Board #447: Enhancing Lecture Material with Conceptual Videos: A Supplementary Learning Experience

Mr. Thomas Rossi, University of New Haven

Thomas Rossi is a senior lecturer in Computer Science at the University of New Haven in the department of Electrical and Computer Engineering and Computer Science. His research focuses on improving the post-secondary experience for students through the use of current computing tools and technologies. Thomas graduated with his MS in Computer Science from the University of New Hampshire in 2016. He has previously worked at the Rochester Institute of Technology and at Penn State Erie, the Behrend College.

Dr. Pulin Agrawal, Pennsylvania State University
Negein Immen, Pennsylvania State University
Angelina Krystal Valentin, Pennsylvania State University

I am currently a computer science major at Penn State Behrend.

Neha Sagi, Pennsylvania State University
Domenico Alford-Egizio, Pennsylvania State University

Enhancing Lecture Material with Conceptual Videos: A Supplementary Learning Experience

Abstract

This research paper explores the use of conceptual videos to supplement a first-year programming course, although our hypothesis can't be confirmed due to data issues, it aligns with other studies indicating an improved learning experience. According to verbal reports, students often struggle with retaining and comprehending lecture content, especially when reference materials are limited to lecture notes and slides.

College students collectively undertook this project to investigate the use of conceptual videos as supplementary pedagogical tools. They sought to develop materials enhancing course comprehension, covering fundamental topics from variable declaration to arrays and functions through a quick topic rundown and detailed programming examples starting from the project's creations. The team embarked on the production of a series of educational videos. These dynamic tutorial videos deliver an immersive learning experience that is often lost in different lecture styles or written material. The college students being the coaches of each video compares to peer-teaching which can enrich the learning experience by offering an additional layer of support and engagement alongside the expertise of professors.

These videos were intended not as replacements for the lecture materials but as complementary resources to reinforce newly acquired knowledge for a deeper understanding. Further, they would serve as valuable review tools not only for students currently enrolled but also for upperclassmen seeking to refresh their programming skills. This enhances concept retention and increases student engagement, potentially leading to improved attendance, participation, and grades in computer science classes.

Late recovery of data was a substantial setback, resulting in the inability to complete the videos in time for testing and hindering the ability to comprehensively assess the efficacy of these supplementary videos in enhancing the learning experience. Despite this setback, the project benefited the students who took on this project by honing their C++ programming skills as well as their communication skills.

Introduction

Understanding the foundational concepts of any academic discipline is pivotal for subsequent academic success. This essential paradigm underscores the significance of refining instructional approaches in early courses to equip students with a solid understanding of fundamental subject matter. Students seized the opportunity to contribute to the Computer Science and Software Engineering (CSSE) department's modes of education by creating an instructive series of videos focusing on introductory programming topics in C++. This endeavor aimed to fortify the foundational knowledge of students enrolled in the introductory programming course.

The conceptual video series covers key topics aligning with an introductory programming course's curriculum, including Variables, Data Types, Making Decisions, and Functions. Created by individuals with a deep understanding gained from completing the course, the videos aim to enhance students' grasp of foundational programming principles. The methodology involved collaboration among five students, crafting comprehensive outlines reviewed for structural integrity. Filming proceeded under collective expertise, shaped by their CMPSC-121 experience. However, a setback in video editing due to hard drive data recovery delays hindered a conclusive assessment of the educational model's effectiveness.

Despite the unfortunate impediment in data collection, this research posits, based on extant research, that conceptual videos hold the potential to significantly enhance the learning experience of students. The repercussions of this initiative transcend the immediate context, underscoring the viability of similar student-led educational initiatives in the future. This experience illuminates that active student involvement in the educational process can serve as an efficacious mechanism for fostering a dynamic feedback loop, thereby ensuring the continual refinement and authenticity of academic courses within esteemed institutions.

Background

Investigation into the use of conceptual videos as supplementary tools in a first-year programming course is informed by the systematic review titled "Blended Learning Models for Introductory Programming Courses." The study classified models into five types, including Flipped, Mixed, Flex, Supplemental, and Online-Practicing models, with a focus on enhancing the learning experience of novice programmers [1].

These discoveries emphasized the effectiveness of blended learning approaches, with the Mixed model, known for flexibility, showing potential for improved student performance[1]. The study emphasized the significance of monitoring online components for student engagement and recognized the value of interactive videos and self-learning skills in programming courses[1].

According to a study by Ljubojevic, the findings affirm that "streaming supplemental videos improve students' ability to learn in an autonomous way," highlighting the potential positive impact of the videos we created [2]. Moreover, the research emphasizes that "videos are a tool for engaging the verbal (linguistic), visual (spatial), and musical (rhythmic) intelligence of the student in the learning process" [2]. This suggests that our videos not only serve as a means for students to reinforce classroom learning but also contribute to an enjoyable learning experience, ultimately enhancing performance and retention over rote learning.

Our research builds upon these insights, presenting conceptual videos as a supplementary tool. Drawing inspiration from the favorable results seen in blended learning models, our approach integrates dynamic tutorial videos formulated by students serving as coaches. This provides an extra layer of support, relatability, and engagement while still maintaining traditional instructional methods

Materials and Methods

The creation of these instructional materials involved a collaborative effort among five students who had completed the Intro to Programming (CMPSC-121) course. The topics covered in the conceptual video series aligned with the curriculum of the course, ranging from introductory concepts like loops to more advanced programming principles like functions and pointers. Our methodology was comprehensive, beginning with the development of detailed outlines and scripts that were reviewed by a member of the faculty teaching the course. Notes and slides were used extensively to assemble the scripts and guide the filming process, ensuring a structured and informative presentation.

We meticulously structured the sound and video elements of the instructional videos to ensure clarity and coherence. During the filming process, the team benefited from the expertise of a student with external experience in editing software, guiding the process to maintain a professional and polished output. Furthermore, our videos were designed to be around ten minutes long, aligning with student preferences for shorter content that enhances engagement

and retention. This comprehensive yet concise format ensured that key concepts were thoroughly explained and understood without overwhelming the audience.

The filming phase spanned several weeks, with each student conducting multiple takes and demonstrations to perfect their designated topic. The students were allowed to use a studio space on campus that included a green screen, and studio lighting. The camera used was able to shoot videos in 4K and other microphones were used for audio purposes. This rigorous approach was critical to maintaining a high standard of quality in our educational materials.

However, the editing phase encountered issues with the drive, leading to ongoing editing processes. The editing is being worked on using Final Cut Pro, to complete as many videos as possible despite data loss that was partially recovered from the drive.

Results

Unfortunately, we were hindered by delayed data recovery that rendered some video content unavailable at the time of publication and thus prevented a comprehensive analysis of the videos' effect. Nonetheless, the inherent worth of this project should not be overlooked. From the already existing literature and preliminary observations, we strongly believe that the videos would have had a positive effect on the student's learning experience. The use of multimedia such as video in pedagogies is consistently highlighted in educational research, particularly for technical subjects like programming. These resources often make learning more interactive and create a more interesting learning environment for such courses as philosophy.

Also, the creation of such videos was an educational experience by itself for these students. It was not just that they confirmed their grasp of programming ideas, but also they improved teamwork, communication, and problem-solving. This is crucial because it highlights one of the central aspects of learning, namely peers' teaching as well as the development of own student resources. Such endeavors may facilitate comprehension and memory, not only for the makers but perhaps also for fellow individuals.

The project was successful in a different, essential way, as we observed some positive qualitative results. Certainly, the project would have been of immense impact providing an engaging and practical experience to the student authors as well as the course attendees adding the value of greater comprehension to an engagement with course materials.

Conclusions

In conclusion, despite the unforeseen setback caused by delayed data recovery, our exploration into the usage of conceptual videos as supplementary tools in a first-year programming course has induced valuable insights and positive outcomes. Although recorded videos were lost, the students involved in this process benefited extensively. The focus on developing educational materials, specifically conceptual videos, has not only honed their C++ programming skills but also improved their communication abilities.

The primary pursuit of the conceptual videos was to enrich course comprehension by offering an immersive and engaging learning experience. While our hypothesis could not be confirmed due to data issues, related studies imply that a favorable impact on student understanding and engagement would likely have occurred. Furthermore, the unique aspect of peer teaching, where college students operated as coaches in the videos, adds a novel layer of support and engagement alongside the expertise of professors.

Acknowledgments

We would like to express our gratitude to students Dongyun Lim, Valentina Aguirre, Caleb King, and Theo Ebenezer for their contributions to the creation of the original videos for this project. Although they were not involved in writing and publishing this paper, their efforts were essential in this project.

Citations

[1] A. Alammary, “Blended learning models for introductory programming courses: A systematic review,” PLOS ONE, vol. 14, no. 9, p. e0221765, Sep. 2019, doi: 10.1371/journal.pone.0221765.

[2] M. Ljubojevic, V. Vaskovic, S. Stankovic, and J. Vaskovic, “Using Supplementary Video in Multimedia Instruction as a Teaching Tool to Increase Efficiency of Learning and Quality of Experience,” Int. Rev. Res. Open Distance Learn., vol. 15, pp. 275–291, Jul. 2014, doi: 10.19173/irrodl.v15i3.1825.