

Affordable Learning Georgia Affordable Materials Grants Continuous Improvement Grants Final Report

General Information

Date: 09/12/2024

Grant Round: Round 22

Grant Number: M220

Institution Name(s): University of Georgia

Team Members:

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Project Lead: Nandana Weliweriya Liyanage

Course Name(s) and Course Numbers:

Each Fall semester - 3 sections of PHYS 1251 (38057, 38058, 50072)

Each Spring semester- 3 sections of PHYS 1251 (45294, 45296, 64932)

PHYS 1211,

PHYS 1111

Final Semester of Project: Spring 2023 (but the martial is being used even in fall 2024 semester)

If applicable to your project:

Average Number of Students Per Course Section: 72 (in PHYS 1251), 169 (in PHYS 1211), 165 (in PHYS 1111)

Number of Course Sections Affected by Implementation of Revised Resources: 6

Total Number of Students Affected by Implementation of Revised Resources:

432 (was the target total students for two semesters of six sections of 1251 courses). But up to this date the PI used and using the developed resources in high enrolment intro level

courses beyond the suggested ones and it has impacted over 1000 students over the last 4-5 semesters.

1. Project Narrative

Title: Integrating Well-Aligned Pre-Lecture Videos in Student-Centered Large Enrollment Undergraduate Physics Courses.

The objective of this continuous improvement proposal was to enhance the quality of pre-lecture videos for introductory undergraduate Physics courses. Building on the initial transformation achieved with Grant Round 21, we have successfully produced 12 high-quality pre-lecture videos on key topics in Newtonian mechanics. Thanks to the support from this grant and additional internal funds from UGA, the project team has exceeded the original goals, as detailed below.

2. Materials Description

The new approach aims to enhance pre-lecture videos with integrated near and far transfer questions, promoting active learning and deeper comprehension. Traditional methods relying on textbook reading have limitations, including time constraints, motivation issues, and missed discussions. Sole reliance on pre-lecture videos is passive and lacks practical applications, resulting in surface-level understanding. Our primary goal is to improve pre-lecture preparation by integrating near and far transfer questions. The proposed approach aims to: **Promote Active Engagement:** encourage students to actively engage with pre-lecture videos by solving integrated multiple-choice questions (MCQs) designed to assess their understanding. **Enhance Comprehension:** shift the focus of in-class discussions to practical applications and real-world examples, enabling deeper understanding and concept retention. **Improve Problem Solving Skills:** enhancing comprehension and fostering problem-solving proficiency.

This project seeks to address the following research questions:

- How does integrating near and far transfer questions into pre-lecture videos impact student engagement, measured by quiz interactions and completion rates?
- What is the effect of near and far transfer questions in pre-lecture videos on students' comprehension and real-world application of STEM concepts, including in-class discussions, problem-solving, and worksheets?
- How can data collected through iPads, including voice and pen movements, provide insights into student problem-solving, learning patterns, and engagement? Can this data inform algorithms predicting student grades based on engagement and transfer question performance?

Implementation and Data Collection:

With the support of Affordable Learning Georgia grant, the PI Weliweriya has already implemented prelecture videos in his PHYS 1251 courses¹, contributing to 5% of the final grade. While these videos have high completion rates, they remain passive and lack mechanisms for data collection, opportunities

¹ Current pre-lecture videos available at <https://www.youtube.com/@nandanaweliweriya-physicsa997/videos>

for students to assess their understanding during video consumption. Overcoming these limitations, this project focuses on 536 students across two semesters: spring and fall in 2024, encompassing three sections of studio physics (PHYS 1251) and two sections of Engineering Statics ENGR 2120 at UGA. Project leads oversee the development and administration of the pre-lecture video quizzes for their courses. They have access to 38 iPads and Apple pencils for data collection, and the XR platform records students' learning artifacts encompassing verbal and written elements. Upon receiving approval from the IRB, data collection begins in fall 2024 with a unique approach in studio physics courses. Students utilize iPads for pre-lecture quizzes, with devices rotated monthly to ensure data collection from a diverse student population, despite limited device availability. PHYS 1251 is a prerequisite for ENGR 2120, taken by engineering majors in the subsequent semester. In spring 2025, data collection will expand to Engineering Statics courses, offering valuable insights into knowledge transfer within STEM disciplines. Additionally, project leads, who also serve as course instructors, will document in-class student problem-solving activities, adding depth and granularity to this project.

3. Materials Links

Current pre-lecture videos available at <https://www.youtube.com/@nandanaweliweriya-physicsa997/videos>

4. Future Plans

Implementation and Data Collection:

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Achieving beyond the initial project proposal

As the project team, we are deeply appreciative of the funding agency's support for the initial phases of this project. The funds have been instrumental in providing valuable experience to both graduate and undergraduate students involved in creating these pre-lecture videos. Currently, these videos are integrated into UGA's eLC; learning management system, complete with embedded near and far transfer questions. They support thousands of students each semester, offering affordable and effective educational resources.

Several notable achievements have emerged from this initiative. Principal Investigator (PI) Nandana Weliweriya's dedication to enhancing learning experiences has been recognized with multiple accolades, including three consecutive CTL LTG grants and Affordable Course Materials Grants from the UGA Provost's office and the USG. Recently, Nandana was honored with the Franklin College's Sandy Beaver Excellence in Teaching Award (2024) and UGA's Creative Teaching Award (2024).

The impact on individuals involved in the project has been profound. Graduate students Zainil Charnia and James Sargent, initially planning to leave UGA with their master's degrees, have decided to continue their education towards a Ph.D. David Seiden, an undergraduate who contributed to recording and implementing the pre-lecture videos, is now pursuing graduate studies at UGA under the PI's supervision. Michael Cai, a high school student from Peachtree High School who began with basic programming skills, has developed into a leading programmer on our projects and is now studying at Columbia University. Robin Allen, a graduate student who completed his master's program under the PI, has expressed gratitude for the science communication skills he gained, which helped him in his application to the US Navy and his pursuit of becoming an astronaut with NASA.

The PI is also collaborating with faculty members both within and outside the department to extend these innovative approaches to other STEM disciplines. The overarching goal is to develop open-access educational resources that benefit students beyond UGA and USG, reaching learners nationwide.

Website: <https://www.stemin3d.net/aboutme>