students and teach another content area (e.g. perhaps sand molding). A metric can then be applied to capture some feedback on educational effectiveness against a control. A plan is to digitally record the class, and then replay and analyze it for data on time-on-task (e.g. discussion lengths) and quality (level of questions and discussion).

Conclusion

The actual creation of quality video is quite expensive (both in time and money) due to production and editing issues. Though pitfalls can exist, high quality educational modules can be created.

Both students and instructor concur that the supplemental use of content specific videos enhances the education experience in our foundry courses. Though supported by observations and surveys, assessing the educational effectiveness is still problematic. A casting process metric was created for this purpose and is scheduled for use in our spring 2010 casting course.

Acknowledgements

Many thanks go to Mike Meier (www.KStreetStudio.com) for his generosity and skills. The videos may show CWU facilities and personnel, but they wouldn’t have been created without Mike.

Thanks also to Bill Cattin and the students of MET345 for using the videos and providing feedback for this project.

Bibliography

1. Waters, C., 'Redesigning Materials Science for Millennial Student Learning', ASEE Annual Conference, Austin, TX, 2009
2. 'Foundry Videos', Georgia Tech, www.ndsl.org, 2009.
3. Bloom, B.S., "Taxonomy of Educational Objectives: The Classification of Educational Goals", P201 1956.
4. 'Foundry Safety', Inductotherm Corporation, www.inductotherm.com , 2009.
5. MET345 Production Technology, www.cwu.edu, 2009
6. Adobe Premiere Pro CS4, Adobe, www.adobe.com, 2009.
7. Vimeo, LLC, www.vimeo.con, 2009
8. Joan Vandervelde, http://www.uwstout.edu/soe/profdev/videorubric.html , UW Stout, 2009

Appendix A: Casting Operations Metric on Green Sand Preparation

Casting Rubric: Preparing Green Sand

Objective: Measure the ability of a student to use the CWU Foundry equipment to prepare one wheelbarrow of green sand.

Resources: The evaluator will need to observe a student in the foundry.

Constraints: Available raw materials (sand, water, clay content, equipment) are required.

Metric assessing 'content':

	100%	50%	0	Score:
Safety	Wears appropriate PPE	Some PPE missing	Disregard for safety.	
Product Quality	Useable green sand	Poor quality sand	Unusable sand	
Use of Equipment	Equipment used and left in good condition.	Equipment needed attention after student used it.	Disrespect displayed for equipment.	
Quality of work	Student performed the operation competently.	Student needed help in completing the task.	Student workmanship is unacceptable.	

Metric assessing 'operation':

	Compare time to baseline (%)	Score:
Awareness Note: baseline time set.	Time to identify the equipment related to sand preparation.	
Plan Note: baseline time set.	Time for a dry-run of what the student plans to do in preparing the sand.	
Quality of work and ethics	Percent of time spent on the process (vs. distractions).	

1/26/10 Craig Johnson cjohnson@cwu.edu