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# Board 5: Work in Progress: Effectiveness and Utility of Video Feedback for CAD Models

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He is currently interested in innovative, student-centered teaching methods including problem-based and flipping teaching.

# Effectiveness and Utility of Video Feedback for CAD Models

## Introduction

Feedback on student work has been shown to be essential to student improvement and achievement [1]. At the same time, not all feedback is effective [2]. The mode and manner of feedback directly impacts student outcomes[3]. This was brought to the fore during the COVID pandemic when instructors shifted their lecture and discussion online. Although instructors quickly pivoted to online instruction, they largely did not change their feedback methods/modes (e.g., written comments, scored exams)[4].

Recorded video feedback (VF) has been explored as a potential method to give specific and detailed feedback to students. VF has been used for written student work (problems sets, essays) where instructors record comments over students' submission[5-6]. VF has shown promise as a way of giving feedback to nonwritten work such as student presentations[7]. In this paper, we explore the use of VF for another nonwritten form of student work: CAD models.

## Video Feedback Method

VF is the recording of audio and visual feedback directly over work submitted by students (see Figure 1). The recordings are shared with students via a cloud repository with access controls to maintain feedback confidentiality and reduce sharing among students and to maintain privacy.

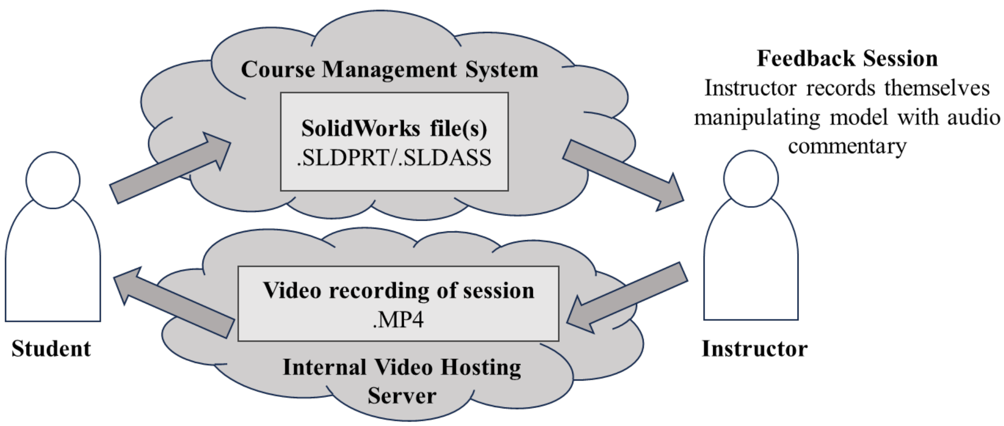


*Figure 1. Video Feedback Overview: Student submits SolidWorks files to course management system. Instructor records themselves manipulating the file. Video recording is posted to video hosting server where students can view it. Server is secured and access to file is limited to selected student. Students can view files on any device that can view MP4 videos over the internet.*

This study involves CAD models generated by students in a one-credit Solid modeling class (CAD in BME at the University of Miami). Students were given seven homework assignments that involved creating models (both part and assembly files) based on dimensioned drawings with some written instruction (See example in Figure 2). The instructor gave feedback about each submission before the next assignment was due. The models from each assignment were used in subsequent ones, requiring students to correct errors as the semester progressed.

In a traditional setting, feedback was given via written comments in a learning management system (Blackboard). For VF, Zoom was used to screen record the instructor's voice as they interacted with SolidWorks CAD models submitted by students. These recordings were uploaded to a video hosting site controlled by the university (Microsoft streams/SharePoint), and secure links to videos were sent to each student. Only the student in question could directly view the video and downloading was not allowed. The video hosting site also auto generated captions.

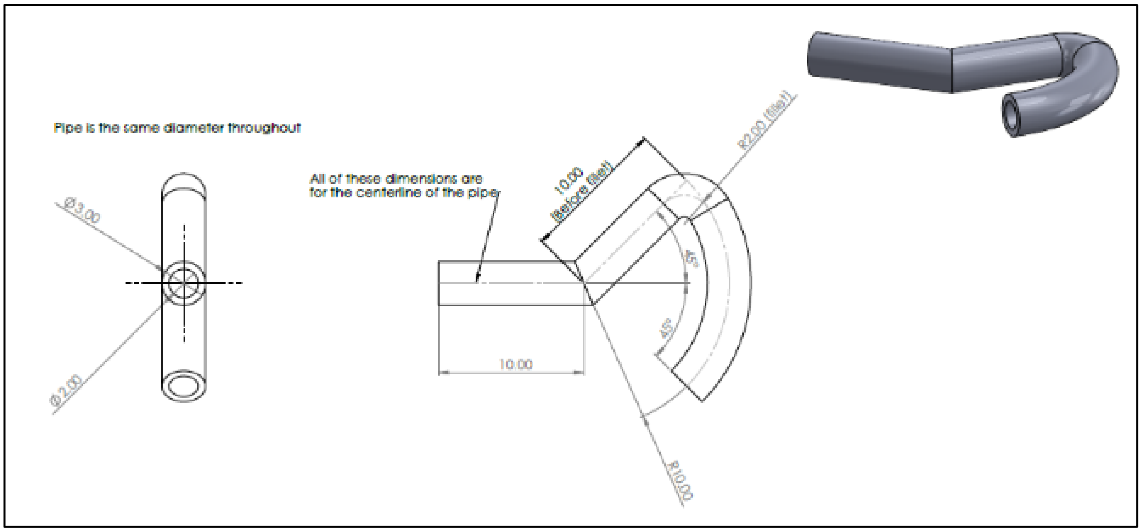

*Figure 2. Example of drawing from assignment. Students replicated the model and instructor gave VF on the submitted model.*

**Data Collection and Metrics**

This is a retrospective study, using data from four semesters taught by the same instructor (the University of Miami IRB has determined that this study is exempt from review.) The traditional cohort (Fall 2019 n=9 students) was taught using written feedback, while the VF cohort consists of three classes (Fall 2021/Spring 2022/ Fall 2022/ n=4/11/20 = 35 total). Two sets of data were collected from each cohort: analysis of student final projects and video file data.

The final project in each class was similar, asking the students to create a model or assembly (collection of parts) that demonstrated their skill. Students had freedom to choose objects that they wanted to model for this project. Emphasis was placed on creating error-free parts with fully defined features, while using tools efficiently. The number of features in each submission, and the sum of unique parts, configurations, and subassemblies (items) was counted for each submission. These are viewed as measures of submission complexity. To measure accuracy and efficiency, we counted broken items, underdefined sketches, and features that appeared to be redundant or extraneous and then divided this total by the number of items in the submission to calculate an error rate per submission (error rate). Finally, we count the number of times that each student used a tool that was not directly taught in class (new tools). This is viewed as a measure of a student's ability to acquire skills independently.

The video hosting site collects basic metrics about the feedback videos. The number of views per file is used to gauge student utilization of VF. Instructor effort is estimated by summing the length of all videos and dividing by the number of students and the number of assignments.

**Findings**

Figure 3 shows the whisker box plots for number of features and items per submission. Both mean and median increased in all VF cohorts as well as for All the VF students combined indicating an increase in complexity.

Figure 4 shows whisker box plots for error rate and number of new tools used. Though the change in means suggest improvement (lower error rate and higher new tool usage) The data overlaps significantly and has many outliers so no conclusion can be drawn.

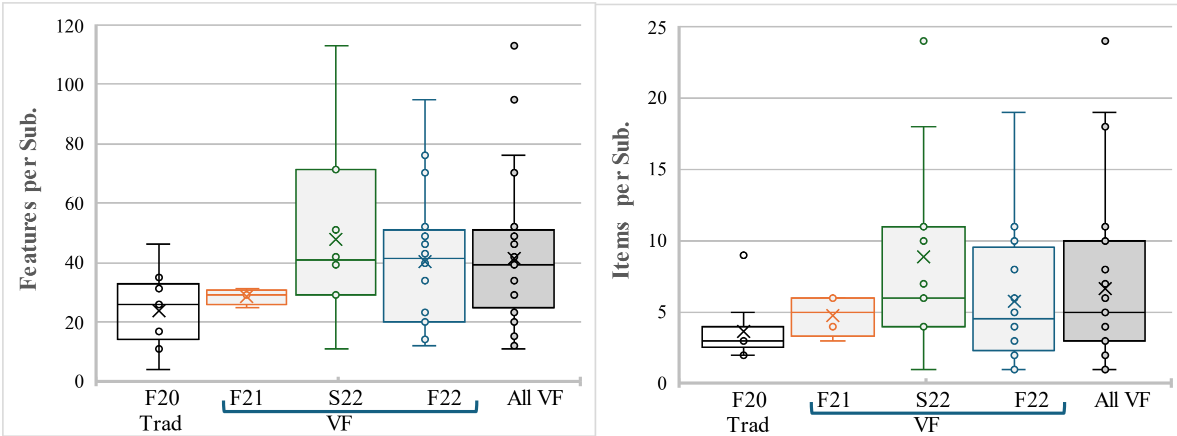


*Figure 3. Measures of complexity in Traditional vs VF cohorts. Both exclusive mean (middle bar) and median (X) number of features and items per submission increase in the VF group compared to the traditional (F21 = Fall 2021, S22=Spring 2022).*

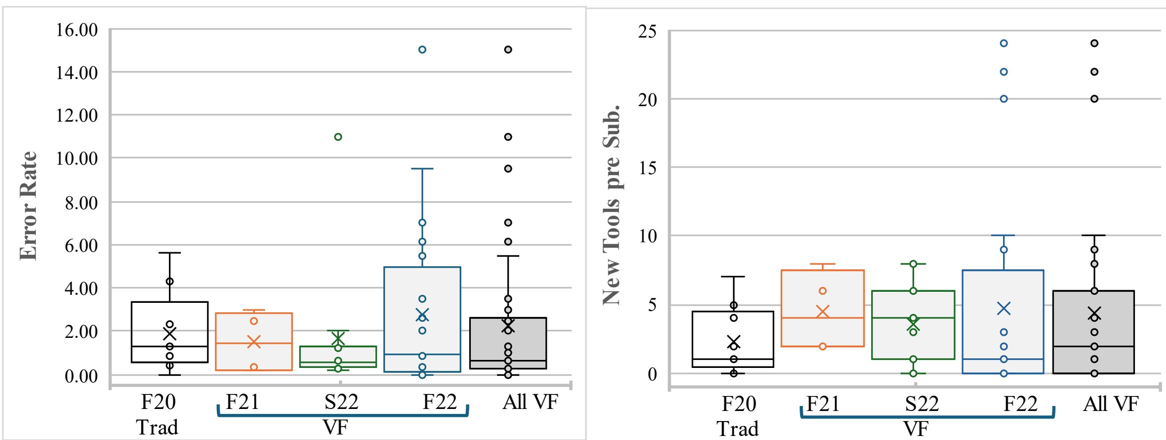


*Figure 4. Error rate and number of independently acquired tools (New Tools) between cohorts do not show clear change.*

There are clear indications that the videos were viewed. 47% of videos were watched once, 27% twice, and 15% three or more times. Only 17% had no views. The combined mean video length per student was 51.8 minutes or approximately 7.5 minutes per student per assignment.

## Conclusion

VF is a viable option for giving feedback on CAD models. It allows instructors to tailor their feedback to each student and to demonstrate rather than describe. The data suggests that students review the feedback and that this leads to higher levels of complexity in their work. The accuracy of their work and independent skill acquisition does not appear to be impacted by VF. The main critique is that it may be time consuming for the instructor. However, averaging 7.5 minutes of recorded video per assignment suggests that VF is feasible.

As with most retrospective studies, there is potential for confounding. Since the traditional cohort was also the first cohort chronologically, there is the possibility that the instructor skill improved rather than the skill of the students. Future work includes examining student receptiveness and comfort with this method as well as looking at how instructor experience with VF can decrease the time required to provide it. We would also like to see if there is a correlation between the number of times a student views their feedback and their skill acquisition. We feel that this may give insight into how to scale VF in large classes.

**References**


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