



Tecnológico
de Monterrey

CIIE CONGRESO INTERNACIONAL
DE INNOVACIÓN EDUCATIVA



 Tecnológico
de Monterrey

Study of the Effectiveness of Interactive Videos in Applied Electronics Courses

Graciano Dieck-Assad ¹ *, *Juan M Hinojosa-Olivares* ¹, *Jordi Colomer-Farrarnos* ²

¹Tecnológico de Monterrey, Ave. Eugenio Garza Sada 2501, Monterrey 64849, NL, Mexico

² Universidad de Barcelona, Gran Via de les Corts Catalanes 585, 08007 Barcelona, España

graciano.dieck.assad@tec.mx, juhinojo@tec.mx, jcolomerf@ub.edu

Tecnológico de Monterrey, December 17 2019



Introduction

- Very **few research articles** were available in the last 10 years which **address the impact of screen cast** and interactive videos in higher education today.
 - IEEE Conferences and journals: 3
 - British Journals: 1
 - Australian (ANZIAM): 1
 - ASEE/IEEE: 1
 - Other EU: 2
- Most contributions address areas other than engineering and they mostly include non-interactive videos.
- This paper reports the results of an initial study of the impact of using **interactive videos in Science and Engineering courses** at Tecnológico de Monterrey and at The University of Barcelona.
- The methodology investigates the **effectiveness of interactive videos** in **Electronics Engineering courses and i-Week activity** at the Tecnológico de Monterrey in the Monterrey campus and **EE/BE courses** at the Universidad de Barcelona in Spain. Both, overall understanding of course content and engagement level are addressed.



Problem Description

- During the last 10 years, engineering students have oriented their learning process towards professional outcomes and acquisition of competences. University teaching includes different conceptual, procedural, and value contents at different levels of science and engineering. However, the traditional class exposition has been questioned due to:
 - **Lack of student interest** in certain non-dominant courses within their major degree program.
 - **Specific distractors** such as cellphones and portable computing equipment like tablets, notebooks, and other mobile gadgets.
 - **Student boredom with specific exposition styles** of the teacher, leading to lack of motivation and interest.
 - **Excess of activities and other work responsibilities** that the students are immersed during their university experience.
 - **Mismatch in student learning style** versus professor teaching style, and a lack of communication between professors and students. This is worse when the class is not taught in the student's native language.



Problem Formulation and Objectives

- **What is the effectiveness** of interactive videos for undergraduate students in their professional specialty courses?
- **How do we promote the “engagement” and commitment** of the students in undergraduate courses to their professional development of outcomes and competences?
- The idea is to determine the effectiveness level in the learning process and the “engagement” of the students when interactive videos are used in engineering courses. The specific **objectives** are:
 - **Quantify the student performance** with and without the interactive videos for the specific applied electronics classes.
 - **Determine the “engagement” level** (satisfaction with the learning developed concepts) by the students.
 - **Compare the student’s performance** in several controlled sections; some with interactive videos and others without them.
 - Determine the performance and level of “engagement” with a typical i-week activity such as EFR-2019



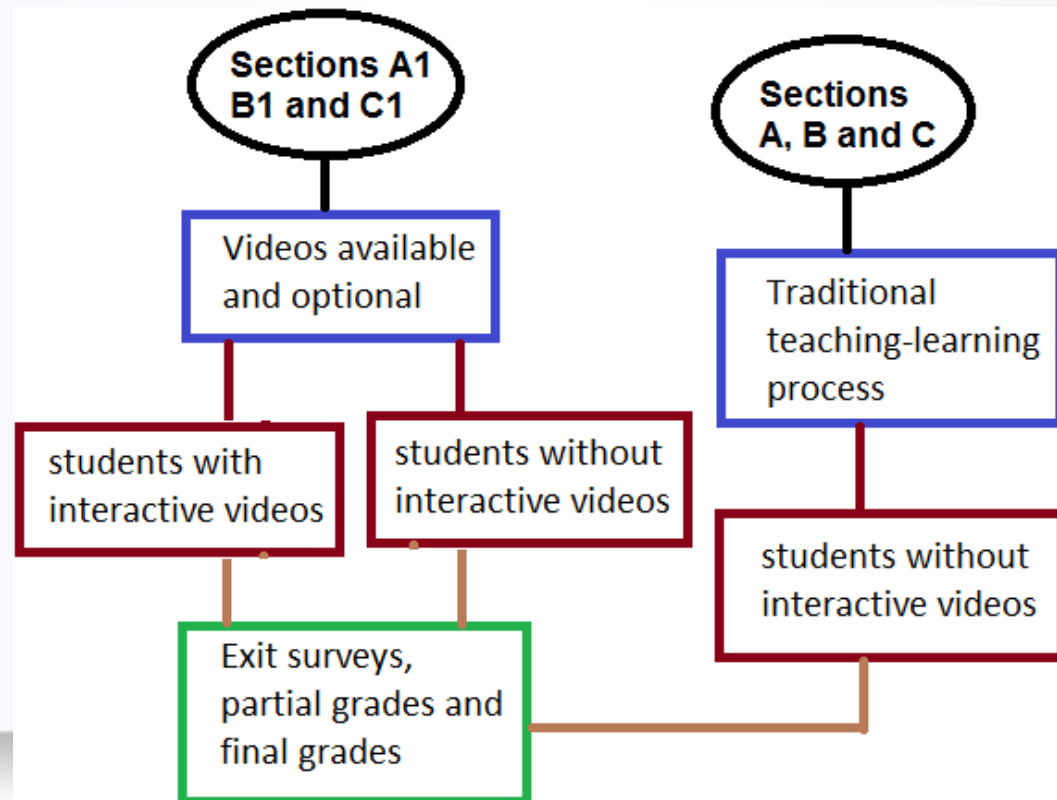
Justification

- **Research in education** shows studies of effectiveness when using videos at the undergraduate level focusing in nursing and health sciences [1]. Need more multidisciplinary studies.
- **Interaction in short videos** to discuss specific concepts has not been analyzed in terms of *effectiveness of learning*, and *engagement*. We have found **2 contributions analyze the impact on “engagement” and commitment** [1, 2].
- Studies of interactive video´s effectiveness are **not available** with results and discussions for **courses in science and engineering**.
- Here we provide an initial step by reviewing results of interactive video effectiveness in Electronics courses taken by most engineering majors. Using interactive videos in i-week and i-semester activities are discussed also.



Methodology

- Videos were developed or adopted using the **ScreenCast-O-Matic [11]**, **EDPuzzle [9]** and **OBS-Studio** platforms with the following guidelines:
 - The interactive videos are **shorter than 15 minutes**.
 - They **discuss relatively complicated concepts**.
 - They also incorporate examples of **design problems**.





Control Sections – TEC.mty

| Group | Number of students | Partial exams | Final Exam | Term Project/projects | Interactive videos |
|-----------|--------------------|---------------|------------|-----------------------|--------------------|
| A | 17 | 2 | 1 | Yes | No |
| B | 17 | 2 | 1 | Yes | No |
| C | 27 | 2 | 1 | Yes | No |
| A1 | 16 | 2 | 1 | Yes | Yes, 13 |
| B1 | 34 | 2 | 1 | Yes | Yes, 13 |
| C1 | 37 | 2 | 1 | Yes | Yes, 13 |
| D | 30 | 2 | 1 | Yes | Yes, 13 |



Results: TEC-Group I – Spring 2016

- Comparison Group I: Controlled sections A and A1
 - Students from section “A1” who performed relatively well in their video scores had a much better performance in their overall grade, with an average of 84 and a standard deviation of 8 (less dispersion).
 - Students from group “A1” who did not perform very well in their video scores had a lower performance in their overall grade with an average of 67 and a standard deviation of 21 (more dispersion).
 - Students from section “A” did get an average performance of 70 in their final grades with a standard deviation of 15.

| Section | Number of students | Video scores | Interactive Videos available | Average Final Grades | Standard Deviation |
|---------|--------------------|--------------|------------------------------|----------------------|--------------------|
| A | 17 | NA | No | 70 | 15 |
| A1 | 9 | >52 | Yes | 84 | 8 |
| A1 | 7 | <52 | Yes | 67 | 21 |



Results: TEC-Group II- Spring 2017

- Comparison Group II: Controlled sections A,B,C and A1, B1, C1
 - Students from sections “A1,” “B1,” and “C1,” who performed relatively well in their video scores (having scores above the class average), had a much better performance in their overall grades with averages of 84, 80.7 and 83, and standard deviation values of 8, 8.5, and 6.7, respectively.

| Section | Number of students | Video scores | Interactive Videos available | Average Final Grades | Standard Deviation |
|---------|--------------------|--------------|------------------------------|----------------------|--------------------|
| A | 17 | NA | No | 70 | 15 |
| B | 17 | NA | No | 76 | 17.4 |
| C | 27 | NA | No | 79 | 8.5 |
| A1 | 9 | >52 | Yes | 84 | 8 |
| A1 | 7 | <52 | Yes | 67 | 21 |
| B1 | 23 | >76. | Yes | 80.7 | 8.5 |
| B1 | 11 | <76. | Yes | 78.6 | 11.8 |
| C1 | 22 | >47. | Yes | 83 | 6.7 |
| C1 | 15 | <47. | Yes | 73.5 | 14.51 |



Results: TEC-Group III – Spring 2018

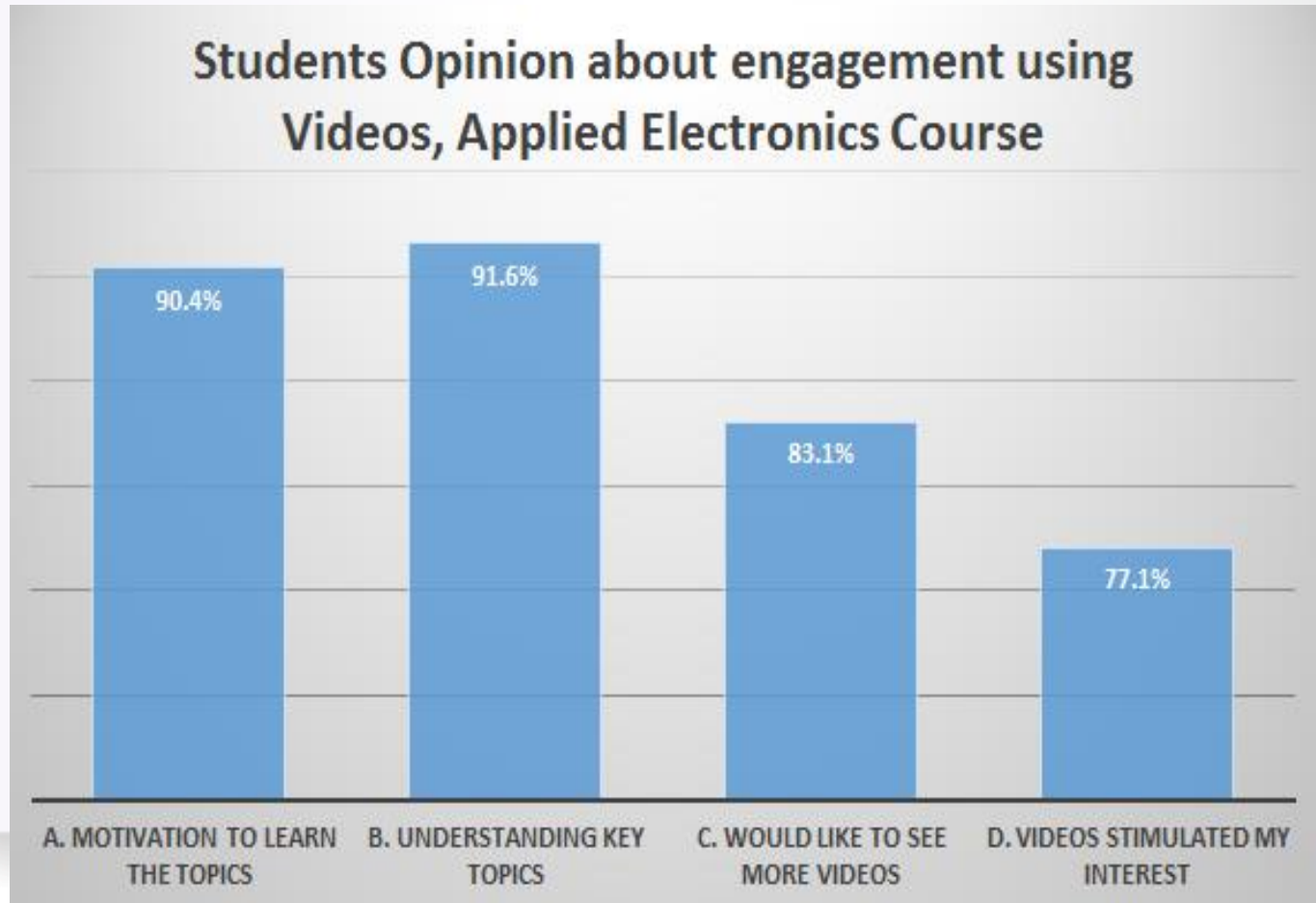
- Comparison Group II: Controlled sections A,B,C, D
 - Students from section “D,” who performed relatively well in their video scores (having scores above the class average of 73), had a much better performance in their overall grade with an average of 81.8 and a standard deviation value of 7.9.

| Section | Number of students | Video scores | Interactive Videos available | Average Final Grades | Standard Deviation |
|---------|--------------------|--------------|------------------------------|----------------------|--------------------|
| A | 17 | NA | No | 70 | 15 |
| B | 17 | NA | No | 76 | 17.4 |
| C | 27 | NA | No | 79 | 8.5 |
| D | 17 | >73 | Yes | 81.8 | 7.9 |
| D | 13 | <73 | Yes | 76.5 | 12.95 |



Results: TEC-student engagement

- TEC.mty: Exit survey applied after the final examination (Spring 2017).
 - **Motivation** and Understanding (90.4%).
 - Took advantage of the videos to **understand key topics** (91.6%);
 - Students would like to **see more videos in other topics** (83.1%),
 - Students were **stimulated about the topics** shown (77.1%)

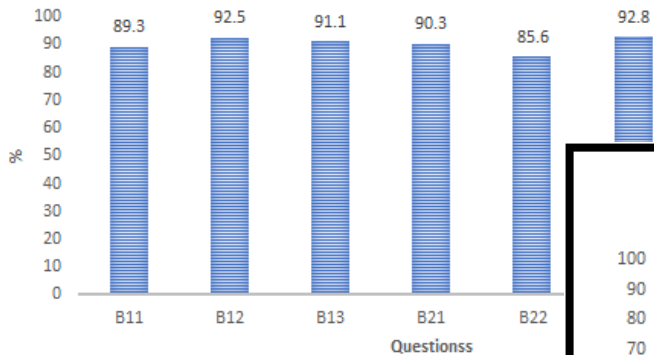




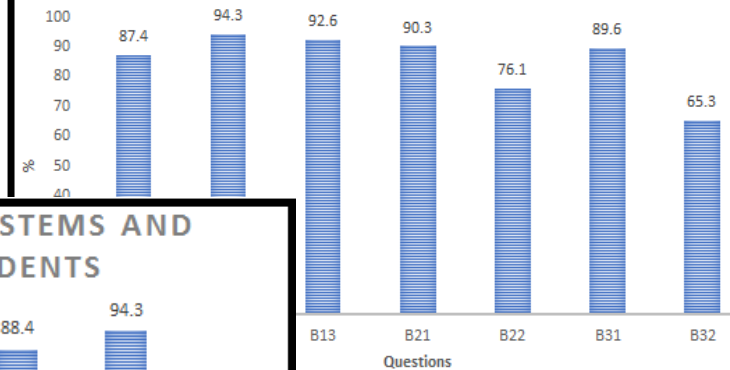
Results: UB-student engagement

- University of Barcelona: Exit survey during 2018 and 2019.
 - B11-How **valuable** are videos to reinforce class materials?
 - B12-Do videos **help in understanding**, even better, the course contents?
 - B13-Do they help in **maintaining a continuous tracking** of the course contents?
 - B21-Have you noticed if videos **influence positively** the final course results?
 - B22-Does your **interest for the course increase** with the use of videos?
 - B31-About **time allocation**, is it adequate for the videos?
 - B32-Is the **number of videos** used in the course adequate?

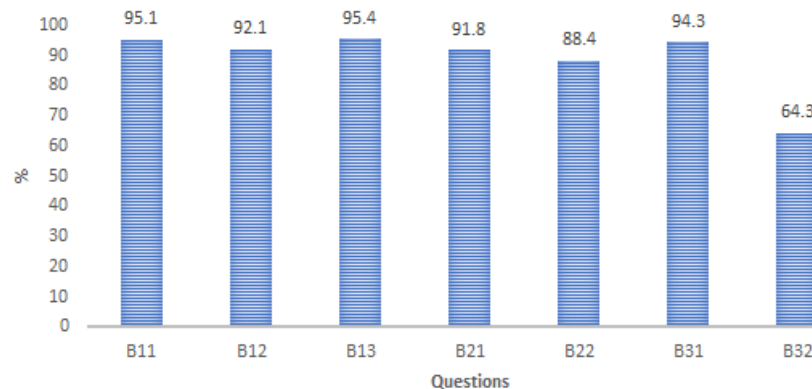
ENGINEERING PROJECTS * 32 STUDENTS



APPLIED ELECTRONICS * 38 STUDENTS



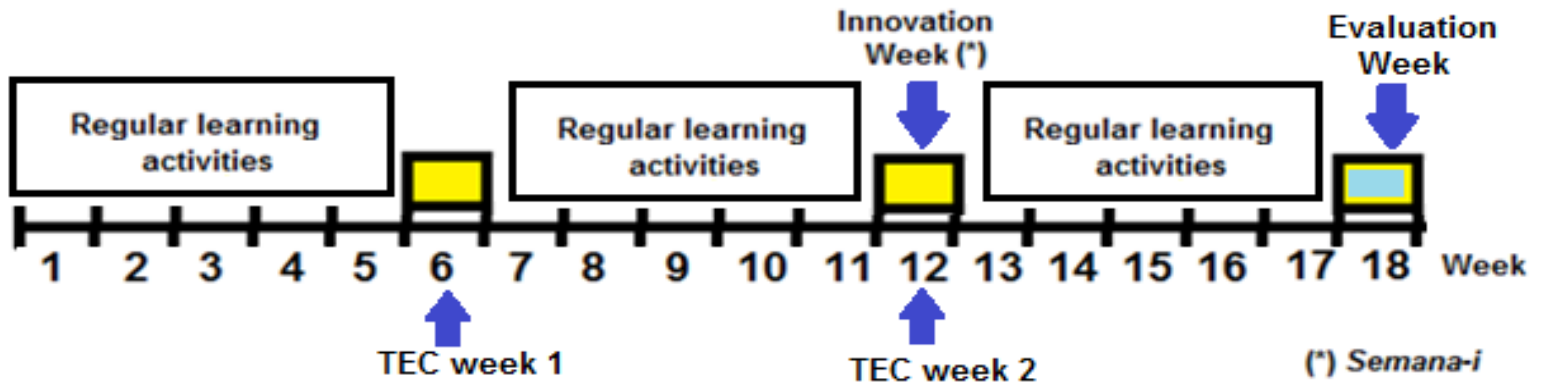
DESIGN OF BIOMEDICAL SYSTEMS AND EQUIPMENT * 21 STUDENTS





Tecnológico de Monterrey

Innovation-Week/ TEC-week



• EFR-2019 Schedule

| | Monday 24 | Tuesday 25 | Wednesday 26 | Thursday 27 | Friday 28 |
|---------|--|---|---|--|--|
| 9 AM | Registration and Take off | Fractures, immobilization, and dragging | RCP, Cardio-Pulmonar Reanimation | Presentation and use of the AED (Automatic External Defibrillator) | Team presentations in classrooms |
| 10 AM | Motivation and preparation | Dismays, recuperation posture | Wounds, burns, bandages and convulsions | New recommendations for RCP From AHA (American Heart Association) | Team presentations in classrooms |
| 11 AM | Scene Evaluation | Workshop QPR "Question, Persuade and Refer" | Wounds, burns and convulsions | bandage practice, evaluation of Heimlich and RCP | Presentations of the better evaluated teams |
| 12 PM | Heimlich Maneuver | Workshop QPR "Question, Persuade and Refer" | Practice and evaluation of RCP and Heimlich | Review and description of presentation logistics and procedures | Presentations of the better evaluated teams |
| 2:30 PM | Team formation and Scene Evaluation Practice | Practice of immobilization, dragging and Heimlich | Practice and evaluation of RCP and Heimlich | Development of integrative activities...by teams | Evaluation and individual certification exam |
| 3:30 PM | Initiation: Projects EFR-f...by teams | Continuation of integrative activities...by teams | Continuation of integrative activities...by teams | Continuation of integrative activities...by teams | Diploma delivery and Closure |





Results – i-week-TEC student engagement

- Exit survey applied after the i-Week EFR activity to 182 students from all majors

| How did students like...? | % of students saying: EXCELLENT | % of students saying: VERY GOOD |
|---|---------------------------------|---------------------------------|
| Workshop content | 59 | 33 |
| Instruction by SSNL | 61 | 28 |
| Consulting/instruction by TEC faculty | 73 | 22 |
| Time allocation | 39 | 33 |
| Supporting materials including the interactive VIDEOS | 62 | 37 |

| Were your expectations fulfilled? | Would you recommend the i-week EFR activity? |
|-----------------------------------|--|
| YES | YES |
| 88% | 92% |

Opinions of 182 students taking an exit survey at the end of the workshop



Conclusions

- The study **assessed impact** on the overall course grades as well as students' opinions about their engagement.
- To test the impact on learning outcomes, **control group of students were examined**. The experimental groups had 13 customized short, interactive videos (15 minutes or less) through the semester.
- The total **number of students exposed** to interactive-videos was for **TEC: 124** from spring-2016 through spring-2018, and for **UB: 156** from the spring-2017 through spring-2019. The final exam, overall grades and an exit survey show a **slight reasonable impact in final grades** and **huge impact in student's engagement**, both at TEC de Monterrey and University of Barcelona, Spain.
- Also, in i-week activity EFR-2019, students are highly motivated with the video material presented.
- The interactive **video strategy continues both at TEC de Monterrey and at the Universidad de Barcelona**, Spain, for 2019 and beyond, including i-Week activities and i-Semester groups.



Thank You - Acknowledgments

- The authors would like to acknowledge the financial and technical support of Writing Lab, TecLabs, TEC de Monterrey, in the production of this work.
- In addition, the authors would like to acknowledge the Mechatronics, Electrical and Biomedical Engineering department at TEC de Monterrey, and the Electronics Engineering Department at Universidad de Barcelona for their support in developing the tests, programming the sessions, and performing the pilot testing of this study.
- Also, during the 5 years of implementation of “*Emergency First Response Project*” (EFR), the authors would like to acknowledge the following participating professors: María Guadalupe Piña, Hugo Alvarado, Dolores Lankenau, Bertha L. García de La Paz, Alejandro Cervantes Villarreal, Antonio Mejorado Cavazos, María Marcela Dieck Assad, Martha Sordia Salinas, Javier Rodríguez Bailey, María Elena Dieck Assad, Josefina Rangel Sánchez, Delia Castro, Heidi Alejandra Rosas Treviño, Francisco Rodríguez Abrego, Dorilián López Mago, Miguel Angel Pérez, José Julio León, Jaime Martínez Garza, Juan Raúl Esparza, Alejandra González Avila, Rafael Salazar Chávez, Ivón Rodríguez, Juan Carlos Lavariega Jarquín, Alfonso Avila Ortega, Jakeline Marcos Abed and Sergio Omar Martínez Chapa. In addition, a great acknowledge must go to personnel from the Mexican Health Ministry, Nuevo León State Jurisdiction 3: Maria Gloria Chavez and Luis Ernesto Rodríguez.