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Effect of Recorded Video Instructions on Students Performance and Learning Experience in Engineering Technology Education

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Biography

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Session XXXX

Effect of Recorded Video Instructions on Students Performance and Learning Experience in Engineering Technology Education

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Abstract

In the early spring 2020, when COVID-19 pandemic started spreading all over the world, like any other educational institutions, the engineering technology department at our university completely moved to a virtual environment regardless of lecture or hands-on nature of the course. Online meeting platforms, recorded video instructions, and simulation software became the only source of communication while face-to-face meetings were fully restricted. The online meeting platforms provided a scope of recording the instructions. Several faculty members in this department grabbed this opportunity to record their lectures and later making those available to the respective students. The recoded lecture videos eventually became popular for several benefits. It is reported that the recorded video instructions help the students to revisit several important topics while they prepare for assignments or examinations. At the same time, teachers can utilize more time to focus on improving their instruction materials and tools. However, some lengthy videos were found to be ineffective on several occasions, because of the lack of feedback opportunity and a one-way communication setting. This study investigates the students' learning experience and their overall performance while recorded video instructions are readily available.

Introduction

Engineering technology education largely emphasizes on hands-on activities in addition to the theoretical background building. Hence, lab-based classes are equally important as lecture classes. Even, several lecture classes need direct assistance from the instructors especially where mathematical or design problems need to be solved. This regular way of learning environment was disrupted in Year 2020 when world started experiencing one of the worst pandemics in the history. During the COVID-19 pandemic, all face-to-face labs and lecture classes had to go on virtual environment. Video instructions became the only source of communication while face-to-face meetings were not possible. The online meeting platforms provided a scope of recording, which also encouraged the teachers to record the lectures and later making them available to the students. This process made the recoded lecture videos popular for several benefits. After getting vaccinated, schools are now returning to the normal phase and the face-to-face instructions are becoming possible. However, the recorded video instructions are still being used in several labs and theory courses due to some of their useful outcomes. Recorder video instructions are helping the students to revisit several important topics while they

prepare for exams. Students can also refer to certain lecture videos if they miss any class. At the same time, teachers are now getting more time to focus on several new topics and bring improvements in them. On the other hand, video instructions for lab experiments are making it convenient for both the instructors and the students. It is expected that the recorded video instructions should improve students' performance and learning experience. However, it was not proven to be effective in several cases where students may need one-to-one guidance for completing certain assignments. This study is aimed to investigate the students' learning experience and overall performance while recorded video instructions and lectures are readily available to the students. The scopes and possibilities for improving the video lecture quality are also addressed in this study.

During spring 2020, we had to adapt complete online teaching in both theory and laboratory courses in response to the growing COVID-19 pandemic. We received a one-day training from the online service developers of the university on the virtual platform called 'WebEx' to deliver our lectures by sharing the contents of our laptop. We used to post the recorded video lectures later in the Moodle with a goal on student engagement and learning considering it as a second chance to keep on track the understanding of the concept. Improvement came within three weeks as we all were adjusting to the new situation despite stress and anxiety. But the real problem was that all the students did not have equal accesses to, and expertise on digital technologies [1].

We followed a hybrid process called 'HyFlex' in the Fall of 2020. The lecture courses were taught online whereas the lab courses were taught face-to-face for Spring 2021. At that time, we posted the video earlier in the Moodle so that the students can watch the video as an additional resource for preparation for the lecture. The live lecture was recorded again if there are changes and later posted which help the students to review it for the third time. We went back to the original face-to-face teaching in both the theory and laboratory courses for the last Fall 2021. The faculty as well as the students were not ready for a rapid change of educational delivery.

Running Strategy for Online Courses and Labs

During spring 2020, one of the authors taught both EET 1320 Electrical Principal II course and EET 1321 the associated laboratory course. Both were taught completely online using video platform called 'WebEx' and recorded. Then the recorded videos were posted in the Moodle for the students to review, if necessary, in their own time. The students started performing the entire laboratory experiments by building circuits using discrete components on breadboards in EET 1321 AC circuits laboratory course until the middle of March 2020. Immediately after that they began assembling the circuits and collecting data on the laptop screens by using a simulation software called MultiSim 12. Initially it was a shock to them. But gradually they became used to the new life as their performance improved. The students were advised to install the software in their own computers if possible. The installation procedures were sent to them with links to some example videos. The students watched some power point presentation of working labs posted in the Moodle before doing actual lab at the prescribed time. The instructor continued providing prelab lecture what he was doing in face-to-face time [2].

In fall 2020, EET 3310 Digital Circuits II course was taught completely online using the video Platform 'WebEx'. This time the lecture was prerecorded and posted earlier in the Moodle so that they

can go through it before coming to the lecture class. The EET 3311 Digital Circuits II laboratory course was taught using 'HyFlex' method of delivery of course materials. In a HyFlex method, courses are delivered both in person and online at the same time by the same faculty member. Students can then choose for each class meeting whether to show up for class in person or to join it online. In NSU, the course was divided into two sections. The students in one section were coming to the class in person for half of the time whereas the other section members were getting instructions online [3]. During the HyFlex delivery of laboratory courses a short, prerecorded video showing lab set up and procedure of taking measurements was also added.

In spring 2020 and spring 2021, IET 4730 Manufacturing Process course was taught by one of the authors. This is a four contact hours course, where two contact hours are allocated for lab experience and hands-on activities. The classes in spring 2020 started face-to-face, however in the middle of the semester the class had to move on the virtual platform. The lecture classes were effectively conducted on WebEx, but it became very difficult for conducting the lab works and students' performance evaluation on the online platform. The instructor adopted some new strategies to adopt with the changed environment. He recorded some video instructions for hands-on activities or lab experiments and allowed the students to bring necessary lab equipment to their residence. Thus, instead of working in the lab in small groups the students could work on the experimental activities by themselves while following the video instructions. Live prescheduled meetings on WebEx were also arranged to help them doing their labs more effectively.

IET 3510 Motion and Time Study was taught in fall 2020 and in fall 2021. This is a lecture-oriented course coupled with a semester project conducted in different industries. The semester project is designed to adopt the students to work in a group within a real industrial environment. However, due to the pandemic the course was offered online, as well as group projects and physical visits to the industry became infeasible. Hence, unlike previous years, in fall 2020 and 2021 the semester project was assigned to individual students based on some recorded video clips of the assigned workstation(s) imitating virtual visits to the industry. Multiple recorded videos of some industries were assigned to the students for completing some other assignments. Students reported problems in collecting information about the physical condition of the assigned workstation, because they only had the recorded videos.

IET 3900 Industrial Machinery was offered in fall 2020 for the first time in the department and offered in fall 2021 once again. This course was initially designed to teach face-to-face with some hands-on activities in the class or at some industry visits. However, due to the pandemic this plan was changed, and the course had to offer online. During the scheduled meetings on WebEx the instructor used to deliver live lectures with the help of power point slides, screen sharing, pen pad, document camera and available online videos relevant to the specific industrial equipment. The lecture sessions were recorded and made available to the students for future reference and revisit. In addition, the instructor made some short lecture videos on some specific topics requested by the students. Those videos were also associated with short quizzes drawn from a large question bank.

Teachers' Perspective

The recorded video posting has opened a vast learning environment for undergraduate engineering

and technology education. An increasing number of instructors in this field are using self-posted videos with a goal on student engagement and learning. Mayer's Cognitive Theory of Multimedia Learning [4] states that learning is improved when the student is presented with a combination of auditory and visual input compared to auditory and visual input alone. The students enjoyed watching videos two different times in addition to normal class time. The benefits should be enormous. This suggests that multimodal approaches such as video have the potential to be successful. A similar link could be made to the framework of Media Richness Theory [5], where the level of richness of a given medium is ranked according to how well ambiguities can be resolved in a learning situation. Video, with the combination of text, image, and sound, would be considered a richer medium within this framework than e.g., a textbook. The use of video as a learning tool can also help teachers address the different pedagogical needs and preferences of various groups of learners among their students. The video contents were extended to laboratory preparation, problem-solving sessions, and advanced course materials for particularly interesting students.

To engage with the students effectively is the goal of a successful instructor, We need the right approach to make education appealing to them. One time lecture at a particular time for fifty minutes (three times a week) or one hour and fifteen minutes (twice a week) is not good enough for being attached wholeheartedly towards learning. Sometimes the students are physically present in the classroom, but they are mentally somewhere else. This gap of learning can be mended if they get a second chance of watching the recorded video in his/her right time. A handful of students watched the prerecorded video posted in the Moodle before coming to the class. More students watch the video after attending the in-person lecture class of the professor. This situation is even worse for the laboratory courses. A negligible number of students read the lab book before coming to the class. Here a short video describing lab set up and performance became a game changer. But the quality and the presentation style of the materials must be attractive to them. The millennium and Generation Z are glued to the cell phone which does not mean that they are busy with learning educational stuff. There are numerous attractive videos available in the YouTube and other online social medias on a particular topic. So, it is not an easy task to make an attractive video explaining an engineering problem for different levels of students in the same class.

Students' Perspectives and Performance

The same students who registered in EET 1320 and EET 1321 courses also registered in EET 3310 and EET 3311courses in the next semester. In case of theory courses there were almost no difference in terms of performance in their final exams. But for the associated laboratory courses of EET 1321 and EET 3311, there were noticeable differences in performances in the final exams. The students said when asked that the constant access to the filmed lectures strengthens their ability to master the course materials. But they are more positive about short videos about laboratory set up and preparation. It helped them a lot to complete the lab experiment with nearly clear understanding with a minimum intervention of the instructor and they feel very good about it. The magic is the short video. They said almost unanimously that any video more than 10 minutes is ineffective as they loss their interest and concentration in it. The students in some other universities enjoyed 'screencast' method of delivering the course materials. A flipped classroom approach with screencasts increases out-of-class engagement, higher attendance, and more active participation in the class [6].

The students in IET 3510, IET 3900 and IET 4730 reported that they prefer to have distinct short video instructions on some specific topics. Specially, they mentioned about the uses of some concise videos on lab instruction, numerical problem, assignment related topic, report formatting guideline, and software application. The overall attitude of these students is very positive about the recorded video lectures. In the course evaluation reports they expressed their opinion and feelings in different ways. Some of the relevant comments from the students are mentioned here to present the overall impression regarding the recorded videos.

1. "Extra videos made to explain things and gave detailed and real-life examples all the time."
2. "Extra links/videos about material, and lectures were detailed. …… . After lectures more links and YouTube videos were given to further understand teachings."
3. "If I had any questions, he would answer them as quick as possible and he provided link to videos on how to do the assignments."
4. "Things like providing in-person labs, multiple video links for materials, and make-up days for labs are the things that set him apart from the rest."

It was also evident that the overall performance of the students also improved over time, and this improvement has a clear correlation with the availability of video instructions. In Table 1, a summary of the overall performance in three different courses are presented. In the year 2019, all these three classes were face-to-face and there was no video lecture or instruction was available for the students. In 2020, the respective professor started posting few video instructions but was not very effective due to the length and lack of preparation. In 2021, the number and quality of the video were improved, in terms of relevance and duration. While video quality has improved, students have also adjusted to an online format compared to 2020. Figure 1 shows that the percentage of students earning B or better grade has increased significantly, when the professor started posting many short video lectures relevant to the specific topics demanded by the students.

Table 1: Overall performance of the students correlating the video lectures

Course Name	Grade	Year 2019 (No video lecture posted)	Year 2020 (Started posting few video lectures)	Year 2021 (Posted many video lectures)
IET 3510 Motion and Time Study	B or better	20	17	4
	C or less	13	13	4
	Total enrollment	37	40	8
IET 3900 Industrial Machinery	B or better	N/A	19	14
	C or less	N/A	8	2
	Total enrollment	0	27	16
IET 4730 Manufacturing process	B or better	26	24	25
	C or less	7	3	5
	Total enrollment	33	27	30
Total % of students earned B or better grade		69.70%	71.43%	79.63%

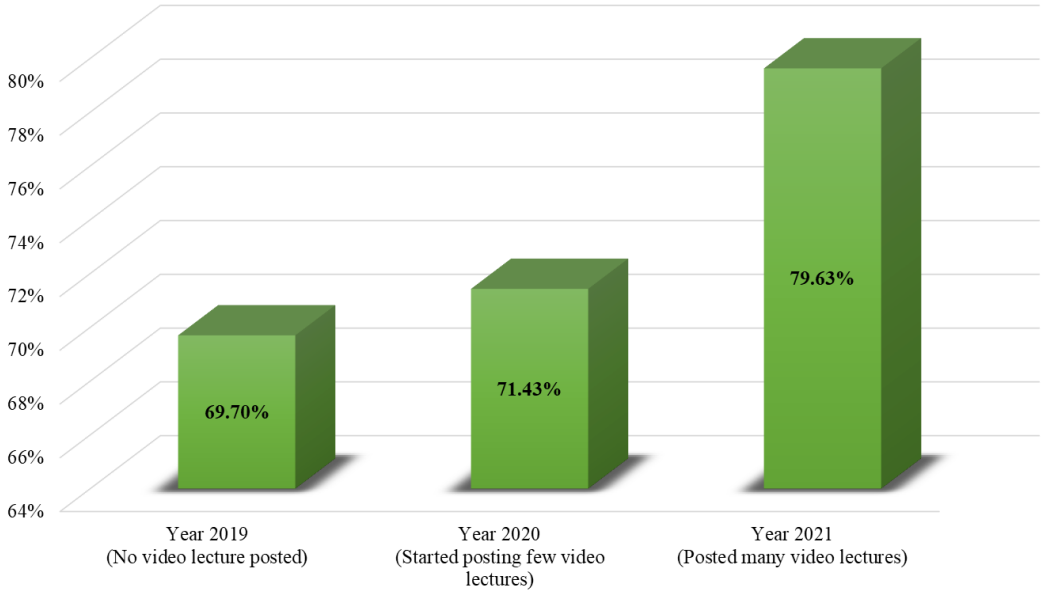

Figure 1: Total % of students earned B or better grade in ET courses

Conclusion

Addition of recorded video lectures is working but in a very slow pace. We need to encourage the students to watch the videos as many times needed before getting better or full understanding. The video delivery method called "screencasts' is bringing positive results in different universities as we have discussed in this paper. One lengthy video for lecture class was not effective to them whereas as the short videos on laboratory base courses became more effective. We will be successful if we can bring the benefits to the students so that they can get strength to hang on until finishing their degrees. More and more appealing quality videos will bring intending results in future. The 'HyFlex' method of teaching should not be followed for lab-based courses in engineering and technology programs. During a 'HyFlex' method of teaching the students ended up doing one laboratory experiment in two weeks which was supposed to be completed in one week.

The final recommendations ensued from this study can be summarized as follows,

(a) make concise videos on lab instruction, numerical problem, assignment related topic, report formatting guideline, and software application,
(b) make the videos less than 10 minutes long,
(c) keep the video lectures readily available to the students,
(d) get regular feedback from the students and implement changes as needed,
(e) make short quizzes relevant to the video lectures which are essential to follow.

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Dr. Islam earned a Ph.D. in Electrical Engineering from University of Wyoming in 1990. His concentration was in power electronics and control system areas. His Masters was from Manhattan college, New York, in electrical engineering with emphasis in telecommunications systems. He has been teaching in Electrical engineering and Electronics Engineering Technology programs for more than thirty-two years in the United States and in Canada. Since joining the NSU in January 2000, Dr. Islam has been teaching circuits, electronics, analog and digital communications, automation and control, medical digital signal processing, electric motor control, and alternative energy systems courses in the EET program and developed the curriculums for the courses and the associated labs. He is a 'Life Senior Member of IEEE' and a member of ASEE. He has four years of working experience in electronics, telecommunications, and power generation and transmission companies. His research interests are in digital electronics, control systems, wireless and wired communications systems, biomedical instrumentations, and alternative energy systems.