Integrating Game Play into an Inclusive Computing Project in Calculus Class: Designing and Analyzing Priority Switches for Competing Devices and Apps

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Abstract: This study explores the integration of game play into an inclusive, hands-on computing project in Calculus class. The project is focused on designing and analyzing priority switches for applications competing for computational resources on embedded devices such as smart watches and tablets. By engaging students in real-world problem-solving through the form of game play, the project enhances their understanding of mathematical concepts, particularly derivative, while fostering inclusivity in STEM education. The initiative was implemented in a Calculus class with diverse student backgrounds, incorporating structured interventions such as icebreakers, pre- and post-surveys, and interactive lab activities. A key component involved using a hardware emulation setup with an FPGA-based system to simulate communication resource competition. Survey results and informal assessments indicate that the hands-on approach increased student engagement, conceptual understanding, and interest in mathematics and technology. However, some logistical challenges, such as scheduling gaps between theory and lab activities, highlighted areas for improvement. This research underscores the importance of interactive, interdisciplinary learning experiences in promoting student participation and inclusivity in STEM fields.

Keywords: *calculus, inclusive education, STEM, derivative, game play, interactive learning, priority switches*

INTRODUCTION

In our project, we aim to make mathematics classes more engaging and relevant for engineering and computer science students. Our primary focus is on fostering active learning while creating an inclusive environment, particularly for minority and female students. To achieve this goal we thoughtfully structured group activities, allowing students to collaborate with peers who share similar backgrounds, majors, or identities while also providing opportunities for diverse group interactions. This practice helps build a sense of belonging while encouraging broader perspectives.

Recognizing that students are highly motivated by hands-on, interactive experiences, we created an atmosphere of curiosity – one that sparks excitement about "what's happening in class" and, in turn, cultivates deeper engagement with assignments. To better support underrepresented students, we introduced targeted interventions before the beginning of major class projects. These included initiatives such as class icebreakers, pre-project discussions, pre-surveys, dedicated in-class discussions, post-surveys, and small-group conversations with instructors.

Institutional Profile

Fiorello H. LaGuardia Community College of the City University of New York is known for its multicultural and diverse environment and a highly heterogeneous student body. This second largest urban community college is located in Long Island City and serves over 45,000 students from the metropolitan area. Over 60% of students live on low financial supply, often handling multiple jobs, taking care of their families and facing extreme life hardships. The heterogeneity of the population of students is at the same time a challenge and a benefit since there is a visible group of ambitious and hardworking students who already have detailed plans for their professional careers, in particular for transferring to a four-year college and earning a bachelor's degree. The Department of Mathematics, Engineering, and Computer Science offers mathematics education to all majors. It was the departmental and college initiative to introduce inclusive projects in mathematics classes of all levels, including developmental courses. Sample class projects are available via departmental web page, and instructors are encouraged to create their own projects and seek feedback from the course coordinators. Previous experience with project-based learning places students at an advantage when they join a summer or a year-long research project or transfer to a 4-year college.

LITERATURE REVIEW

Inclusive mathematics classrooms can be fostered through a manifold of pedagogical and didactical approaches, by physical and organizational environments, and by student-centered learning environments (Höveler 2019). Research indicates the importance of hands-on activities, real-world applications, and adapting curriculum to be relevant to students, all of which contribute to a more inclusive setting (Faragher 2016).

To create inclusive mathematics environments, educators should have critical consciousness, use a more expansive view of mathematics, adapt curriculum and instruction to be relevant and engaging, include experiential learning, collaborative work, and prioritize deep mathematical thinking. Incorporating activities that allow students to physically interact with mathematical ideas enhance their understanding and interest in math study (Faragher 2016). Using tailored materials and visual aids can help develop concepts thoroughly (Gardesten 2023). Connecting mathematics to real-life situations improves student performance (Faragher 2016). Collaborative teaching models engage students alongside general and special educators and community professionals in problem-based activities (Malian 2011). Co-teachers can support activities through professional development that creates content-rich and differentiated instruction for all students (Malian 2011). Mathematics curriculum and instruction should be adapted to be relevant to all students in the class. Inclusive learning environments require teachers to notice, relate, and adjust their approaches to meet students' individual preferences and prior knowledge (Höveler 2019). Teachers who recognize that students are experts on their own uses of mathematics can engage students as key contributors to their own learning.

Inspired by these pedagogical methodologies, we as instructors of math, engineering, and computer science courses discussed creating an inclusive project for students in a mathematics class. The topic of computational resource competition among smart devices and apps is selected since this prevalent problem is experienced by the general public, its fundamental mechanism is relevant to computing concepts studied in the target math class, and the physical setup for simulating this real-world problem through the form of game play is feasible with the available software and hardware resources used in other computing classes in the department. Details of project idea, classroom implementation, assessment results, and conclusions are introduced in the rest of the paper.

METHODS

Project Idea and Modifications

Background Information

The project idea arose during our discussion on a real-world problem to be incorporated in teaching a Calculus class. We consider that the experience of resource competition on smart devices is prevalent among students in the class, especially during remote classes when they need to access Zoom meetings on computers connected to multiple smart devices with various applications running at the same time. Students mentioned that their internet is excellent but sometimes due to unknown reasons the communication quality is disturbed. It is possible that multiple devices connected to their computers (security cameras, doorbells, heaters, air conditioners, washers, dryers, water kettles, smartwatches, Bluetooth speakers, TVs, etc.,) are competing for limited computational resources on the motherboard. The resource allocation process executed by the computer system is based on priority, i.e., the application request with higher priority gets served earlier (Tanenbaum 2023). The concept of priority is related to the math topics introduced in a Calculus class. Thus, we anticipate that this problem would stimulate students' curiosity and motivate them to track down the root cause while gaining thorough understanding of those math topics. To make the learning process more experiential and interactive, we incorporate game play in this project through computer programmable hardware emulation to allow students to express the priority concept as math formulas in software program and to observe their program outcome in a physical setting by playing switch flipping game with teammates to imitate the resource competition scenario.

Math Concept

In modern computer operating systems, processors handle resource allocation requests from different users based on their priority. For example, a program generating a notification of low battery level or virus detection has higher priority than a program showing daily news or weather information. The request with higher priority gets served earlier. There are different criteria to measure priority. One criteria relatively easy to apprehend is to use the derivative of the request data rate, i.e. the frequency of requests from one user, for the computer to make decision on resource allocation.

The Derivative is a fundamental math topic taught in the Calculus class. Consider the scenario with two users (devices or apps) competing for communication on a smartphone (let us say, Bluetooth connection with a smartwatch and running the Zoom app). Their requests are sent via two communication channels with limited data rates according to the functions, respectively:

$$f_1(x) = \frac{1+sinx}{2} \text{ and } f_2(x) = \frac{1+sin(2x-\frac{\pi}{6})}{2} \quad (1),(2)$$

When the value of $f_1(x) + f_2(x)$ exceeds 1, which is 100% of the data rate capacity, the users begin competing. Since the actual data transfer cannot exceed 1, the transfer follows the function

$$D(x) = min\{1, (f_1 + f_2)(x)\} \quad (3)$$

When competition occurs, the winning user with higher priority is identified, in this case it refers to the data rate function with a larger derivative (sudden increment of data amount within a time window). If at a given time x, it happens that the sum of values $(f_1 + f_2)(x) \leq 1$ then both requests are sent without interruption. However, if at a given time x, the sum of values $(f_1 + f_2)(x) > 1$ then the following selection criterion is applied:

$$S(x) = \begin{cases} f_1(x), if\,(f_1 - f_2)'(x) > 0, \\ f_2(x), if\,(f_1 - f_2)'(x) \leq 0 \end{cases} \tag{4}$$

Based on this math concept, we formulate the following initial assignments in the project to familiarize students with the issue of competing user devices/apps:

a) Use software to sketch the graph of the function $D(x) = min\,\{1, (f_1 + f_2)(x)\}$ modeling data usage by two user devices.
b) On the graph of $D(x)$ mark in red the intervals where the data from f_1 is transferred and in blue where the data from f_2 is transferred.
c) Compare the priority using the data rate derivative of the first user (smartwatch) in comparison to the second user (Zoom app). Do you think that designing the priority this way will cause disruptions while using Zoom? Do you think that this will cause disruptions while using a smartwatch?
d) Describe the functions that model the delays on each device.
e) How would you modify this priority to match the needs of the users in a better way?

Figure 1 shows a sample graph of the functions $(f_1 + f_2)(x)$ and $D(x)$. The unsent data is accumulated where $(f_1 + f_2)(x) > 1$, which is marked with a red color.

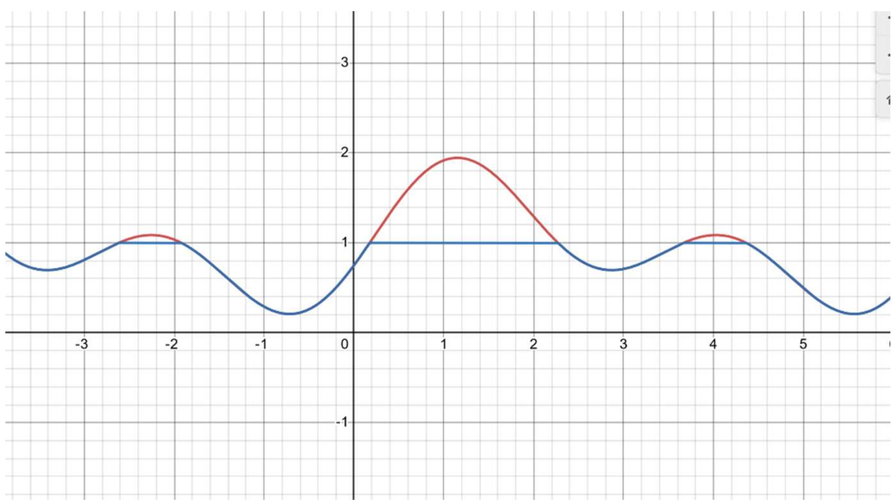

Figure 1. Graphs of the functions $(f_1 + f_2)(x)$ and $D(x)$.

Hardware Emulation

The second part of the project is to embody the math concept of derivatives in a software program, and allow the students to observe their program outcome on the hardware device with input/output interfaces on the motherboard The hardware device used to imitate the communication resource competition scenario is the Terasic DE1 System on a Chip (SoC) evaluation board embedded with Altera Cyclone V FPGA and ARM Cortex-A9 processor (Terasic 2025). Microsoft Windows XP or later with 64-bit OS and Quartus II software development environment are required to compile projects for DE1-SoC. A common programming language used to configure the FPGA to represent the logic relation between input and output interfaces is Verilog. This programmable hardware device offers a convenient and flexible means to achieve the goal of providing students with immersive experience of understanding the mathematical concept of derivatives, through interacting with the integrated interfaces on the circuit board, including switches, buttons, and LED lights. Its integrated interfaces and layout can be observed from Figure 2.

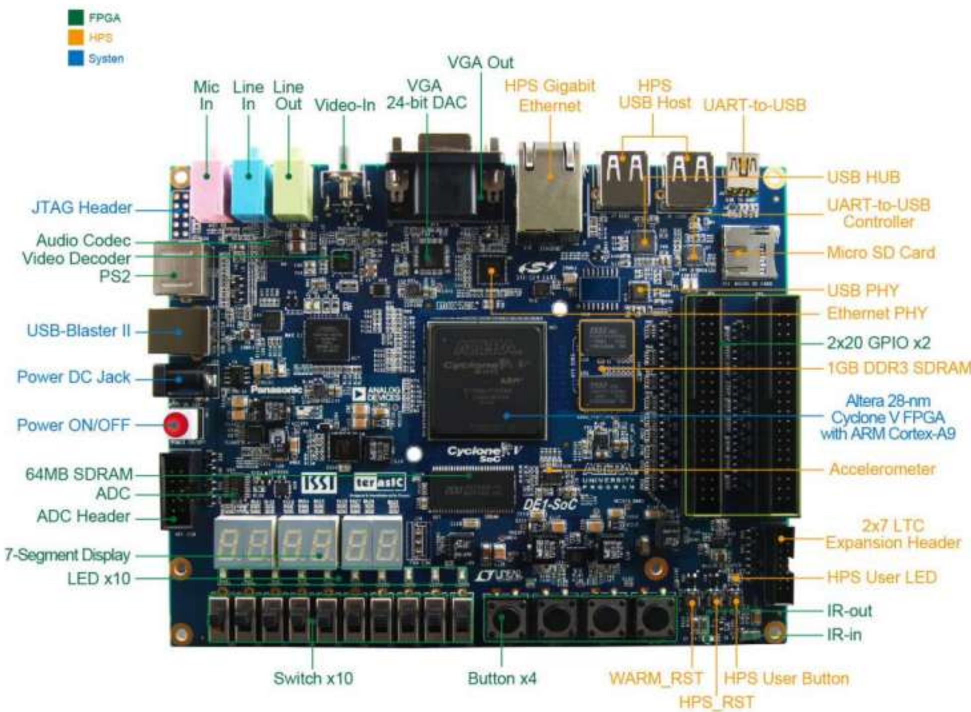

Fig. 2 Terasic DE1-SoC evaluation board.

To support program outcome observation through the form of game play, we choose two switches on the circuit board (bottom left side) as the communication channels for two competing users. The software program is designed in a way that an LED light above the switch with the higher flipping rate will turn on, and the LED light above the other switch will turn off. The flipping rate is an imitation of data rate, and the derivative of this switch flipping rate is calculated as the increased number of flipping actions at the current time unit duration (one second) from the previous one. When the program is executed on the circuit board, two students flip the switches to compete for the light and gain the impression of how the change of derivative affects the winning status.

Classroom Implementation

To implement this project in the Calculus class, we had students interact with each other during an icebreaker activity at the beginning of the semester, study the topic of derivatives in the third week, and after that conduct group work on hardware emulation and game play, followed by a survey on their project experience.

Icebreaker

The encouragement of classroom camaraderie began on the first day of the semester, when students introduce themselves. Depending on the size of the class, the activity can be performed in small groups or within the entire class. Students respond to the following questionnaire following the group conversation:

1. How shall we address you (your name or nickname)
2. Your culture and identity (how do you define yourself, where you are from, what languages you speak, what is in your mind, what are your passions)
3. Your college identity (Your major and classes you are taking this semester)
4. Your personal and/or professional goals for next week, next month, and next year.
5. What are your strengths and weaknesses:

math skills	EXCELLENT	AVERAGE	POOR
writing skills	EXCELLENT	AVERAGE	POOR
public speaking	EXCELLENT	AVERAGE	POOR
collaborative skills	EXCELLENT	AVERAGE	POOR
other skills (name them)			
	EXCELLENT	AVERAGE	POOR

6. Optional: what did you do over the weekend?
7. What similarities did you observe among the classmates?
8. Did you enjoy this activity?

After students introduced themselves, they answered questions about the similarities they found within the classroom. As time passed, a sense of community naturally emerged among them. Many came from Hispanic backgrounds, bringing a shared cultural richness to the classroom. A large portion pursued degrees in computer science, engineering, or applied mathematics, driven by a curiosity for problem-solving and innovation. Outside of the college, many students balance jobs and family duties, adding a layer of discipline and time management to their daily routines. Weekends often follow a familiar rhythm – some unwound by playing soccer, a passion that connect them beyond the classroom.

Through icebreaker activities, students uncovered surprising connections with their classmates. They discovered that someone they had just met was from the same country or that they shared multiple courses. Others realized they spoke the same language or had similar weekend routines – whether working a shift or playing a soccer game. These small but meaningful connections created a sense of belonging within the group. Friendships took root, making collaboration more natural and discussions more engaging. The classroom, once just a space for learning, transformed into a supportive environment where students not only grew academically but also built relationships that enriched their journey.

Classroom Teaching

The topic of derivatives is introduced in the third week of the semester, following the topics of limits and asymptotes. After presenting the formal definition, the math instructor explained the geometric interpretation of derivative to help students visualize the concept. This led to an in-class discussion where students explored the idea of incremental change – how a function responds to an infinitesimally small change in time. To reinforce their understanding, students were asked to share both mathematical and real-world examples that resonate with them. These included sudden changes in mood, abrupt spikes in blood pressure or other vital signs, sharp voltage shifts in a circuit, or rapid temperature fluctuations in a room.

Following this discussion, the instructor from computer engineering discipline introduced the Terasic DE1 SoC evaluation board to the class, sparking curiosity and enthusiasm. Students asked about the connection between derivatives and the programming aspects of the activity, gaining valuable interdisciplinary insight. They had the opportunity to examine the motherboard up close, and their excitement was evident, especially among the computer science students, who could barely contain their enthusiasm. After this classroom activity, students filled a presurvey designed to gauge their interest in STEM discipline (Appendix: Pre-survey on interest in math and technology).

Experiment

After the introduction on math theory and hardware information, students visited a computer lab to conduct experiment on hardware emulation. To familiarize students with hardware development, a sample Verilog program was introduced as a tutorial for students to study hardware control. Afterwards they worked in groups of two or three to modify the sample program and implement the derivative-based resource allocation algorithm described in the previous section Equation (2):

a) Look up the Terasic DE1 user manual, and find out the supported clock frequency, its signal name and pin number used in FPGA program. Also specify the signal names and pin numbers of on-board LED lights and switches.
b) Follow the video tutorial to create a HelloWorld FPGA project
   - My First FPGA Tutorial, Part 1, https://www.youtube.com/watch?v=5R5Tw_zSKZM
   - My First FPGA Tutorial, Part 2, https://www.youtube.com/watch?v=qrWP2IsD9w0
c) Modify the Verilog program in the example to detect the pulses generated by two switches and to turn on the light representing the switch with higher increase in the number of pulses detected in two consecutive seconds, using a clock of 50 MHz. Choose two LED lights on the device to represent the winning status, i.e., the light above the selected switch turns on while the other light turns off.
d) Flip the two switches to compete for the light. Observe the relation between the pattern of flipping action and the light status.

Figure 3. Activity in the lab

Figure 3 captures students in the computer lab, working collaboratively in pairs or small groups of three. The post-survey was proctored immediately after the activity to gather their reflections and insights (Appendix: Post-survey on interest in math and technology).

RESULTS

Informal Assessment

Beyond formal evaluations, the instructor's keen observations play a crucial role in assessing student engagement, not just academic understanding, but also the dynamics of involvement, interactions, collaboration, and confidence.

When the activity was introduced, students were eager to try it out. All students showed enthusiasm before and during the activity, but students majoring in computer science appeared particularly delighted while inspecting and touching the Terasic DE1-SoC evaluation board displayed to them in class. During the activity in the computer lab, students appeared peaceful and focused. While working in groups they demonstrated a spirit of teamwork, collaborating smoothly and harmoniously. These informal assessments, though unstructured, offer invaluable insights into the learning experience, painting a fuller picture of student growth beyond measurable outcomes.

Formal Assessment

The survey used the Likert scale with five levels (from left to right): agree, somehow agree, neutral, somehow disagree, disagree. It is important to recall that the Likert scales can be subject to response bias, where respondents may agree or disagree with all the statements. The scale layout can also affect response bias, with respondents tending to choose options on the left side of the scale or at the top of the scale (Likert 2025). All questions are included in the appendix.

The class consisted of 15 males and one female. The data reveals that the Asian/Pacific Islander and Hispanic groups have the highest representation, with 6 students each. All other ethnic categories have 1 student represented.

The answers to the second question summarize the distribution of students across four academic majors, indicating their respective numbers. This data highlights that the Mechanical Engineering major has the highest enrollment of 7 students, while Business Administration has the lowest, with 1 student. Five students major in Computer Science and the female student is among them. Three students major in Electrical Engineering.

Twelve students participated in the pre- and post-survey. Answers to further questions are represented in the circular diagrams to display the fractions of students who agreed (blue), somehow agreed (red), were neutral (orange), somehow disagrees (green) or disagreed (purple) with the statements.

Results in Pre-survey

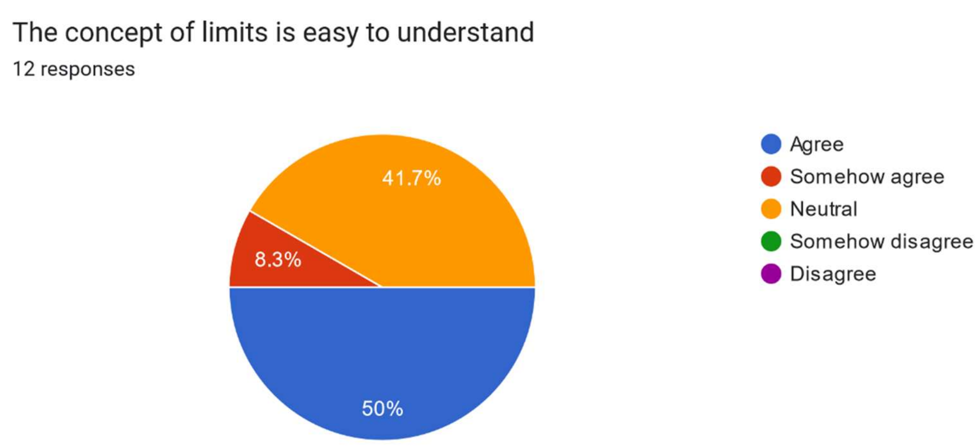

Figure 4. The concept of limits

The concept of limits, introduced at the beginning of the semester, appears to have become more accessible to students over time. Despite initial challenges, students now largely agree that limits are relatively straightforward to understand. Notably, there were no dissenting views regarding the statement that "limits are easy to understand," suggesting a consensus within the class. This likely reflects the effectiveness of teaching methods, practice opportunities, and the cumulative nature of learning foundational mathematical concepts.

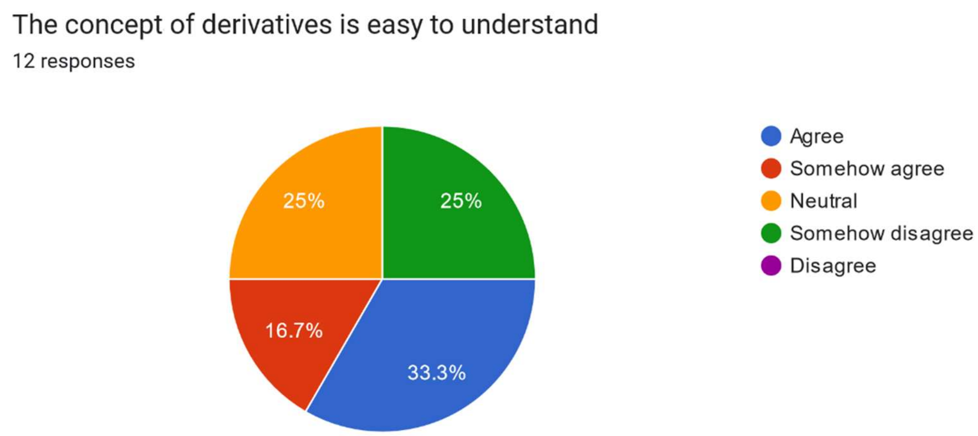

Figure 5. Concept of derivatives

In contrast, the concept of derivatives, introduced more recently, has elicited a broader range of opinions regarding its level of difficulty. Approximately 25% of students indicated that they do not find derivatives "easy to understand," yet no one expressed a strong disagreement. This variability may reflect the newness of the topic and students' differing levels of comfort and familiarity with applying derivatives in problem-solving. It is reasonable to expect that, as with limits, students' perceptions may shift toward greater ease of understanding as they gain more experience with the topic.

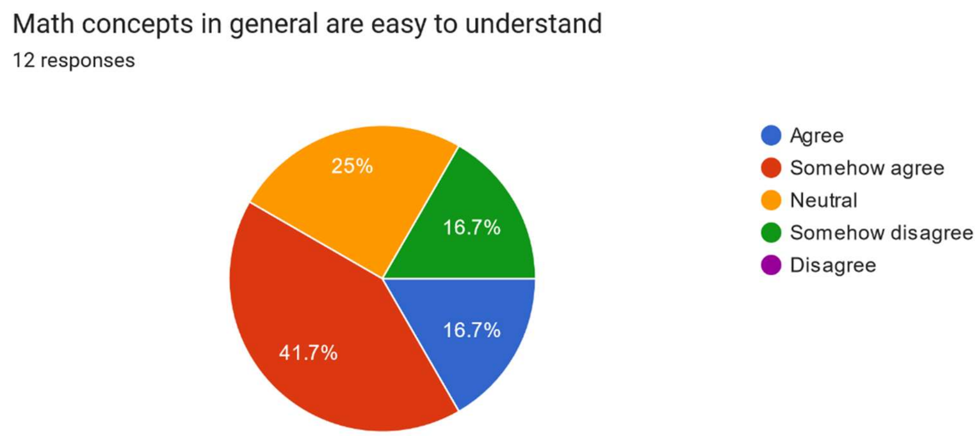

Figure 6. Math concepts in general

When considering mathematics concepts in general, the trend mirrors the discussion of derivatives, with some students expressing a moderate level of difficulty while others display more confidence. This pattern suggests that student perceptions are influenced not only by the complexity of the material but also by their familiarity with specific topics and their confidence in applying them in various contexts. As the semester progresses, these judgments may align more closely, particularly if reinforced by continued practice and targeted instructional support.

Results in Post-survey

Students' perception of the activity somehow resembles their perception of mathematical concept with one student expressing his strong opinion (disagree).

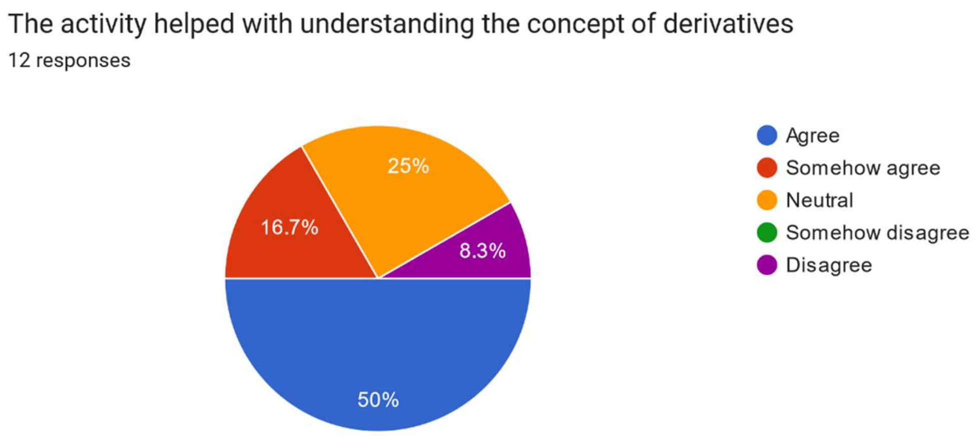

Figure 7. Effectiveness of the activity for explaining derivatives

While most students remained positive or neutral about the effectiveness of the activity, one person was in strong disagreement with that statement. He justified his statement by answering in the follow up question that he did not see any connection between math concepts.

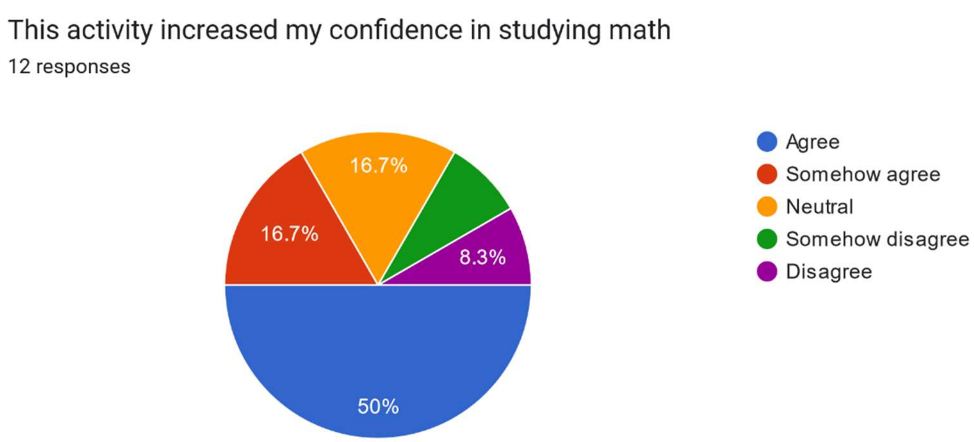

Figure 8. Self-confidence

Based on the students' responses, the activity had an uneven influence on their confidence in studying mathematics, while a vast majority of the students agreed with the statement, two students disagreed. One student justified his statement by saying "I don't understand how the activity uses derivatives" and the other "I don't see any connection between math concepts." Both students expressed their interest in "knowing how math examples are related in field of technology" and seeing "real world applications".

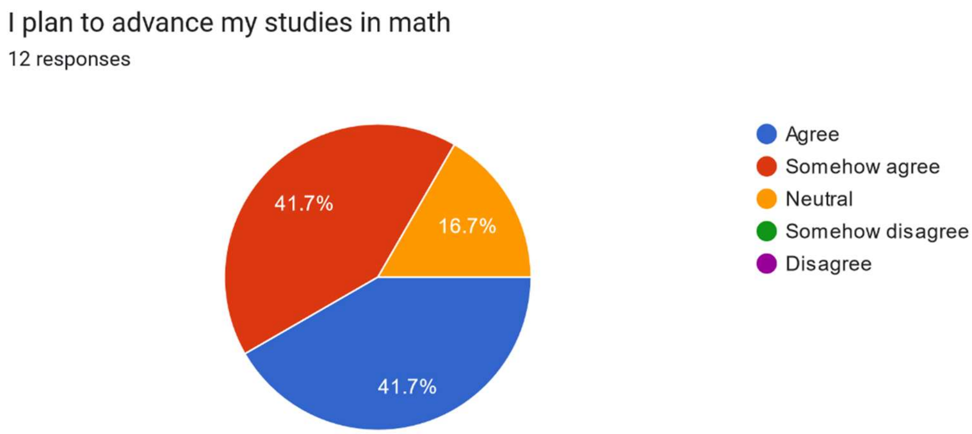

Figure 9. Interest in math

A vast majority of students are planning to advance in their studies in mathematics, regardless of their major, this is a requirement of their academic programs. However, they are interested in advancing their studies in technology as well, even if this may not be related to their major:

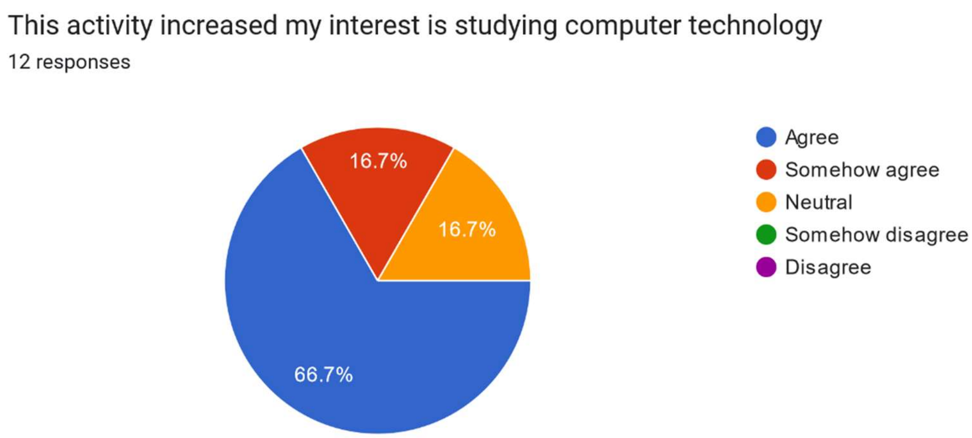

Figure 10. Interest in technology

DISCUSSION

Written Reflection

Students' long answers to the last question in the pre-survey ("Do you wish to advance your study in math and technology?") are displayed in Table 1 below. Students' responses vary in length, motivations. and reasoning.

I wish to advance my study in math.
Yes
Yes because it is required for my degree.
Even though math is challenging, technology has always been an Interest of mine so I'll do my best to advance my studies.
Yes, although my math is not very good though, I love the concept of math and enjoy it very much, which makes me wanna try my best in the class even if i struggle so much im willing to understand and pass my math classes.
Yes, I do because it is required for my field of study.
Yeah i do want to advance my study in math and technology because i think it will help with my major which is computer science.
Yes I want to make my math strong
I am not sure right now but may be in the future i will decide
Yes. As, there is a lot of scopes in this field with Elon musk surprising us with his new advanced technology I think there is a lot more possibilities in tech than the current situation .
Yes because I love the subject and want to learn more
I would want to learn more about technology and how to use it to the best of it's ability.

Table 1. Display of students' writing in the pre-survey (original spelling and grammar)

In the post-survey, a majority of the students (about 85% of those who completed the second survey) indicated that the activity helped with understanding the concepts of derivatives to some extent. Two students were neutral about it and nobody denied the statement. Students found physical interaction and gameplay more engaging and helpful than reading about the concepts. Table 2 displays students' writing (original spelling and grammar):

I liked physically interacting with the device.
Physical device is more easier or I feel more better with handling then math and examples.
I feel as if hands on and interacting with the device was more helpful since I was able to physically interact with the item and understand how it's works instead of being confused when reading a book about the device.

The activity helped students see how math is used in real-world applications. Interacting with the device made the concepts easier to understand and grasp
The activity helped students see how math is used in real-world applications. Interacting with the device made the concepts easier to understand and grasp.
Because outside of equations and number solving, you get to see how a certain concept is proved in real life.
This activity was fun and showed how math can be used in the real world.

Table 2. Display of students' writing in the post-survey (original spelling and grammar)

The activity provided visualization and contextual learning, which are often lacking in traditional reading-based approaches. At the same time students considered it to be more like a game, less like a lecture. They emphasized in the answer to the open-ended question that the gameplay aspect of the activity made learning more enjoyable and engaging compared to traditional learning. Students wrote:

> "It made it more fun and easier to understand in terms I can understand"

> "Interacting with the physical device through gameplay helps a lot in terms of understanding math concepts. It offers active engagement, visualization, motivation, contextual learning, feedback and adaptation. Reading can provide foundational knowledge and theoretical background but may lack the interactive elements that lead to a deeper understanding."

However, one student wrote

> "I don't understand how the activity uses derivatives."

Which suggests that the activity still needs some refinement. In particular in terms of logistics and scheduling. The lecture motivating the activity and introduction to the derivatives took place a few weeks before the actual lab visit, which created a certain disconnection among the topics.

The Story of the Female Student

In this class I have witnessed the very moment when the female student could fall or strive.

This student was returning to college after a five-year break and was understandably anxious about whether she could keep up in a math class. Her concerns proved valid at first. She struggled with arriving on time and maintaining focus during the two-hour sessions. However, after failing the first quiz, she began seeking advice on how to improve.

In my Calculus I course, I often discuss strategies with students for overcoming academic challenges. She listened closely, made changes, and worked diligently. She completed all the homework and quizzes, regularly sought help from tutors, and demonstrated genuine commitment.

Unfortunately, just before the final exam, she lost her job and asked to reschedule due to emotional stress. When we met to discuss math questions, it became clear to me that her focus was too scattered for her to do her best work. I shared my concern, and we mutually agreed she would take an Incomplete (INC) and defer the exam until after the winter break.

When we met again a few weeks later, she was a different person. She excitedly told me she had found a new job, which was better aligned with her major, in a healthier environment, and with a higher salary. She also shared how much she had disliked her previous job but hadn't realized how much it drained her until she lost it.

With renewed energy and focus, she took the final exam. When I calculated her scores, her course grade came out to a B. She was thrilled, since not only had she improved her job situation, but she also gained the confidence that she could succeed in college. We both knew that taking the exam earlier, under stress, would likely have resulted in a much lower grade.

CONCLUSIONS

This study highlights the effectiveness of integrating game play into an inclusive computing project in Calculus class that connects mathematical theory with real-world applications. By engaging students in designing and analyzing priority criteria in resource allocation for competing smart devices, we provided an interdisciplinary learning experience that deepened their understanding of derivatives and their applications in technology. The combination of structured classroom interventions, interactive lab activities, and hardware emulation helped foster a more inclusive learning environment, particularly for underrepresented students in STEM.

Student feedback and survey results indicate that in general the project increased engagement, confidence, and interest in both mathematics and technology. Many students found the hands-on interaction with physical devices more intuitive and engaging than traditional lecture-based approaches. The use of collaborative activities also contributed to a stronger sense of community in the classroom, further promoting inclusivity.

Despite these successes, challenges remain. The scheduling gap between introducing derivatives in lectures and the hands-on lab experience created a disconnect that affected some students' comprehension. Additionally, while most students saw clear connections between mathematics and technology, a few struggled to grasp the relevance of derivatives within the activity. Addressing these issues through improved scheduling, clearer instructional scaffolding, and additional examples of real-world applications will enhance the effectiveness of future implementations.

Overall, this study underscores the value of interdisciplinary, project-based learning in fostering both mathematical understanding and a sense of belonging in STEM education. By refining our approach and continuing to prioritize inclusivity, we can create learning environments that better support all students in their academic and professional journeys.

Students generally found that interacting with the physical device made the math concepts easier to understand, more engaging, and more relevant to real-world applications. The interactive and visual nature of the activity facilitated a deeper understanding compared to traditional reading-based or lecture-based approaches. Thus, the mathematics classroom became more inclusive by addressing students' needs and sparking their interest and involvement in the topic of derivatives.

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REFERENCES

[1] Faragher, R., Hill, J., Clarke, B. (2016). Inclusive Practices in Mathematics Education. In: Makar, K., Dole, S., Visnovska, J., Goos, M., Bennison, A., Fry, K. (eds) *Research in Mathematics Education in Australasia 2012-2015*. Springer, Singapore. https://doi.org/10.1007/978-981-10-1419-2_7.

[2] Gardesten, M., & Palmér, H. (2023). Students' participation in mathematics in inclusive classrooms: a study of the enacted mathematical and relational knowing of teachers. *Mathematical Thinking and Learning*, *27*(2), 157–177. https://doi.org/10.1080/10986065.2023.2258485.

[3] Höveler, K. (2019). Learning Environments in Inclusive Mathematics Classrooms: Design Principles, Learning Processes and Conditions of Success. In: Kollosche, D., Marcone, R., Knigge, M., Penteado, M.G., Skovsmose, O. (eds) *Inclusive Mathematics Education*. Springer, Cham. https://doi.org/10.1007/978-3-030-11518-0_8

[4] Malian, I. (2011). MVIP: Math Villages for Inclusive Practices: A Model to Engage All Students and Teachers in STEM Experiences, *Electronic Journal for Inclusive Education*. Volume 2 Number 7 (Winter/Spring 2011) Article 4.

[5] Tanenbaum, A. S., Bos, H. & Johnson, T. (ed.) (2023). *Modern Operating Systems*. Pearson. ISBN-13: 9780137618880.

[6] Terasic DE1 System on a Chip (SoC) evaluation board, online available https://www.terasic.com.tw/cgi-bin/page/archive.pl?Language=English&No=836.

[7] Likert Scales: Definition, Examples, Tips & Analysis, online available: https://www.surveymonkey.com/mp/likert-scale.

APPENDIX: PRE-SURVEY AND POST-SURVEY

Pre-survey on interest in math and technology

Name: Date:

1. Gender: Female Male Other

2. Ethnicity:
   a. American Indian or Alaskan Native
   b. Asian / Pacific Islander
   c. Black or African American
   d. Hispanic
   e. White / Caucasian
   f. Multiple ethnicity/ Other

3. Major:

4. The concept of derivatives is easy to understand
   Agree Somehow Agree Neutral Somehow disagree Disagree

5. The concept of limits is easy to understand
   Agree Somehow Agree Neutral Somehow disagree Disagree

6. Math concepts in general are easy to understand
   Agree Somehow Agree Neutral Somehow disagree Disagree

7. Do you see the necessity or applications of math in your field of study? Explain.

8. Do you use computers or technology for fun? Explain.

9. Do you know examples of math in computers or technology? Explain

10. Do you wish to further advance your study in math and technology? Explain

Post-survey on interest in math and technology

Name: Date:

1. Gender: Female Male Other

2. Ethnicity:
    a. American Indian or Alaskan Native
    b. Asian / Pacific Islander
    c. Black or African American
    d. Hispanic
    e. White / Caucasian
    f. Multiple ethnicity/ Other

3. Major:
4. The activity helped with understanding the concepts of derivatives

    Agree Somehow Agree Neutral Somehow disagree Disagree

5. This activity increased your confidence in studying math

    Agree Somehow Agree Neutral Somehow disagree Disagree

6. I plan to advance my studies in math
    Agree Somehow Agree Neutral Somehow disagree Disagree

7. This activity increased my interest is studying computer technology
    Agree Somehow Agree Neutral Somehow disagree Disagree

8. I wish for more example of using math in technology. Explain

9. How do you consider the difference between reading about these examples and interacting with the physical device through game play, in terms of helping to understand the math concept? Explain

Małgorzata Marciniak, an Associate Professor at LaGuardia Community College (CUNY), specializes in pure and applied mathematics and mathematics education. She's Managing Editor for the *Mathematics Teaching-Research Journal*, Acting Editor-in-Chief for *Asian American Voices*, and an editor for *Ad Astra*. In 2024, she co-edited *Ongoing Advancements in Philosophy of Mathematics Education*, and in 2025, published *Creativity in STEM Fields: a View from and Eclectic Mind*. Dr. Marciniak is fascinated by creativity theories and the omnipresence of mathematics.

Yun Ye joined LaGuardia in 2014 as a faculty member at the Department of Mathematics, Engineering and Computer Science. She is an IEEE senior member, and member of National Center for Women & Information Technology. She has designed course assignments and student projects to promote computational thinking across disciplines, with supports from Tech Scholars, Research in the Classroom, WiTNY, QSTEM, CRSP, CiPASS, CUNY 2X Tech Academy and CRSP-HRPT Alliance Scholars Program.