



Integrating student-made screencasts into computer-aided design education

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ABSTRACT

This paper presents the design strategies of an engineering education research project funded by the National Science Foundation (NSF) and discusses its findings. Study participants were the students who enrolled in “Mechanical Engineering Drawing” course and learned about computer-aided design (CAD). We grouped students into the control group and experimental group. Students in the control group received a traditional and teacher-centered instruction. The screencast tutorials were provided to them by their instructors. Students in the experimental group experienced a student-centered instruction. Instead of being provided instructor-prepared screencast tutorials, in the experimental group, students developed their own. They shared their tutorials with one another through an Internet portal; they reviewed and commented on each other’s tutorials. These activities were 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. The data used in this paper were collected in Fall 2014 and Spring 2015 and the findings are discussed in this paper.

KEYWORDS

CAD; screencast; student-centered instruction

1. Introduction

Emerging technologies have changed the way that people teach and learn knowledge. “Screencast” in this paper is 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 [10]. It is cost-effective and user-friendly. It helps to 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.) [10]. 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 [9], engineering [3],[7],[8],[12],[16], and nursing [11]. 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 [4], [5]. 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 he/she wants and move with his/her own pace. He/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 [10].

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 is 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 up with the pace of 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 [1]. Learners may become less activated and engaged, which will undermine the learning outcomes [6]. Therefore, the teaching method where the instructors generate the screencasts is not considered learner-centered [2].

The purpose of this research is to improve undergraduate engineering students' CAD learning and help them develop life-long learning skills and positive engineering attitudes by assigning students active roles to generate and share the screencasts with one another. In this study, students generate CAD screencast tutorials, record the supporting audio, share the videos with their peers, and provide feedback to each other's screencast. We hypothesized that (1) when students actively participated in generating the screencasts, they would develop the feelings of belonging and ownership about the knowledge that they are learning; (2) when student learned from their peers, they would 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 addition, we hypothesized that students' attitudes towards engineering could improve due to their active involvement in the learning activities in engineering.

2. Methods

The project was implemented in a freshman "Mechanical Engineering Drawing" class offered in Mechanical Engineering Department at Prairie View A&M University in Fall 2014 and Spring 2015. The course was designed to teach students engineering graphics and three-dimensional (3D) modeling using CAD software. This course provided 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 could obtain an NX borrowing-license, which allowed students to use NX on their personal computers over the semester. Students returned the license after they complete the course. The Techsmith's Snagit software was 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 [13]. Each student in the class was provided a Snagit software license so that they could 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, was used for the students to make and post their screencast videos and provide feedback. Ecourses was 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 all participating students' sections into two groups randomly. One group was designated as the control group and the other was designated as the experimental group. Students in the control group received a traditional, teacher-centered instruction, which included lectures and instructor-prepared screencast tutorials of 3D modeling and drafting. Students in the experimental group were exposed to a student-centered instruction. In the experimental group, students were asked to generate screencasts and share them with their peers through an Internet portal; they reviewed and commented on each other's tutorials. Students in the experimental group 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 was to promote student collaboration and peer-to-peer mentoring among the group members. Below, we explain the exercises that students completed.

2.1. Screencast exercises

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

Students in the experimental group were divided into small groups to implement the project activities. Each group included about six students. Among these six students, each was 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 Fig. 2. Then in the third homework, the students switched the roles.

In order to balance the workload between the control and experimental groups, three modeling assignments as seen in Fig. 1. were also given to students in the control group, but they did not generate and shared screencasts with one another.

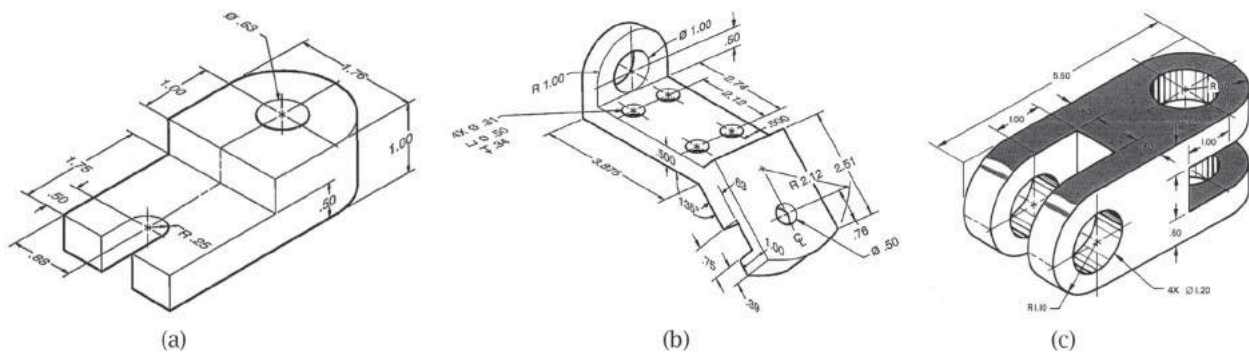


Figure 1. Screencast homework models.

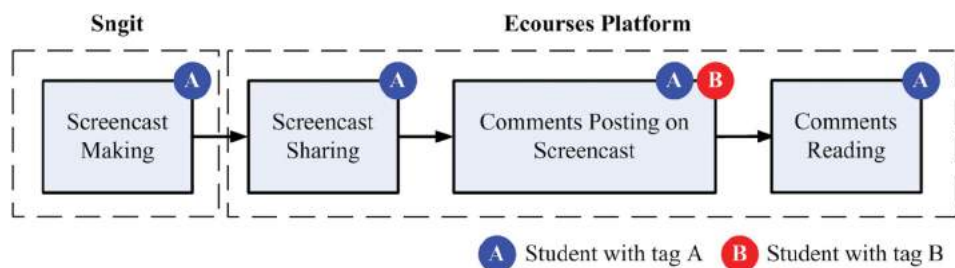


Figure 2. Tasks for the students with different tags in the second screencast homework.

2.2. Research instruments and data collection

In order to capture the effect of the project activities on students' learning outcomes, we used four instruments: a life-long learning scale, an engineering attitude survey, a CAD modeling exam, and an exit project survey. We received approval from the Institutional Review Board (IRB) at the university to conduct this study. Students, who volunteered to participate, 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 [15] 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. An engineering attitude (EA) survey developed by Robinson et al. [14] was used to capture students' attitudes towards engineering. The EA survey included twenty-five items with a six-point scale. 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 groups at the end of each 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 groups 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. We administered the project survey at the end of the semester for the students in the experimental group only. The survey responses are used to evaluate the project activities and advance the research design in the upcoming semesters.

Focus group interview. An external evaluator is invited on campus to interview with some students and teaching assistants in terms of their experience in the project activities. The information is collected to improve the project design for the upcoming semesters.

3. Results and discussion

The project activities were implemented in the "Mechanical Engineering Drawing" classes in Fall 2014 and Spring 2015. Among the students who provided their signed consent, 80 of them completed all surveys and the CAD modeling exam in the research project, with 40 students in the control group and 40 students in the experimental group. Fifty-six of the participants in this project were African-American students, seventeen of the participants were female students and thirty of the participants were first generation college students. Demographic characteristics of the participants are presented in section 3.2. The screencast homework and the project survey were only assigned to the students in the experimental group, while the CAD modeling exam, the LLL survey, and the EA survey were given to students in both control

and experimental groups. The results of the analyses are specified as follows.

3.1. Screencast homework

The first screencast homework was designed for students to learn how to make screencasts using the 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 Fig. 3.

Other students viewed the screencasts and provided their comments. Two of the comments made by students are presented in Tab. 1. These comments revealed that

Table 1. Examples of the comments made by the students.

Comment 1	You did so well! I really do like your video. What makes me happy about it is the length because most times (at least for me) when I'm looking for a tutorial video online I tend to look for the shortest one because I want to learn it quickly and I only have so much time. From what I have learned so far in college, time 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.

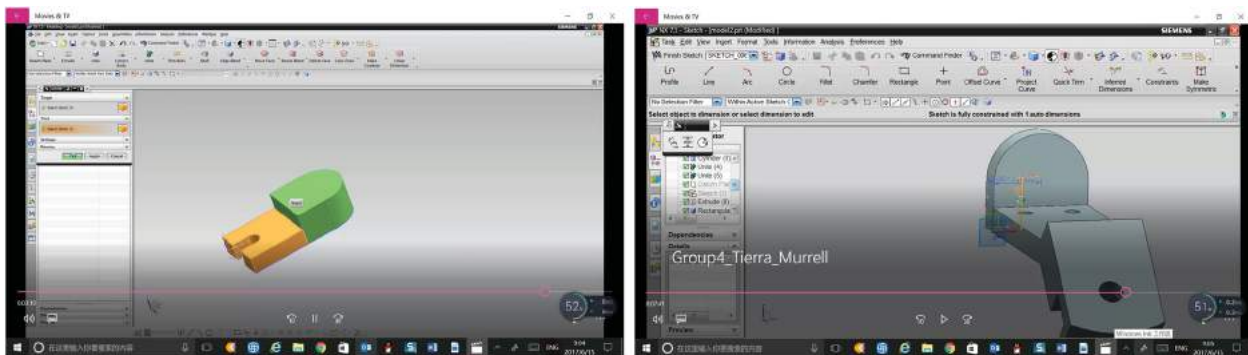


Figure 3. Snapshots of a student's screencast video.

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.

3.2. Participants' demographics

There were 40 participants in control group and 40 participants in the experimental groups. The data presented in this section were collected from a demographics questionnaire that we administered to the students. The

questionnaire asked students to indicate their ethnicity, sex, major, and whether or not they are first-generation-college students in their family. Figure 4 shows the distribution of the male and female students in both control and experimental groups. In the control group, there were 6 females (15%), while there were 11 females (27%) in the experimental group. Figure 5 represents the distribution of the students who were first-generation-college students and the students who were not-first-generation-college students in both groups. Thirteen participants in the control group (32%) were first-generation-college students, while 17 participants in the experimental group (42%) were first-generation-college students. The ethnicities of the participants are shown in Fig. 6. There were 24 African American students in the control group (62%) and 31 African American students in the experimental

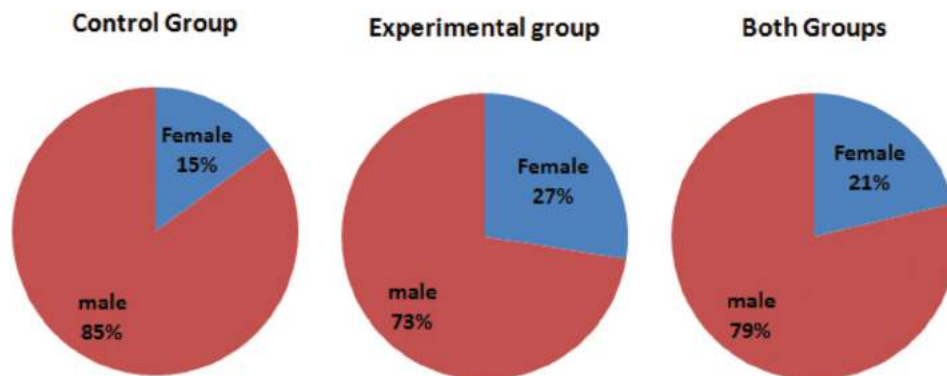


Figure 4. Participants' gender across the groups.

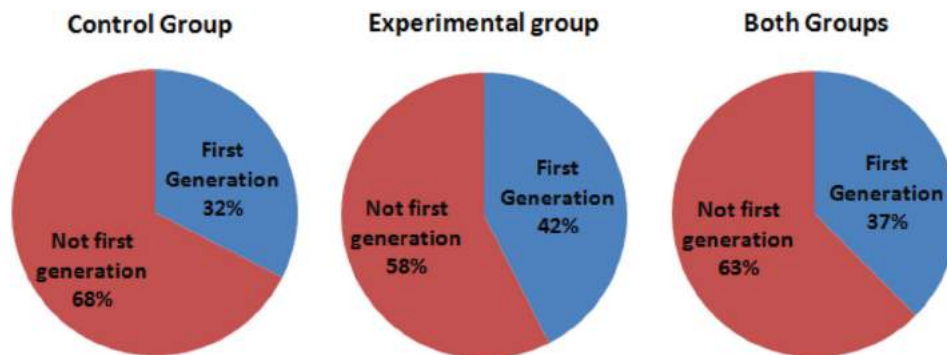


Figure 5. Participants' first generation college student status across the groups.

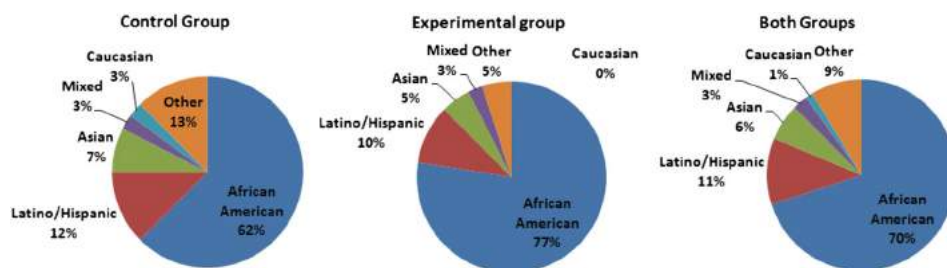


Figure 6. Participants' ethnicities across the groups.

group (77%) in the experimental groups. The percentages of the Hispanic students in the control and experimental groups were 12% and 10%.

3.3. Life-long learning scale and engineering attitude survey

All student participants ($N = 80$) completed the life-long learning scale [15] and engineering attitude survey [14] two times: once at the beginning of the semester and once at the end of the semester. LLL scale 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. 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. 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 (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 Tab. 2. and Tab. 3., with the control group and experimental group denoted as the subscripts "Cnt" and "Exp," respectively. The standard deviation is denoted as "SD."

In the LLL survey, none of the mean values in Tab. 2. were significantly different from each other. Post LLL scores of students in the control group (MCnt = 3.80)

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

	Number of Students	Pre LLL Score Means (SD)	Post LLL Score Means (SD)	Gain Score for the LLL Scale (SD)
Control Group	40	3.72 (0.43)	3.80(0.60)	0.09 (0.41)
Experimental Group	40	3.55 (0.49)	3.59 (0.57)	0.04 (0.40)

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

	Number of Students	Pre EA Score Means (SD)	Post EA Score Means (SD)	Gain Score for the EA Survey Means (SD)
Control Group	40	4.35 (0.49)	4.37 (0.64)	0.016 (0.46)
Experimental Group	40	4.33 (0.47)	4.34 (0.55)	0.01 (0.41)

were not significantly different from their pre LLL scores (MCnt = 3.72) ($t(39) = 1.35$, $p = 0.18$). Similarly, post LLL scores of students in the experimental group (MExp = 3.59) were not significantly different from their pre LLL scores (MExp = 3.55) ($t(39) = 0.67$, $p = 0.5$). When students' gender and LLL gain scores were analyzed, no statistical significance difference was found at the $p < 0.05$ level. Male students' LLL gain score mean was .099 (SD = 0.395), that indicated a slight increase over time. However female students' LLL gain score was -0.042 (SD = 0.432), that indicated a very slight decrease over time. Similarly, when students' first generation college student status and their LLL gain scores were analyzed, no statistical significance difference was found at the $p < 0.05$ level. First-generation-college students' LLL gain score mean was 0.029 (SD = 0.391) which was less than not-first-generation-college students' LLL gain score mean ($M = 0.087$, $SD = 0.414$).

In the EA survey, none of the mean values in Tab. 3. were significantly different from each other. Post EA scores of students in the control group (MCnt = 4.37) were not significantly different from their pre EA scores (MCnt = 4.35) ($t(39) = 0.224$, $p = 0.82$). Similarly, post EA scores of students in the experimental group (MExp = 4.34) were not significantly different from their pre EA scores (MExp = 4.33) ($t(39) = 0.16$, $p = 0.87$). When students' gender and their EA gain scores were analyzed, no statistical significance difference was found at the $p < 0.05$ level. Male students' EA survey gain score mean was .0290 (SD = .442) and female students' gain score mean was -0.082 (SD = 0.385), that again indicated a slight decrease in female students' positive attitudes toward engineering. Similarly, when students' first-generation-college student status and their EA gain scores were analyzed, no statistical significance difference was found at the $p < 0.05$ level. First generation college students' EA survey gain score mean was .0205 (SD = 0.391), which was more than not-first generation college students' EA gain score mean ($M = 0.008$, $SD = 0.458$).

When we analyzed the students' pre, post, and gain score means for the LLL scale and EA survey across the two different types of instruction they received, we did not find any statistically significant difference at the $p < 0.05$ level. Similarly, students' ethnicity and their LLL gain scores, and EA gain scores did not reveal any statistically significant difference at the $p < 0.05$ level.

3.4. Final exam

All 80 students attended the final exam. Table 4 presents the mean scores of the students' final exam for each group. In general, students in the experimental group

Table 4. Data from students' CAD modeling exams.

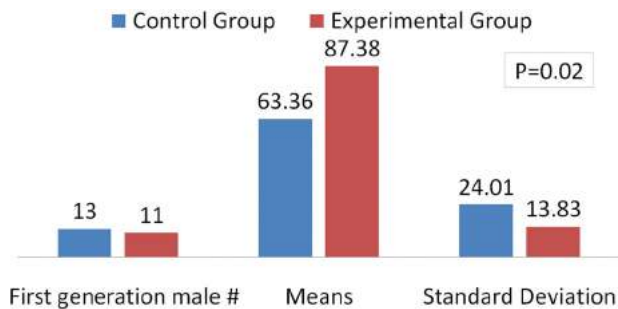
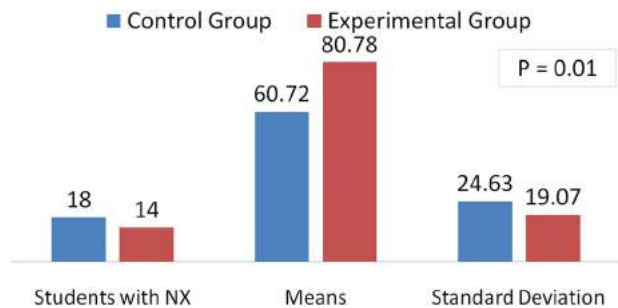
Treatment Type	Number of Students	Final Exam Means	Final Exam SD
Control Group	40	70.80	23.5
Experimental Group	40	77.93	18.8
Total:	80	74.36	21.45

(male and female, $N = 40$) performed better than the students in the control group (male and female, $N = 40$) in the CAD knowledge final exam. The experimental group students' final exam score mean was 77.93 ($SD = 18.8$) and the control group students' final exam score mean was 70.80 ($SD = 23.5$). Cohen's effect size value ($d = 0.33$) suggested a moderate to small difference between the groups' means. However, an independent two -sampled t-test did not reveal a statistically significant difference between the control group students' ($N = 40$) final exam scores and the experimental group ($N = 40$) students' final exam scores ($t(78) = 1.497$, $p = 0.138$) at the $p < 0.05$ level.

When final exam scores were compared between male and female students, no statistical significance difference was found at the $p < 0.05$ level. Male students' ($n = 63$) final exam score mean was 75.19 ($SD = 21.41$) and female students' ($n = 17$) final exam score means was 70.35 ($SD = 22.06$). Cohen's effect size value suggested a small difference between these means ($d = 0.22$). When students' first generation college student status and their final exam scores were analyzed, no statistical significance difference was found at the $p < 0.05$ level. First generation college students' ($n = 30$) final exam score mean was 77.43 ($SD = 21.08$) and not-first generation college students' ($n = 50$) final exam score mean was 72.52 ($SD = 21.66$). Cohen's effect size value suggested a small difference between these means ($d = 0.22$).

The male and first generation college students who were in the experimental group ($N = 11$) performed statistically significantly better than their peers in the control group, who were also male and first generation college students ($N = 13$) in the CAD knowledge final exam ($M_{Exp} = 87.38$, $SD = 13.83$, $M_{Cnt} = 63.36$, $SD = 24.02$, $t(22) = 2.42$, $p = 0.02$) at the $p < 0.05$ level, as seen in Fig. 7. Cohen's effect size value ($d = 1.22$) also suggested a big difference between the groups' mean scores in the final exam. This finding indicates that screencast tutorial exercises have positively impacted the first generation college and male students' CAD knowledge. For the female and first generation college students, the same test did not reveal any significant difference.

Among the students who reported that they installed NX on their personal computers ($N = 32$) in the exit survey, experimental group students ($N = 14$) performed statistically significantly better than the control group students ($N = 18$) ($M_{Exp} = 80.78$, $SD = 19.07$,

**Figure 7.** The means and standard deviations of the final exam scores for the male and first generation college students for both groups.**Figure 8.** The mean and standard deviation of the final exam scores for the participants with NX installed on their personal computers.

$M_{Cnt} = 60.72$, $SD = 24.63$, $t(44) = 2.51$, $p = 0.01$) at the $p < 0.05$ level, as seen in Fig. 8. Cohen's effect size value ($d = 0.91$) also suggested a big difference between the groups' mean scores in the final exam. Among the students who reported that they did not install NX on their personal computers or did not respond to the question ($N = 48$), no statistically significance difference was found between their final exam scores, LLL scale gain scores, and EA survey gain scores.

3.5. 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 group. The exit project survey included 13 questions. Question 2 through 8 addressed the 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 Tab. 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

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

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

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 Tab. 5.

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 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.”

3.6. Focus group interview

The analyses of a focus group interview with several students in the experimental group revealed that students (1) spent a lot of time outside of class to complete the modeling screencast exercises, (2) found the audio recording of the screencasts challenging and time-consuming, (3) enjoyed viewing their peers’ screencast tutorials, and (4) found their peers’ feedback to their own tutorial very constructive. Students spent most of their time in learning how to use the software and record the audio. They mentioned that if they were given several additional exercises, they would generate more improved screencast tutorials with better audio quality. They, again, recommended completing the screencast exercises multiple times without changing the objective so that they will first learn the technical steps in the first couple exercises and then be able to generate advanced tutorials with clear audio.

4. Conclusions and further work

This was our first year 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 group 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 results of the first year implementation of the project activities (In Fall 2014 and Spring 2015). Results showed that the project activities had some improvement on the students' final exams, yet the differences were not found statistically significant for all students. The project activities had the most impact on male and first-generation college students' CAD knowledge. 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. Since this was our first year of implementing the project activities, only three screencast exercises were assigned to students in the experimental group. We will increase the number of screencast tutorial exercises in the upcoming semesters and evaluate the effectiveness 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 effectiveness of the student-centered instructional method.

Acknowledgements

This work is supported by the National Science Foundation under HRD Grant Number 1435073. Any opinions, findings, conclusions, or recommendations presented are those of the authors and do not necessarily reflect the views of the National Science Foundation. The authors also thank the PACE program (Partners for the Advancement of Collaborative Engineering Education) for providing NX software.

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