Benefits of Video Tutorials for a Computer Aided Design Class

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Abstract

Introduction to Engineering II (ENCP A102) at University of South Carolina Aiken is a computer-aided design (CAD) class using Creo Parametric, a feature-based solid modeling program. In spring 2019, the author instructed students in a traditional classroom setting, going step-by-step through the first ten lessons in Toogood[1]. However, in spring 2020 when classes shifted online due to the pandemic, the author decided to shift his instruction to a recorded video format. This approach provided students with more flexibility and a greater sense of control over their learning process. Students responded very well to this approach and performed better, on average, than in 2019. Therefore, the author used this video tutorial approach throughout the 2021 spring semester. Students once again responded well and performed better, on average, than students in the previous two years.

Keywords

Computer aided design (CAD), video recorded lessons, feature-based solid modeling

Introduction

The second Introduction to Engineering course (ENCP A102) at University of South Carolina Aiken (Uof SC Aiken) is a computer aided design (CAD) class wherein students learn to create three-dimensional (3-D) views and two-dimensional (2-D) drawings of mechanical components in Creo Parametric, a feature-based solid modeling program. In the 2019 spring semester (SP19), the author instructed students in a traditional classroom setting, going step-by-step through the first ten lessons of Toogood[1]. In the 2020 spring semester (SP20), the class began with the same approach. However, when classes shifted online due to the pandemic, the author decided to shift his instruction to a recorded video format. This approach provided students more flexibility and a greater sense of control over their schedule and learning process, which the author felt was important to their well-being during the early stages of the pandemic. Students responded very well to this approach, performing better on average than students in the previous year. Additionally, the author received many positive comments from students. Therefore, the author decided to use this video tutorial approach throughout the 2021 spring semester (SP21). With classes now back in a physical classroom, students were asked to bring in headphones to watch the video tutorials at their own pace. Students once again responded with positive feedback and performed better, on average, than students in the previous two years.

In previous research in this area, Abdulrasool, Salah Mahdi, et al.[1] found that integrating computer simulations with traditional classroom teaching of Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), and Computerized Numerical Control (CNC) technologies improved the learning effectiveness of students. This outcome was determined by having two groups of students, one that received traditional classroom teaching and the other

whose instruction also included computer software assisted instruction. Both groups were evaluated to have very similar "pre-learning indicators" and the group that received the computer assisted instruction scored significantly higher for five different learning outcomes. Noviyanta and Ngadiyono[2] created video tutorials to instruct students in an Indonesian Vocational High School on how to create manufacturing drawings using Autodesk Inventor 2013. Teachers from the high school and Yogyakarta State University lecturers evaluated the effectiveness of the tutorials as "very good" and two different groups of students rated them as "very good" and "good." Al-Hamad[3] determined that a hybrid approach of traditional classroom teaching along with independent student viewing of PowerPoint slides and digital video presentations was the most effective method in teaching CAD/ CAM /CNC tasks. The author explained that students thought this was the best approach (via survey) because the various modes of instruction made the learning process more enjoyable and consequently more effective.

The purpose of this research paper is to communicate the improvement of student performance in the use of 3D modeling Creo Parametric software when the author transitioned from traditional classroom instruction to the use of video recordings as the primary method of instruction.

Discussion and Results

The focus of ENCP A102 at UofSC Aiken is on creating 3D models of parts and assemblies. The class begins with hand drawings using orthographic and isometric views. After students gain some spatial understanding using hand drawings, the author proceeds with instruction of the Creo parametric feature-based modeling program. This program is used in many industries to develop 3D renderings and 2D engineering drawings. In SP19, the author taught in a traditional manner, going step-by-step through the lessons in the Creo Parametric tutorial[1]. Several homework assignments were given to help students become proficient in the use of Creo commands and functions. In SP20, half (five of ten) of the Creo lessons were taught in a traditional classroom manner, while the other half were taught using recorded videos. In SP21, the number of Creo lessons taught via video recordings was increased to seven of ten. While the homework assignments varied somewhat over the three years, the type and complexity of objects in the assignments were kept consistent. Figure 1 shows that student performance on homework assignments improved notably from 2019 to 2020 to 2021.

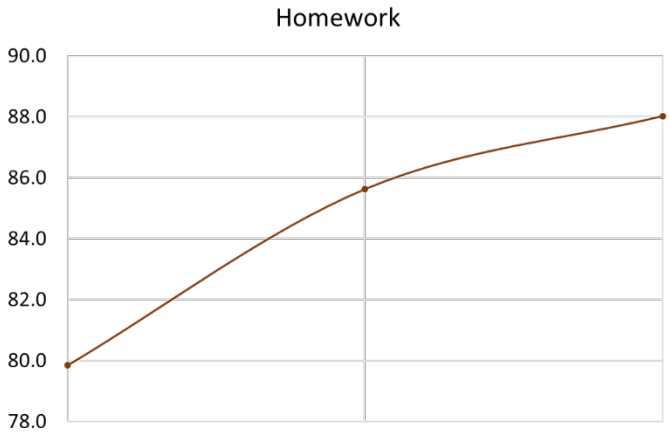

Figure 1. Average grades for ENCP A102 homework for SP19 – SP21.

Regarding exams, a midterm and final exam were given in each of the spring semesters, 2019 – 2021. The midterm exams tested students on the ability to model a single physical part of moderate complexity. On the final exam, students were required to model several parts and bring them together into an assembly. To ensure the integrity of the exams, the actual parts and assemblies were changed from one semester to another. However, careful attention was given to ensure a consistent level of complexity and difficulty for the exams from one year to the next. Figure 2 displays examples of the assemblies that students were tasked to create on the final exams from 2019 – 2021.

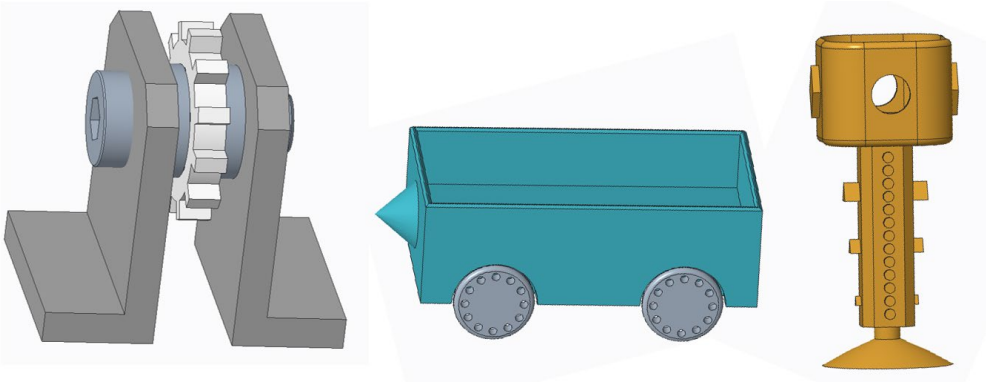

Figure 2. Assemblies required to be modeled by students on the ENCP A102 Final Exam for SP19, SP20, and SP21.

As with the homework, Figure 3 shows that student performance also improved on exams from SP19 to SP21.

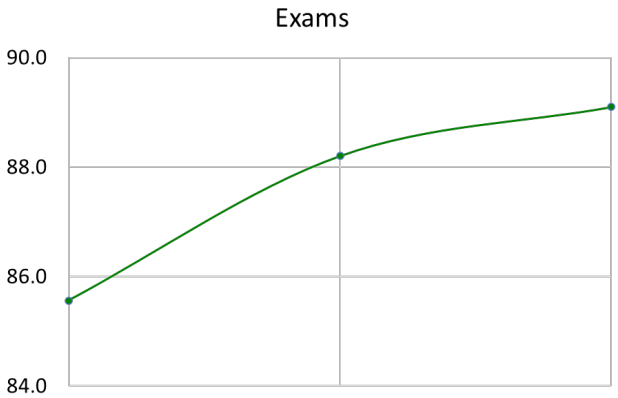

Figure 3. Average grades for ENCP A102 exams for SP19 – SP21.

A final project was also consistently assigned in ENCP A102 from SP19 to SP21. For this project, students created a 3D model and a corresponding 2D drawing of an object of their choosing. The evaluation rubric for this project included level of complexity of the object, accurate representation of the object, proper dimensioning, creativity, and clarity and accuracy of the drawings. As seen in Figure 4, student performance improved on the final project in each year from SP19 - SP 21. Since student performance improved in homework, exams, and the final project with each year, the overall course averages also increased from SP19 – SP21. Figure 4 also shows the improving trends for overall course averages for SP19 – 21.

Figure 4. ENCP A102 averages for the final project and overall course grades for SP19 – SP21.

The author attributes the improvement in student performance across the board in ENCP A102 from SP19 – SP21 to the shift to the video recorded format. The reason for this attribution is that the course content, assignments, and assessments were all kept consistent throughout this period. While the homework varied somewhat, students were consistently required to model parts of similar complexity with each of the tools covered in the first ten chapters of Toogood[1].

In addition to the positive trends in academic performance, students provided very positive feedback on the video tutorials in the UofSC Aiken Student Evaluations in Teaching (SETs). One of the questions asked of students was: "What were the most effective things the instructor did for this course?" In response to this question in SP21, 52% of the students answered with the recorded video tutorials. Specific student comments on the video instruction included:

- "I believe the videos were the most effective tool the instructor used…"
- "The recorded videos were extremely helpful for understanding the material."
- "I really liked the videos. If I missed something I was able to rewind and go back…"

Conclusion

When the pandemic disrupted the 2020 spring semester, the author sought to help students to cope with the situation by providing more flexibility in the mode of instruction. With this goal in mind, the author decided to record videos showing the steps of Creo Parametric tutorials for the ENCP A102 class. This approach allowed students to access the videos at convenient times, to work independently at their own pace, and to rewind a video if they missed something the first time around. At the conclusion of that semester, several students remarked that they preferred the video tutorial approach over the more traditional classroom methods in the first half of the semester. The author therefore decided to use the recorded video format for most of the ENCP A102 Creo Parametric lessons in the 2021 spring semester. The result of this sequence of instruction was that students performed progressively better in all areas (homework, exams, and final project) from 2019 - 2021 as the amount of video recorded lessons increased. While some of the specific content of the homework and exams varied with each semester, the required learning outcomes and tools, and the level of complexity of assignments were maintained at a consistent level. The author therefore concludes that video tutorials are beneficial towards the improvement of student learning and performance in computer aided design classes.

References

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