Exploring the Impact of Peer-Generated Screencast Tutorials on Computer-Aided Design Education

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Deniz Eseryel joined North Carolina State University as a Chancellor’s Faculty Excellence Program cluster hire in the Digital Transformation of Education. She is an Associate Professor in the Department of Curriculum, Instruction, and Counselor Education specializing in Digital Learning and Teaching. She is also a Senior Research Fellow at the Friday Institute for Educational Innovation. The important but little understood question that has motivated her program of research is: How can we effectively and efficiently promote cyberlearning in complex knowledge domains such as STEM (science, technology, engineering and mathematics)? Towards this direction, she (1) investigates the development of higher-order thinking and complex problem-solving competencies following a comprehensive framework that includes cognition, metacognition, cognitive regulation, motivation, emotion, and epistemic beliefs; (2) develops innovative assessment methods that can benchmark progress of learning and the development of complex problem-solving competencies; (3) develops new and effective approaches to design state-of-the-art digital learning environments (such as intelligent tutoring, system dynamics modeling, simulations, virtual reality, and digital games) to facilitate complex problem-solving competencies; and (4) investigates effective ways to prepare teachers and administrators for digital transformation of education to support effective integration and seamless adoption of advanced learning technologies into education. In addition to her work focusing on STEM learning in K-20 educational settings, her research was also carried out in professional contexts including army, aircraft maintenance, air-traffic control, emergency response, environmental sciences, climate change, medical education, instructional design, architecture, construction science, mechanical engineering, industrial engineering, and systems engineering.

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I am a junior mechanical engineer at Prairie View A&M University. I currently tutor in UGS NX 7.5, a CAD based class that implements both hand and computer based drafting. My main duty is to lecture the CAD section of the class known as Intro to Mechanical Drawing along with the tutoring or any other related duties that entail.

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I was born and raised in Houston Texas. I have worked in the professional field for five years as an environmental technician at Southern Union. I am also currently attending Prairie View A&M University to pursue a Mechanical Engineering degree.
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My name is Deron Arceneaux; I am a sophomore at Prairie View A&M University. I am a member of the National Society of Black Engineers, and a member of the American Society of Mechanical Engineers. In these organizations I participated in many community service events, I am a very active member in these organizations. I am also a teachers assistant for the Mechanical Engineering Drawing I, in this class we teach NX 7.5 CAD software.
Exploring the Impact of Peer-Generated Screencast Tutorials on Computer-Aided Design Education

Abstract

This paper presents the design strategies of an engineering education research project funded by the National Science Foundation (NSF) and discusses the preliminary findings. Study participants were the students who enrolled in the "Mechanical Engineering Drawing" course and learned about computer-aided design (CAD). We grouped students into two sections as control section versus experimental section. Control group students received a traditional and teacher-centered instruction. The screencast tutorials were provided to them by their instructors. In the experimental section, students designed their own screencast tutorials. They shared the tutorials with one another on the Internet. They reviewed and commented each other’s tutorials. This activity was student-centered. We captured students’ attitudes towards engineering and their life-long learning skills before and after the semester, and their CAD knowledge at the end of the semester. This is the first implementation of the research project and our preliminary findings are discussed in this paper.

Introduction

Emerging technologies have changed the way that people teach and learn knowledge. “Screencast” in this paper will be defined as a digitally recorded playback of a computer screen output, which often contains audio narration to visually present procedural information. It is a unique E-learning tool. It is cost-effective and user-friendly. It helps generate multimedia instruction that is authentic, situated, and motivating and can also be applied in various educational settings (e.g., the classroom, self-paced environment, collaborative learning environment, etc.). Instructors can develop screencasts to deliver CAD software tutorials. The user-friendly and cost-effective features of the screencasts allow the course instructors to frequently update the learning material and keep up with the pace of the software evolution. Generating a screencast for CAD instruction requires the same amount of time as preparing a class demonstration because the screencast simultaneously captures the users' actions on the computer screen. The screencast videos are typically extracted in formats that are compatible with other players and world-wide-web browsers. The screencasts can be easily shared on the Internet.

Screencasts have been used as educational tools in a variety of disciplines, for example, statistics, engineering, and nursing. Research has shown that teaching with screencasts has many benefits. Learners perceive the screencast tutorials to be more explicit and user-friendly than the static versions of instruction. Screencasts are considered to be more effective learning tools than written notes or textbook exercises because they are animated and include audio. For visual and auditory learners, screencast tutorials are more preferable instructional tools. Screencasts also have the advantage of more user control and autonomy. The learner can stop, rewind, and replay a screencast as many times as she wants and move with her own pace. She can watch the screencast at any location and time on a world-wide-web browser that can be on a personal computer, a tablet, or a smart phone. The initial learning is fast since students do not spend time in interpreting the steps and avoid the laborious trial-and-error process. Since a
student learns by observing the desired behavior of an expert on the screencast, it aids learners with low self-efficacy in exploring the demonstrated behaviors\textsuperscript{1}.

Teaching how to use CAD software with the screencasts has additional benefits. The learners can learn about a key technique in CAD by simply watching the screencast. An audio explanation behind the screencast can explain how and why the key technique is important. The CAD screencasts are sustainable. Once they are prepared, they require minimum maintenance and could be used by future users. The CAD software are updated quite frequently. Creating updated screencast tutorials on the most recent CAD software would require less time and fewer resources than creating written tutorials or handouts. In other words, the screencast tutorials can help students and instructors keep pace with the software upgrades.

In most studies reported in the literature, instructors generated the CAD screencasts and then distributed them to the students. The students watched the CAD screencasts and learned about the CAD software techniques by following the directions. Even though the instructor-generated CAD screencasts have both visual and verbal stimuli, this conventional use of the CAD screencasts in learning has some disadvantages. The students are still kept passive in the learning process and they simply receive the provided instruction. They do not participate in designing the material that they learn. The learner may memorize the steps presented and copy them to the application environment without meaningfully understanding the task\textsuperscript{10}. Learners may become less activated and engaged, which will undermine the learning outcomes\textsuperscript{11}. Therefore, the teaching method where the instructors generate the screencasts is not considered learner-centered\textsuperscript{12}.

**Study Purpose**

The purpose of this NSF funded engineering education project is to improve undergraduate engineering students’ CAD learning and help them develop life-long learning skills and positive attitudes towards engineering by assigning students active roles to generate and share the screencasts with one another. In this work, students generate CAD screencast tutorials, record the supporting audios, share the videos with their peers, and provide feedback to each other’s screencast. When students actively participate in generating the screencasts, they will develop the feelings of belonging and ownership about the knowledge that they are learning. When student learn from their peers, they may develop the habits of life-long learning skills that involve an understanding that one can always learn new things by reviewing others’ instructions or tutorials. In the meantime, students’ altitudes towards engineering could improve due to their active involvement in the learning activities in engineering.

**Study Rationale**

Life-long learning rationale: One purpose of this project is to enhance students' life-long learning skills. When students know that the material they generate will be used by their peers, they will be more willing to put extra efforts in their work and do their best. Commenting on each other’s screencast and reviewing these comments enhance their engagement in their design tasks. Peer-to-peer learning will be fostered and encouraged, and the idea of conversing new things with peers is developed. This is more of an authentic learning activity than simply
learning the material from an instructor-generated screencast. Students who are recording the audios along with their screenshots will be meta-cognitively involved in their tasks. This will help improve students’ meta-cognitive skills partly because they will be required to think aloud as they record the supporting audios. Students creating the screencasts will take both an instructor role and a learner role at the same time. They will have to think from multiple perspectives. These different role-taking strategies will improve students’ meta-cognition and their comprehension of the CAD tools. The students, who create screencasts and learn from viewing their peers’ screencasts in the class, will know that they can always learn new knowledge similarly in their future lives. Realizing that your peers have the potential to teach you new knowledge and being aware of available resources are critical for life-long learning skills. Students who view the peer-generated screencasts and give feedbacks to the designer would need to make clear and reasonable judgments in their explanation, which in turn, helps to develop critical thinking skills. In addition, students will share different ways of making the same CAD models in their tutorials, which may trigger students' curiosity for solving problems using different methods.

Engineering attitude rationale: We anticipate that experimental student's attitudes towards engineering will improve due to the implemented project’s activities. The collaboration among the group members will help students realize the importance of team-work and information sharing in engineering. In the screencast tutorials, students make efforts to provide clear and instructive video tutorials, which may help them understand the importance of oral communication and presentation skills in engineering beside the problem solving skills. In the meantime, the practical attribute of this project might change students' original impression that engineers only deal with theory and solve complex mathematical problems. But instead, engineering could be an interesting and fun career.

Study Methods

This paper presents our first implementation of the project activates. We anticipate collecting data over the next three years with more than hundred student participants. The project was first implemented in a freshman "Mechanical Engineering Drawing" class offered in Mechanical Engineering Department at Prairie View A&M University in Fall 2014. The course has been designed to teach students engineering graphics and three-dimensional (3D) modeling using CAD software. This course provides students practical experience on how to use the CAD software named NX in 3D modeling and drafting. NX license has a "borrowing-license" option. Each student in the class can obtain an NX borrowing-license, which allows students to use NX on their personal computers over the semester. Students return the license after they complete the course. The Techsmith's Snagit software is used as the tool to make the screencasts in this project. Snagit supports long-time video capturing and MPEG-4 video format, which is compatible with many devices, including PCs, tablets, and smart phones. Each student in the class was provided a Snagit software license so that they can install the software on their personal computers. By using Snagit, all the actions on computer screen plus the audio can be recorded as a screencast. In this project, an online course management system named Ecourses is used for the students to make and post their screencast videos and provide feedback. Ecourses is the web-based course management platform used by the university to deliver online courses and
provide web-based resources for face-to-face courses. Ecourses offers a "forum" function, in which students can share the screencast files and provide comments to each other.

We grouped the students into two sections. One was designated as the control section and the other was designated as the experimental section. Students in the control section received traditional instruction. In the experimental section, students were asked to generate screencasts and share them with each other. Students in the experimental section were divided into several small study groups. Typically, each small group included five or six students. All project activities were assigned in a group format. Our purpose has been to promote student collaboration and peer-to-peer mentoring among the group members. Below, we explain the exercises that students completed.

**Screencast Exercises**

Three screencast homework were assigned to students in the experimental section. The first homework was designed for students to be familiar with Snagit software and Ecourses platform. Every student made a screencast of the modeling procedure of a simple model in Figure 1(a), and posted it on Ecourses. The second and third screencast homework with the models shown in Figure 1(b) and 1(c) were designed for students to work in groups.

![Figure 1](image1.png)

Figure 1. Screencast homework models

In Fall 2014, students in the experimental section were divided into nine groups. Each group included about six students. Among these six students, each were assigned with one of the two tags: "tag A" for generating a screencast and "tag B" for providing comments. Students with different tags took turns in the activities they completed. For example, in the second screencast homework, students with tag A generated and posted their screencasts, while students with tag B viewed the screencasts and provided feedback to the student with tag A. This process is visually represented in Figure 2. Then in the third homework, the students switched the roles.
In order to balance the workload between the control and experimental sections, three modeling assignments as seen in Figure 1 were also given to students in the control section, but they did not generate and shared screencasts with one another.

Research instruments and data collection

In order to capture the effect of the screencast tutorial exercises on students’ learning outcomes, we used four instruments: a life-long learning scale, an engineering attitude survey, a CAD knowledge exam, and an exit project survey. We received approval from the Institutional Review Board (IRB) at the university to conduct this study. The students who were enrolled in the CAD course in Fall 2014 were invited to participate in the research. Students who volunteered participating provided their signed consent. All students enrolled in the course were asked to complete the class activities, but we only analyzed the data generated by the students who provided their consent. The research instruments are presented as follows.

Life-long learning scale and engineering attitude survey: We have chosen to use a life-long learning (LLL) scale designed by Wielkiewicz and Sinner\textsuperscript{14} to capture students’ intent to learn from others in contexts other than a school environment. The LLL scale included sixteen questions with a five-point scale (see Appendix for the list of the items). An engineering attitude (EA) survey developed by Robinson et al.\textsuperscript{15} was used to capture students’ attitudes towards engineering. The EA survey included twenty-five items with a six-point scale (see Appendix for the list of the items). EA survey and LLL scale were administered at the beginning and at the end of the semester to capture the changes in students’ attitudes towards engineering and their life-long learning tendencies. These two surveys were given to students in both control and experimental sections.

Final exam: A final exam was given to students in both control and experimental sections at the end of the semester. It was designed to evaluate students' modeling skills and CAD knowledge. Students were given four modeling problems with the same degree of difficulty. The grade for each student was recorded and a comparison was made between the control and experimental sections to evaluate the effect of the project activities on students’ CAD knowledge and modeling skills.

Exit project survey: To explore students’ experiences with the screencast activities in the experimental section, we designed an exit project survey (see Appendix for the list of the items).
We administered the project survey at the end of the semester for the students in the experimental section only. The survey responses are used to evaluate the project activities and advance the research design in the upcoming semesters.

Results and Discussion

The project activities were first implemented in the "Mechanical Engineering Drawing" class in Fall 2014. There were 72 students in the research project, with 23 students in the control section and 49 students in the experimental section. The screencast homework and project survey were only assigned to the students in the experimental section, while the CAD modeling exam, LLL survey and EA survey were given to students in both control and experimental sections. Not all 72 participants completed all pre and post LLL scales and EA surveys. The number of participants in each exercise and the results of the analyses are specified as follows.

Screencast homework

The first screencast homework was designed for students to learn how to make screencasts using Snagit software and how to share videos and comments using Ecourses. In the second and third homework, students made screencast, shared their video tutorials, and added comments. The snapshots of one student's screencast video are shown in Figure 3.

![Figure 3. Snapshots of a student's screencast video](image)

Other students viewed the screencasts and provided their comments. Two of the comments made by students are presented in Table 1. These comments reveal that students were actively involved in viewing and evaluating the screencasts that their peers generated. Most comments were detailed and valuable. There were two advantages of adding and sharing comments: (1) Students viewing the screencasts could think about the pros and cons of the screencasts and be aware of such problems in their own screencasts, and (2) students generating the screencasts could read the comments and improve the quality of their future screencasts.

<table>
<thead>
<tr>
<th>Table 1. Examples of the comments made by the students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comment 1</td>
</tr>
</tbody>
</table>
is a big factor especially once you enter the work force. Whoever is hiring you may prefer someone who can get things done at a faster pace if that makes sense. Back to your video, it’s real good as far as directions. I knew exactly what you were explaining as it was easy to follow. I’m not entirely sure if a person new to NX would follow it as easily but I’m pretty sure that someone aware of how NX works and has used it before would. One more thing, next time check if you're too close to the microphone because there were times when your breathing was loud (I'm not sure how to describe it...or maybe it was something else) and I had to turn my volume down. Overall really great!

Comment 2

Giving a visual representation of the object at the beginning of the video was a great start. This allows the individual watching the video to have a general idea of what he will be designing. The instructor took his time explaining the different methods used to create the model. The instructor took his time explaining in detail what inferred dimensions are and what the dimensions of his drawing are. Hiding the sketch lines as he goes was very helpful, showing me distinctly what he was selecting. After completing each portion, the instructor would rotate the image so the viewer would have a good idea of what was done. Overall, the video was great and instructive, making it easy to follow and recreate the drawing.

Life-long learning scale and engineering attitude survey

All student participants (N=72) completed a demographic questionnaire at the beginning of the semester. The questionnaire asked students to indicate their ethnicity, sex, major, and whether or not they are first-generation-college students in their family. Students completed the life-long learning scale and engineering attitude survey two times: once at the beginning of the semester and once at the end of the semester. Out of 72 participants, 57 students completed all surveys (i.e., pre and post LLL scales and EA surveys), with 17 students in the control section and 40 students in the experimental section. Fifteen students missed completing one or more of the pre LLL scale, post LLL scale, pre EA scale, or post EA survey. Therefore, we excluded the data for these 15 students in the analyses of the LLL scale and EA survey. LLL scale has included 16 Likert-scale items on a five-point scale (Always or daily =5, Often =4, Sometimes =3, Rarely =2, Never = 1). All items in the LLL scale were positive (see Appendix for the LLL scale items). EA survey included 25 Likert-scale items on a six-point scale (Very strongly agree =6, Strongly Agree =5, Agree =4, Disagree =3, Strongly Disagree =2, Very Strongly Disagree =1). Not all items in the EA survey were positive (see Appendix for the EA survey items). We calculated students’ mean scores in all pre and post surveys. When the items were negative, we reversed students’ responses (e.g., Very Strongly Agree= 1, and Very Strongly Disagree= 6 in the negative EA survey). Next, each student’s gain scores were computed in both surveys by subtracting the pre score from the post score (e.g. gain LLL score = post LLL score – pre LLL score and gain EA score = post EA score – pre EA score). The mean scores and the standard deviations are represented in Table 2 and Table 3, with the control section and experimental section denoted as the subscripts "Cnt" and "Exp," respectively. The standard deviation is denoted as "SD".
In the LLL scale, analyses were made to compare the pre, post, and gain scores of the mean values for the control and experimental sections. Only one statistically significant difference were found. Control session (N\textsubscript{Cnt}=17) performed better than experimental session (N\textsubscript{Exp}=40) in the post LLL scale (M\textsubscript{Cnt}=3.92, M\textsubscript{Exp}=3.59, t=-2.23, p<0.05), as seen in Table 2. Levene’s test for unequal variances rejected that group variances were different (F=.42, p=.52). Because of the uneven number of participants in each session, we also ran non-parametric Wilcoxon test and found the same result (Z=1.98, p<0.05).

When the pre LLL scores and post LLL scores were compared for each section separately by running two independent t-tests, no difference was observed. In other words, pre LLL scale responses from students in the control section (M\textsubscript{Cnt}=3.80) were not significantly different from those in the post LLL scale (M\textsubscript{Cnt}=3.92) (t(16)=1.97, p=0.06). Similarly, the pre LLL scale responses from students in the experimental section (M\textsubscript{Exp}=3.55) were not significantly different from those in the post LLL scale (M\textsubscript{Exp}=3.59) (t(39)=.67, p=0.5).

Table 2. The mean scores of the students’ responses to the LLL scale

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Pre LLL Score Means (SD)</th>
<th>Post LLL Score Means (SD)</th>
<th>Gain Score for the LLL Scale (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Section</td>
<td>17 (2 female)</td>
<td>3.80 (0.41)</td>
<td>3.92 (0.47)*</td>
</tr>
<tr>
<td>Experimental Section</td>
<td>40 (11 female)</td>
<td>3.55 (0.49)</td>
<td>3.59 (0.57)*</td>
</tr>
</tbody>
</table>

* (M\textsubscript{Cnt}=3.92, M\textsubscript{Exp}=3.59, t=-2.23, p<0.05).

In the EA survey, none of the mean values in Table 3 were significantly different from each other. Post EA scores of students in the control section (M\textsubscript{Cnt}=3.53) were not significantly different from their pre EA scores (M\textsubscript{Cnt}=3.61) (t(16)=.756, p=.46). Similarly, post EA scores of students in the experimental section (M\textsubscript{Exp}=3.57) were not significantly different from their pre EA scores (M\textsubscript{Exp}=3.59) (t(39)=.69, p=0.5).

Table 3. Mean scores of the students’ responses to the engineering attitude (EA) survey

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Pre EA Score Means (SD)</th>
<th>Post EA Score Means (SD)</th>
<th>Gain Score for the EA Survey (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Section</td>
<td>17 (2 female)</td>
<td>3.61 (0.30)</td>
<td>3.53 (0.29)</td>
</tr>
<tr>
<td>Experimental Section</td>
<td>40 (11 female)</td>
<td>3.59 (0.19)</td>
<td>3.57 (0.25)</td>
</tr>
</tbody>
</table>

Findings indicate that students’ attitudes towards engineering as captured by the EA survey and their life-long learning skills as captured by the LLL scale were not significantly improved through the project activities. This finding is contradictory to our hypotheses. It is possible that these results were caused by the low number of student participants in the control and
experimental sections. The research team will evaluate and improve the instructional design strategies implemented in this project and continue collecting data for both experimental and control sections.

**Final exam**

All 72 students attended the final exam. Table 4 presents the mean scores of the students’ final exam for each section. The mean value of all students’ final exam scores was 75.5 that was out of 100 and with a standard deviation of 23.18.

When students’ final exam scores were analyzed with respect to their ethnicities, gender, and first generation college student status, no statistically difference was found between the two sections. In other words, students’ ethnicity, their sexes, and their first generation statuses were not any of the predictable variables for their final exam scores.

Table 4. Data from students’ final exams

<table>
<thead>
<tr>
<th>Treatment Type</th>
<th>Number of Students</th>
<th>Final Exam Means</th>
<th>Final Exam SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Section</td>
<td>23</td>
<td>70.26</td>
<td>24.42</td>
</tr>
<tr>
<td>Experimental Section</td>
<td>49</td>
<td>77.96</td>
<td>20.09</td>
</tr>
<tr>
<td>Total:</td>
<td>72</td>
<td>75.5</td>
<td>23.18</td>
</tr>
</tbody>
</table>

When the mean scores of the students were compared between the control and experimental sections ($N_{Cnt}=23$, $N_{Exp}=49$), no statistically significant difference was found at the $p<0.05$ level ($M_{Cnt}=70.26$, $SD_{Cnt}=24.42$; $M_{Exp}=77.96$, $SD_{Exp}=20.09$, $(F(1, 70) = 1.74$, $p=.19$). Because the section sizes were different and the section variances were unequal as indicated by Levene’s test ($F= 5.45$, $p=.02$), we ran Wilcoxon test that assumes unequal variances for the same comparison ($Z=6.8$, $p=.49$, $r=.08$). The result indicates that the sections were not statistically different from each other.

**Exit project survey**

In order to improve the quality of the future exercises of this project, we administered an exit survey with the students who completed the screencast exercises in the experimental section. The exit project survey included 13 questions (see Appendix for the exit project survey items). Question 2 through 8 addressed students’ evaluation of the screencast exercises. Students rated their responses on a scale of three: 1 indicating a response of "not at all," 2 indicating a response of "a little," and 3 indicating a response of "a lot." The project survey data are presented in Table 5. The majority of the participants who installed NX in their personal computers (81.3%) mentioned that their learning has improved "a lot." Forty percent of the students reported that screencast exercises improved their learning of NX software and engineering drawing/modeling "a lot" and more than 45% students reported "a little." While exploring the help of reading and commenting on each other’s screencast videos, the results indicated that more than 86% students found it "a lot" or "a little" useful to learn modeling techniques by making and reading.
comments. When the participants were asked about the easiness of the Ecourses platform, about 70% of students found it very easy to use. Finally, the effectiveness of the Ecourses platform for students’ learning in CAD was rated mostly as "a little" followed by "a lot." Students' rating for each item is tabulated in Table 5.

Table 5. Exit project survey responses for Questions 2 through 8

<table>
<thead>
<tr>
<th>Questions</th>
<th>A lot (%)</th>
<th>A little (%)</th>
<th>Not at all (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did installing NX on your computer improve your learning?</td>
<td>81.3</td>
<td>12.5</td>
<td>6.3</td>
</tr>
<tr>
<td>Did the screencast exercises help you learn the NX software?</td>
<td>42.2</td>
<td>46.7</td>
<td>11.1</td>
</tr>
<tr>
<td>Did the screencast exercises help you learn the engineering drawing and modeling?</td>
<td>44.4</td>
<td>48.9</td>
<td>6.7</td>
</tr>
<tr>
<td>Did commenting to others' screencast videos help your learning of modeling techniques?</td>
<td>26.7</td>
<td>51.1</td>
<td>22.2</td>
</tr>
<tr>
<td>Did reading your group members' comments on your screencast videos help your learning of modeling techniques?</td>
<td>40.0</td>
<td>46.7</td>
<td>13.3</td>
</tr>
<tr>
<td>Was the Ecourses platform easy to use?</td>
<td>68.9</td>
<td>26.7</td>
<td>4.4</td>
</tr>
<tr>
<td>Was the Ecourses platform effective for your learning in CAD?</td>
<td>33.3</td>
<td>55.6</td>
<td>11.1</td>
</tr>
</tbody>
</table>

The last five questions in the project survey explored students’ experiences about what they liked and didn’t like in the exercises, what they learned during the screencast tutorial exercises or from their peers, and what challenges or difficulties they had. One of the most frequent responses given by the participants was how they liked and learned to do different ways for the screencast tutorial. They explicated that they did like to work with their peers because it made it easier for them to understand the exercises. In general, the responses indicated that the experimental group participants liked and learned through the screencast tutorial exercises.

Specifically, Question 9 asked participants what they liked most about the screencast exercises. Out of 49 students, 11 participants used the term "different" for learning the same models from their peers. Participants tended to mention that the screencast exercises gave them the ability to see "how others approached the problems in different ways." When the participants were asked about the challenges or difficulties they had in the screencast exercises with Question 10, most commonly stated the difficulty was about the audio. Thirteen participants noted that they "had audio difficulties" as they were recording their voice because they preferred "a quiet place to record video." Question 11 asked the participants what they learned as they generated the screencast tutorials. The participants stated the importance of peers' work in their learning. Thirteen participants emphasized that they "learned how to do the project better while talking about how to do it to others." When the participants were asked what they learned from their peers' screencast tutorials with Question 12, twenty-one participants used the term "different" in their responses, for example, "prefer to make different models" and "learn alternate forms of developing and designing different models." Question 13 asked for participants’
recommendations to improve the screencast exercises for future students. Eight students included "microphone" in their responses. They had difficulties in hearing the voice in the screencast, as they noted "microphone always muffles the voice" in their answers. Four participants found the screencast exercises "good the way it is," and another three participants recommended that screencast exercises could be "more challenging" or "make the objects harder to draw." Four of the participants recommended to "practice the model a few times so that it would be easier and more effective" before they do a screencast.

**Conclusion and Future Work**

This is our first implementation of the project activities. This paper discussed the use of a learner-centered instructional method. Instead of using instructor-generated screencast tutorials, students were asked to generate screencasts of the CAD modeling procedures and share them with each other in groups. They provided feedback to each other’s screencasts and had the opportunity to reflect upon their own screencast design. Different from the traditional and teacher-centered instruction, students in the experimental section took the lead to create their learning materials and shared them with their peers. They developed the feelings of belonging and ownership as they created these screencasts. Students were actively involved in the screencast-making process and motivated to learn. They also received timely feedback from other students. Students learned from each other and taught each other.

In this paper, we discussed the project activities and presented the preliminary results of the first implementation of the project design in Fall 2014. Preliminary results showed that the project activities had some improvement on the students’ final exams, yet the differences were not found statistically significant. When we compared the students’ responses to the LLL scale and EA survey, we did not find statistically significant results.

The authors will improve the project design and collect more data in the upcoming semesters. The long-term goal is to establish a cyberlearning environment, in which students teach each other new knowledge and skills. Specifically, more screencast exercises will be given to students in each semester. Since Fall 2014 was the first semester to implement the project activities, only three screencast exercises were assigned to students. We will increase the number of screencast tutorial exercises in the upcoming semesters and evaluate the effect of those activities on the same learning outcomes. We will design additional activities to promote the collaboration and communication among students so as to create a mutual learning environment. Finally, the questions of life-long learning scale, engineering altitude survey and exit project survey will be re-examined and might be modified to comprehensively evaluate the effect of the student-centered instructional method.

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References

Appendix

Demographic Questions

1. Your name
2. Section
3. Ethnicity
4. Gender
5. First generation college student status
6. Your major

Life-long Learning Scale

(By Wielkiewicz & Sinner, Personal Communications):
The scale items measure the extent to which the person’s behavior reflects’ positive attitude toward learning, curiosity, and critical thinking.

1. I enjoy intellectual challenges.
2. I read for the sake of new learning.
3. I converse with others about new things I have learned.
4. I like to analyze problems and issues in depth.
5. I see myself as a life-long learner.
6. My regular activities involve reading.
7. My regular activities involve writing.
8. I am a self-motivated learner.
9. I browse libraries or bookstores for interesting books or magazines.
10. I make interesting contributions to discussions in my classes, at work, or with friends.
11. My activities involve critical thinking.
12. I read for pleasure or entertainment.
13. I am curious about many things.
15. I like to learn new things.
16. I do a lot of reading that is not required for my classes or job.

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Engineering Attitude Scale

(By Robinson et al., 1999)

1. Most engineers have poor social skills.
2. Engineers spend most of their time doing complex mathematical calculations.
3. Engineering would be a highly interesting profession for me.
4. A problem with engineering is that engineers seldom get to do anything practical.
5. Engineers deal primarily with theory.
6. Engineers spend relatively little time dealing with other people.
7. Engineers spend most of their time working in offices.
8. Engineers spend most of their time working with computers.
9. Engineers seldom get involved in business decisions.
10. Engineers have little need for knowledge about environmental issues.
11. Engineers have little need for knowledge about economics.
12. Engineers have little need to deal with questions about behavior that is morally right or wrong.
13. Engineers have little need for knowledge about political matters.
14. To be a good engineer requires an IQ in the genius range.
15. Engineering is a poor career choice because job availability is dependent on defense spending.
16. Engineers need a great deal of inborn aptitude for science and mathematics.
17. Most engineers have very narrow outside interest.
18. Engineering is important to future US economic success in the world.
19. Engineers typically have very little common sense.
20. A career in engineering would be financially rewarding.
21. Most of the skills learned in engineering would be useful in everyday life.
22. Engineers are not typically people who are fun to be around.
23. Engineers do not tend to be appreciative of the arts.
24. Engineers are frequently those individuals who were regarded as “nerds” in high school.
25. If I had to do it over again, I would consider a career in engineering.

Key:
1=Very Strongly Agree; 2=Strongly Agree; 3=Agree; 4=Disagree; 5=Strongly Disagree; 6=Very Strongly Disagree
*Negative questions—lower scores indicate a positive attitude

Exit Project Survey

This exit survey is to capture your experiences with the "screencast exercises" you completed this semester. Please answer the questions according to how you feel. Your responses will not impact your course grade. They will be used to improve the quality of the future exercises in this course.

1. Have you installed NX on your personal computer?
2. Did installing NX on your computer improve your learning?
3. Did the screencast exercises help you learn the NX software?
4. Did the screencast exercises help you learn the engineering drawing and modeling?
5. Did commenting to others' screencast videos help your learning of modeling techniques?
6. Did reading your group members' comments on your screencast videos help your learning of modeling techniques?
7. Was the Ecourses platform easy to use?
8. Was the Ecourses platform effective for your learning in CAD?
9. What did you like the most with the screencast exercises?
10. What challenges or difficulties did you have in the screencast exercises?
11. What did you learn as you generate the screencast tutorials?
12. What did you learn from your peers' "screencast tutorials"?
13. What are your recommendations to improve the screencast exercises for future students?

Key to Questions 2 through 8: a lot, a little, not at all