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TRANSFORMING COMPUTER SCIENCE PEDAGOGY: AN EXPLORATION OF SELF-RECORDED VIDEOS (SRV) AS A TEACHING AND EVALUATION TOOL



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Transforming Computer Science Pedagogy: An Exploration of Self-Recorded Videos (SRV) as a Teaching and Evaluation Tool

Synopsis:

This study introduces Self-Recorded Videos (SRV) as a new method to enhance students' performance in computer science coding assignments. Conducted with 41 students in an online Operating Systems course, the study required students to create SRVs for each assignment. The aim was to deepen student engagement and understanding. Post-semester survey results revealed a strong preference for the SRV method, with most students believing it significantly improved their performance. This suggests that SRVs could be a potent tool for boosting student engagement and performance in computer science courses.

Transforming Computer Science Pedagogy: An Exploration of Self-Recorded Videos (SRV) as a Teaching and Evaluation Tool

Abstract

This study aims to introduce Self-Recorded Videos (SRV) as a novel method to help improve students' performance in coding assignments in computer science courses. To our best knowledge, this is the first time the SRV method is applied in the context of computer science classes. The study was conducted with a sample size of 41 students who were registered in the online CSCI 331 Operating Systems course at Fort Hays State University. These students were given specific instructions to create Self-Recorded Videos SRVs for every coding assignment they were tasked with. This approach was designed to encourage students to engage more deeply with their assignments, promoting a more thorough understanding of the material. At the end of the Fall semester, 2023, students were surveyed on their perception of the novel method and how it affects their performance. The analysis of the survey results revealed a strong tendency among the students in favor of the SRV method. The majority of the students believed that the SRV method significantly improved their performance in the coding assignments. This positive feedback suggests that the SRV method could be a powerful tool for enhancing student engagement and performance in computer science courses.

Keywords: *self-recorded video, computer science teaching and evaluation, students' performance, coding assignments.*

Introduction

In computer science courses, students are required to write a lot of code to reinforce their understanding of the discussed concepts in the classroom. Although many students enjoy writing code, some of them might find coding exercises challenging and time-consuming. The author noticed in his computer science classes that students usually achieve relatively high grades in coding assignments, however, they do not achieve the same level of performance when doing written exams. One of the reasons is that students can easily share code from peers or search the Internet for similar solutions to their assignments' problems. Although students are always

encouraged to work with peers to do their assignments, they are still required to demonstrate their genuine participation in code writing and understanding of the underlying principles presented in coding assignments.

Professors usually spend copious time evaluating students' coding assignments to ensure the fairness and correctness of their evaluations. Examining students' code and trying to catch any similarities between them is a very hard and very time-consuming task to do. One alternative to this approach is to ask students to code their assignments in guided classes or lab sessions. However, this approach is deemed to be inadequate since writing code in a short time, like one- or two-hour sessions, provides limited time for students to test their code and fix all possible errors.

From the above arguments, we can realize the significance of an innovative approach that will both boost student learning and decrease their dependency on other means to do the coding. Here comes the innovative idea of incorporating the self-recorded videos SRV approach in computer science classes. SRV's innovative idea has the potential even for other desired outcomes, like, enhanced students' engagement in the course materials, enhanced students' communication skills either with their classmates or with the instructor, preventing or at least decreasing the cheating rate in coding assignments.

Literature review

Although this idea has been applied in many fields, to our best knowledge, this is the first time the SRV method has been applied in the context of computer science classes. Ritchie [1] has used this technique for educational purposes where he found that it was useful to let students watch and assess their own performance. The benefits of implementing the SRV method in teaching go beyond encouraging students to do their coding assignments by themselves to enhancing their communication skills as well. Kovac & Sirkovic [2] concluded in their study that it is of great importance for students to have more opportunities to develop communication skills at the beginning of their university education. The self-assessment has been found to be beneficial for student learning when completed after viewing their video-recorded presentation as observed by Ritchie [1] and Kovac & Sirkovic [2] when concluded in their studies that students self-video

recording increased their motivation to do their assigned training and enhanced significantly the skills gained by the end of the training.

Quigley and Nyquist [5] analyzed a wide range of papers focused on observing university students performing different tasks and activities. They found that in general, students' skills are improved when they are given the opportunity to record and watch themselves performing. Literature has continued to indicate that the use of video recording during communication has been found across many disciplines to be an effective way to help students adopt and learn from the observers' perspective [3][4][5].

Moreover, Marsh and Tailab [6] have observed in their research that many researchers in this field either ignored or could not distinguish between graded and ungraded video recordings. To bridge this gap, they made grading students' presentations part of the class requirements. They concluded that graded presentations have more influence on students' performance than presentations for which students will not be graded. Murphy and Barry [1] added that in general, self-assessment can be ranked as one of the most important factors in improving oral presentation skills. Guo et al. [7] concluded that shorter videos are more engaging than longer videos. The content quality can overcome the production quality. They emphasized that simple and informal videos can be more engaging than studio-produced videos with high production standards.

Case Study Showcase

The author started a new pedagogical experiment. The major goal of this experiment is to increase students' proficiency level in writing code. In this experiment, after finishing writing the code, students must record themselves and submit the recorded video file along with the source code files. In this way, the author believes this will allow students to present their programming skills and creativity in writing the code. Additionally, these videos will be a great asset to evaluate students' mastery level of the required skills and knowledge. By asking students to present their work, it will be possible to identify students' strengths and weaknesses. Consequently, classes plans can be adjusted to resolve any issues that might arise in students' mastery level of the course contents.

Research Questions

The aim of this research is to answer the following questions:

- 1) Does SRV increase students' engagement in the course materials and activities?
- 2) Does SRV increase students' mastery of the discussed computer programming principles in the class environment?
- 3) Does SRV enhance students' communication skills and enhance their participation in the class environment?

Although the results show mixed outcomes, the research results suggest a strong positive impact on students' performance and suggest further research and replications.

Method

In the Fall-2023 semester at Fort Hays State University, students enrolled in the online CSCI331- Operating Systems course were required to record themselves while presenting their coding assignments. Students had the flexibility to choose their preferred programming language. While Java was the most popular choice among most students, some opted for C++ and Python.

Students were advised to use user-friendly video recorders like VidGrid or Zoom, which offer good quality video and audio along with screen capture functionality. Because VidGrid is embedded within the course Blackboard webpage, the majority of students used VidGrid. In addition, VidGrid allows for unlimited online storage to save large video files. To verify their identity, students were instructed to ensure their presence in one corner of the screen during the presentation. In order to familiarize students with the requirements, the instructor prepared a model video for the students to follow. Although students had access to the computer stations in the lab room, the majority chose to use their personal laptops for reasons such as convenience and privacy.

After completing each programming assignment, the proposed SRV method instructs students to record themselves performing the following tasks:

- 1) Running the code.
- 2) Running a specific test or scenario.
- 3) Commenting on the outcomes and how they meet the expectations.

- 4) Explaining the primary functions of the code and their operations.
- 5) Answering specific questions on the code functionality and implementations. Some of these questions might ask students to modify the code either to optimize the code or change the output to meet new requirements.
- 6) Detailing how results were obtained through code tracing.
- 7) Instruct students to change the code in a certain way that will result in a bug (logical or syntactical), then ask students to explain what happened and fix the bug.
- 8) Answering questions about data types, variables, and any other choices made by the student.

Ethics

Due to privacy considerations, the researcher is unable to share the students' recordings. The students have been notified that their privacy will be respected throughout this process and their videos will be securely stored within the VidGrid storage quota, a service provided by Fort Hays State University. The use of these videos is strictly confined to the educational context, ensuring that the students' work contributes directly to the enhancement of instructional quality and learning experiences.

Collecting Data

The data used in this research was collected through a survey that was designed using Google Forms, a user-friendly tool known for its efficiency and accessibility. The survey questions are listed in appendix A for reference. The data was downloaded and analyzed as follows.

Results analysis

A total of 41 students were surveyed. Responses were collected using a 5-point Likert scale, where 5 represents 'Strongly Agree', 4 stands for 'Agree', 3 is 'Neutral', 2 is 'Disagree', and 1 is 'Strongly Disagree'. For each question, a **sum of total points** was calculated based on students' responses. Dividing the sum of total points over the total points possible of 205 points yields a percentage that represents the overall students' acceptance for that particular question. The total points possible were calculated by multiplying 41 by 5 points which represent the maximum points

possible for every question. Table 1 shows the ranking of the survey questions. Below is a detailed analysis of some notable results.

Questions List	SUM of total points	Percentages %
develop your ability to explain complex ideas in a clear and concise manner.	163	80%
more accurately reflect on your understanding of the coding assignment than other evaluation methods.	158	77%
develop skills that will be useful in your future career.	157	77%
feel confident to explain your work.	154	75%
The length of time given to complete and submit the self-recorded video was sufficient for me.	154	75%
demonstrate your understanding of the coding assignment more effectively than other evaluation methods.	151	74%
develop your critical thinking skills.	150	73%
improve your communication skills.	148	72%
The process of recording and submitting a video was easy to follow.	148	72%
learn the required concepts.	147	72%
It was challenging to articulate my thoughts clearly while recording the video.	147	72%
focus on doing the assignment.	145	71%
explain the challenges you had while doing the assignment.	145	71%
identify any mistakes or errors in your code.	141	69%
be more motivated to put more effort into completing the coding assignment.	141	69%
comfortable recording the video when repeated several times and practicing enough.	138	67%
engage with the material in a more creative way.	136	66%
I recommend the self-recording video method to other students as a useful and effective evaluation tool for coding assignments.	136	66%
encouraged to seek help from either classmates or the instructor or any form of available help.	133	65%
It was helpful to watch my own video after recording it.	132	64%
I prefer to use the self-recording video method over a traditional written assignment in the future.	128	62%
It was helpful to watch other students' videos.	126	61%
receive more personalized feedback from your instructor.	124	60%

develop your time-management and organizational skills.	124	60%
develop your teamwork skills by allowing you to collaborate and share your ideas with your classmates.	122	60%
Video recording assignments are very interesting.	122	60%
reduce your anxiety or stress about coding assignments.	97	47%

Table 1 Ranking of the survey questions from top to bottom.

The highest percentage of students' responses (80%) agreed that the SRV method helped them develop their ability to explain complex ideas in a clear and concise manner, figure 1. This suggests that the process of recording and reviewing videos allowed students to practice and improve their communication skills. Although this is not a direct objective of taking computer science courses, it is definitely a useful skill for students'

develop your ability to explain complex ideas in a clear and concise manner.

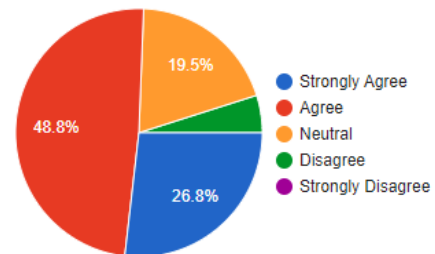


Figure 1: Students' responses to question 11.

futures when they start and progress in their chosen careers. Many employers have clearly stated that the ability to explain complex ideas is at the top of the list of critical skills required for new hires, particularly for software engineers [8]. Furthermore, improving communication skills can generally enhance students' engagement in class activities for both on campus and online students. One of the main reasons why students do not perform well in their studies is their lack of communication with either their instructors, classmates or any other available help resources provided by their educational institution [9] [10].

Moreover, 77% of students' responses agreed that they felt this method more accurately reflected their understanding of the coding assignment than other evaluation methods, figure 2. This indicates that the SRV method may provide a more authentic assessment of students' coding skills and understanding compared to traditional evaluation methods like written exams for example.

The same percentage of students' responses (77%) believed that this method helped them develop skills that will be useful in their future careers, figure 3. This suggests that the SRV method not only enhances students' academic performance but also contributes to their career readiness as well.

more accurately reflect on your understanding of the coding assignment than other evaluation methods.

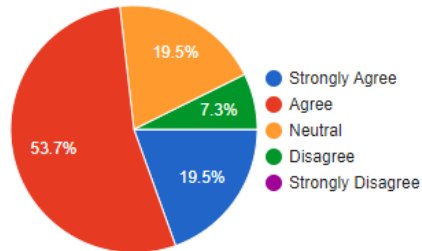


Figure 3: Students' responses to question 16.

develop skills that will be useful in your future career.

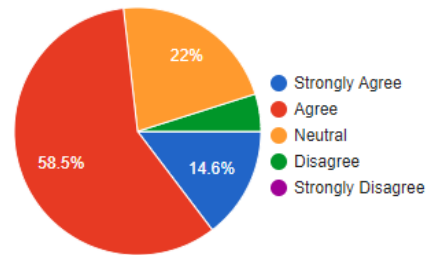


Figure 2: Students' responses to question 13.

Figure 4 shows that 75% of the students' responses agreed that they felt confident in explaining their work, suggesting the effectiveness of the SRV method in teaching computer science courses. However, this confidence could be influenced by other factors such as the student's academic level (freshman, sophomore, junior, or senior) and the difficulty of the course under examination (e.g., operating systems, computer architecture, databases, etc.). Therefore, this finding warrants further investigation and experimental replication to draw more robust conclusions.

feel confident to explain your work.

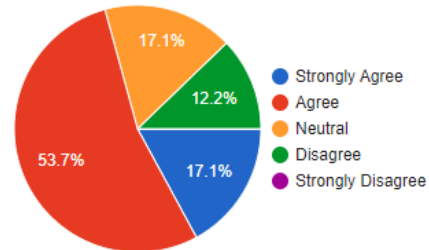


Figure 4: Students' responses to question 3.

demonstrate your understanding of the coding assignment more effectively than other evaluation methods.

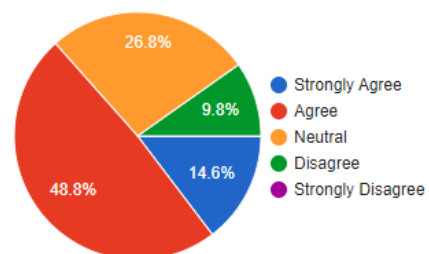


Figure 5: Students' responses to question 10.

Interestingly, 74% of student responses indicated that the SRV method is more effective than traditional methods for demonstrating their understanding of coding assignments, figure 5. This suggests that the SRV method has strong potential to be used as an evaluation method, in addition to being a teaching method, replacing traditional evaluation methods such as written exams.

Figure 6 shows that the SRV method has helped most students to develop their critical thinking skills while presenting their work, which could have positive implications for their future. This is particularly significant as the SRV method has strong potential to enhance student engagement with the material and coding. Often, students are primarily interested in completing assignments for the sake of grades and passing the course. However, with the SRV method, students can be encouraged to think more critically and take a more thoughtful approach to code development.

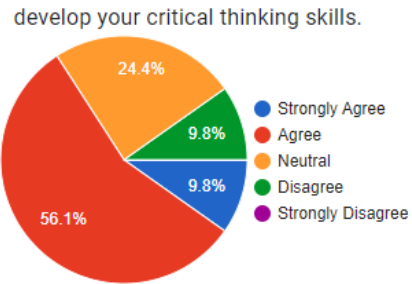


Figure 6: Students' responses to question 14.

As depicted in Figure 7, the majority of students expressed that the SRV method significantly aided them in grasping the necessary concepts. This positive feedback has not only validated the effectiveness of the SRV method but also inspired the author to consider its broader applications. Given its success in enhancing understanding and engagement, there is potential for the SRV method to revolutionize the way computer science is taught. The author is now motivated to expand the use of this method beyond its current scope, applying it to a wider range of computer science courses. This could potentially lead to improved learning outcomes across the board, equipping students with a deeper understanding of complex concepts and better preparing them for their future careers in the field. The author believes that the SRV method, with its unique approach to teaching and learning, could transform computer science education.

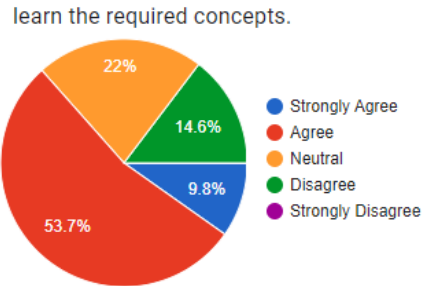


Figure 7: Students' responses to question 1.

A significant 71% of students' responses found SRV beneficial in articulating coding challenges, figure 8. This tool not only aids students in understanding assignments but also helps instructors identify learning gaps. By analyzing these videos, instructors can pinpoint areas of difficulty and develop suitable interventions. This

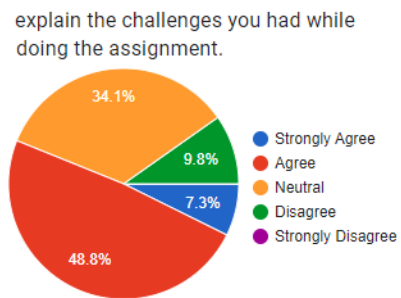


Figure 4: Students' responses to question 4.

feedback loop enhances the learning process, making SRVs a valuable asset in computer science education.

As depicted in Figure 9, SRV method has proven to be an effective tool in helping students debug their code prior to submission. This addresses a common issue where students, often in a rush to meet deadlines, tend to submit their assignments without sufficient review, debugging, and testing, usually just before the last minute. SRV tends



Figure 5: Students' responses to question 7.

to offer an appealing method for students to revisit their work and identify any overlooked errors. This approach is particularly beneficial in engaging students with course materials and activities. SRV is not solely a teaching and evaluation tool for instructors; it also empowers students to enhance their own performance. Encouraging students to review their videos and make necessary edits or modifications before submission could further improve their learning outcomes and coding proficiency. In future research, this aspect of SRV will be emphasized by furthering research and applications.

As illustrated in Figure 10, the majority of students found the SRV method to be a motivating factor in their efforts to complete coding assignments. This innovative approach seems to have a positive impact on students' engagement and commitment to their tasks by encouraging them to take ownership of their learning process. By recording themselves presenting their code, students become more

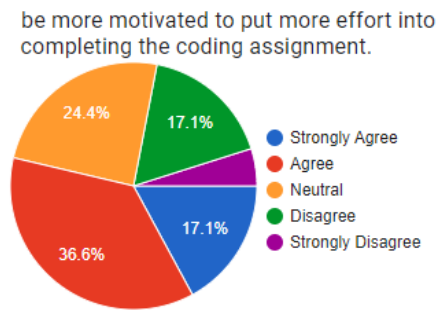


Figure 6: Students' responses to question 8.

aware of their thought processes and problem-solving strategies. This self-reflection can lead to improved understanding and mastery of coding concepts. Moreover, the SRV method provides a platform for students to showcase their work, fostering a sense of pride and accomplishment. This can further motivate students to put more effort into their assignments, striving for excellence and continuous improvement.

On the other hand, the data also reveals some areas for improvement. For instance, only 60% of students' responses revealed that this method helped them receive more personalized feedback from their instructor, figure 11. This suggests that while the SRV method has many benefits, it may not fully replace the need for direct, personalized feedback from instructors. Similarly, only 60% of students' responses believed that this method helped them develop their time-management and organizational skills, figure 12. This indicates that while the SRV method encourages students to take ownership of their learning, it may not necessarily help them manage their time more effectively.

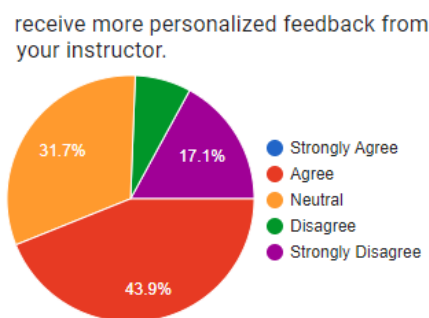


Figure 8: Students' responses to question 17.

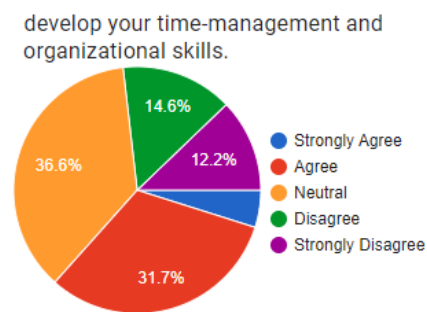


Figure 7: S

Moreover, only 47% of students' responses felt that SRV method helped reduce their anxiety or stress about coding assignments, as shown in Figure 13. This can be an expected concern as the SRV method may introduce new sources of stress for some students. For instance, students may feel anxious recording themselves at home or at a public place. Some may not be confident about the technical aspects of creating and submitting videos while ensuring good video and audio quality. Additionally, the time required to record and review the videos could add to their workload, potentially increasing stress levels. Therefore, while the SRV method offers several benefits, it's crucial to consider these potential challenges and provide appropriate support to help students navigate them effectively.

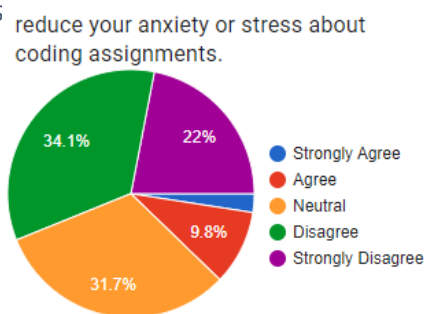


Figure 9: Students' responses to question 12.

Conclusion

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Acronyms

- Self-Recorded Videos SRV
- VidGrid at www.vidgrid.com
- FHSU at www.fhsu.edu

APPENDIX A: Survey Questions

Group 1:-

Does self-video recording while explaining the coding assignment help you ...

- 1) learn the required concepts.
- 2) focus on doing the assignment.
- 3) feel confident to explain your work.
- 4) explain the challenges you had while doing the assignment.
- 5) encouraged to seek help from either classmates or the instructor or any form of available help.
- 6) comfortable recording the video when repeated several times and practicing enough.
- 7) identify any mistakes or errors in your code.
- 8) be more motivated to put more effort into completing the coding assignment.
- 9) engage with the material in a more creative way.
- 10) demonstrate your understanding of the coding assignment more effectively than other evaluation methods.
- 11) develop your ability to explain complex ideas in a clear and concise manner.
- 12) reduce your anxiety or stress about coding assignments.
- 13) develop skills that will be useful in your future career.
- 14) develop your critical thinking skills.
- 15) develop your teamwork skills by allowing you to collaborate and share your ideas with your classmates.
- 16) more accurately reflect on your understanding of the coding assignment than other evaluation methods.
- 17) receive more personalized feedback from your instructor.
- 18) improve your communication skills.
- 19) develop your time-management and organizational skills.

Group 2:-

- 20) It was helpful to watch my own video after recording it.
- 21) It was helpful to watch other students' videos.
- 22) It was challenging to articulate my thoughts clearly while recording the video.

- 23) I recommend the self-recording video method to other students as a useful and effective evaluation tool for coding assignments.
- 24) I prefer to use the self-recording video method over a traditional written assignment in the future.
- 25) The process of recording and submitting a video was easy to follow.
- 26) The length of time given to complete and submit the self-recorded video was sufficient for me.
- 27) Do you want to continue this kind of assignment, or do you want it to be stopped.
- 28) Video recording assignments are very interesting.

Essay question:

- 29) What are your suggestions for improving the self-recording video method as a teaching and evaluation tool?
