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# Enhancing Classroom Engagement: Investigating Student Motivation towards Learning Physics

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**ABSTRACT**

**Purpose of the study:** The aim of this study is to identify effective intervention activities in the physics classroom that enhance student engagement and sustain attention toward learning physics by evaluating the impact of diverse strategies on student motivation.

**Methodology:** The study used Vevox (an engagement platform), group work, physics simulations, and educational videos. Data were collected through pre- and post-intervention surveys, student rankings, and performance evaluations, and analyzed using statistical software for quantitative insights.

**Main Findings:** Group work and physics simulations were found to be the most effective strategies for boosting student engagement and motivation. Students reported increased interest, enjoyment, and improved focus during physics lessons as a result of the interventions.

**Novelty/Originality of this study:** This study offers a novel approach by integrating diverse, data-driven intervention strategies to improve student motivation in physics classrooms, providing actionable insights for educators to create more engaging and effective learning environments.



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## 1. INTRODUCTION

Motivation is recognized as the ultimate driving force when it comes to goal attainment and personal development [1]. Without motivation, individuals may lack the drive to pursue their aspirations and ambitions, which can lead to a sense of stagnation and unfulfillment. The ability to set and achieve goals is a key aspect of human nature [2], [3]. Additionally, motivation is a crucial component of physical and mental well-being. Engaging in activities that one is driven to do can have a positive impact on both. It can also lead to the formation of social connections and relationships. Humans are social creatures and tend to gravitate toward others with similar interests and goals; therefore, a sense of purpose and connection to others can lead to a sense of happiness and fulfillment [2], [3].

Student motivation to learn is an important factor that can influence student success and retention at university. Research has shown that students who are more ambitious to learn tend to have better academic outcomes, such as higher grades and a greater likelihood of graduating. Additionally, student motivation can also have an impact on students' well-being, as more determined students tend to report higher levels of satisfaction and engagement with their studies. The transition into university can be a challenging time for many students, and research has shown that this period can have a significant impact on students' focus and academic outcomes [1],

[4]. Factors such as adjusting to a new academic environmen, feeling a sense of belonging, and developing a sense of purpose can all contribute to students' drive during this period.

Motivation to learn can be categorized into several types. The 'intrinsic' kind is driven by a desire to learn for the sake of learning and is often seen as the most powerful form of determination, as it comes from within the student. On the other hand, the 'extrinsic' sort is driven by external factors such as grades, rewards, or the desire to please parents or teachers [5]-[7]. Motivation by 'affiliation' is propelled by a desire to connect with others and be a part of a group, while its 'power' counterpart is fueled by a desire for control or influence over others. Lastly, 'self-determination' is the drive to direct one's own life and make choices based on own goals, values, and interests. It is important to note that different students can be driven by different factors at different times and that multiple types of motivations can coexist in an individual student. Furthermore, different learning contexts or tasks may tap into different types of ambitions [1], [4], [7], [8], [9], [10], [11] .

There are several reasons why motivation is important in a physics class. Primarily, curiosity is a key factor in student success, as it determines a student's desire to learn and their willingness to put in the effort required to achieve academic goals. Students who are motivated to learn are more likely to participate in class, complete assignments, and perform well on exams. Many factors can influence student motivation, including personal interests and values, the relevance of the material to the student's life, supportive and engaging learning environments. Educators need to understand and foster students' motivation to help them succeed in school and beyond [1], [12].

Educators can identify students' levels of engagement and understanding by utilizing different methodologies, such as classroom observations. In these sessions, the focus is on monitoring behavior and participation in class discussions and activities; however, this approach might not be as effective at college level due to class size, different students' backgrounds, and the fear of saying something wrong [4], [7], [12], [13], [14] . Another effective strategy is to employ surveys and questionnaires to elicit students' interests, goals, and course expectations, and feelings about the subject. This can be done at a different time during the semester to monitor any change in sentiments towards physics. A third viable method is the use of one-on-one conversations. This is an opportunity for instructors to familiarize themselves first hand on what drives and inspires their students. This method might require time to build trust between the instructor and students. The fourth method is the evaluation of student work and performance; students who are motivated to learn are likely to produce higher-quality work and put in more effort [2], [3], [15], [16].

This study investigated the efficacy of various intervention strategies implemented within a comprehensive semester-long educational program. The interventions included using an audience engagement platform (Vevox), physics educational videos, group work activities, and the utilization of physics simulations. The purpose of these interventions was to assess their impact on enhancing students' motivation and enjoyment in physics classes, thereby aiding the physics educator in their teaching endeavors [17], [18]. This study stands out by integrating diverse intervention strategies—such as Vevox for audience engagement, educational videos, group work, and physics simulations—into a single, semester-long program, providing a comprehensive and data-driven approach to understanding their combined impact on student motivation and enjoyment in physics classes, an area that has been sparsely explored in previous research. The advantage of using this methodology is that it allows for the gathering of quantitative data, which can include Likert scale responses or multiple-choice questions that can be easily analyzed using statistical software[11], [13].

## 2. RESEARCH METHOD

This study employed a quasi-experimental research design to evaluate the impact of various intervention strategies on student motivation and academic engagement in physics courses. The interventions were implemented during a semester-long educational program, allowing for the comparison of student engagement levels before and after the interventions. Quantitative methods were used to gather data through surveys, activity rankings, and classroom assessments, while qualitative insights were obtained through participant feedback and observations.

This study was conducted over the 2023–2024 academic year at HCT and KU in Abu Dhabi, UAE, involving 103 first-year university students. Ethical approval was obtained, and participants signed consent forms outlining the study's purpose. Students completed a pre-intervention survey to assess baseline motivation and engagement. Four interventions—Vevox (interactive platform), group work, educational videos, and physics simulations—were implemented during the semester to foster engagement and enhance understanding of physics concepts. After each activity, students completed surveys to rank its effectiveness. A final post-intervention survey measured changes in motivation, engagement, and academic performance, with data analyzed quantitatively and qualitatively.

### 2.1 Participants

This study was conducted at the Higher Colleges of Technology (HCT) and Khalifa University (KU) in Abu Dhabi, United Arab Emirates, during the academic year 2023 and 2024. There were 103 participants in the study, drawn from comparable courses: HCT's Physics I (50 students), and KU's Prep Program Science, Technology, Engineering, and Mathematics STEM/Physics (53 students). All the students had recently graduated from high school and had no experience whatsoever of university-level instruction or courses.

### 2.2 Ethical Approval

All participants signed the research consent form used at HCT and KU, with information about the purpose of the study and the intention of using the data in a publication. This study went through all the principles outlined in both institutions ethical policies and received approval from the respective ethics committee.

### 2.3 Activities

In this study, the authors implemented different activities (listed below) during the semester in the classroom. All activities have one common element which is changing the class environment compared to the traditional teaching method to investigate the engagement of the students with the subject of physics, and determining how it improves their course achievements.

Vevox is an educational platform used for real-time engagement, on which the instructors can generate different types of interactive activities such as Q&A sessions, multiple-choice or open-ended questions, and surveys. The results can be displayed instantly and employed to generate interactive discussions. The participants can also connect with the live polls by using any smart device (smartphones, laptops, tablets) they have, which makes this platform a useful tool in modern hybrid classrooms[19], [20].

Group work The participants, who share similar attributes such as age, background, and experiences, were purposefully divided into smaller groups to foster meaningful discussions surrounding a set of problems relevant to the subject matter. The intention was to harness the collective wisdom and diverse perspectives of the students to collaboratively address these challenges. Within their respective groups, students were encouraged to openly share their thoughts, insights, and knowledge, working together to devise effective solutions [21], [22].

To facilitate a comprehensive understanding of the topic and encourage active engagement, each group was tasked with nominating a representative who would articulate their group's answer to a specific question before the entire class. This approach allowed for the exchange of ideas, insights, and solutions among the various groups, promoting a dynamic and interactive learning environment [3], [22].

Educational physics video, these instructive videos are crafted by a physicist with extensive teaching experience in the field. Leveraging their expertise and pedagogical insights, the physicist ensured that the videos were meticulously designed to address common challenges faced by learners and provide clear explanations that fostered comprehension [17], [23], [24]. Students were given several questions related to the recorded material and asked to solve these problems using the video's guidance.

Physics simulation In this activity, online computer-based simulations, aligning with the curriculum objectives, were used to enhance the teaching, and learning of the principles and concepts of the subject. Having the simulation benefitted students in their efforts to test, visualize, and explore the various physics phenomena related to the subject. In many cases, the simulation gave students the opportunity to create different scenarios by manipulating the variables and the parameters to enhance their understanding of the subject [18], [21]. In this activity, students were asked to do some calculations to match/confirm or predict the simulation results. At the end of each activity, the participants were asked to rank the activity (see Appendix 1) by answering a few questions related to the intervention activity.

## 3. RESULTS AND DISCUSSION

The feedback from HCT and KU students demonstrates a strong consensus on the enjoyment and engagement facilitated by the Vevox platform and collaborative activities. Despite mixed reactions to educational physics videos, where some students expressed a preference for face-to-face guidance, the simulations were generally well-received, albeit challenging due to their learning curve. Overall, these tools were effective in enhancing student learning and engagement.

### 3.1. Vevox

As evidenced by Figure 1 and Figure 2, there was notable agreement between HCT and KU students regarding the evaluation of Vevox. The majority of students 'strongly agreed' that they enjoyed using the platform and that they felt engaged, challenged, and motivated.

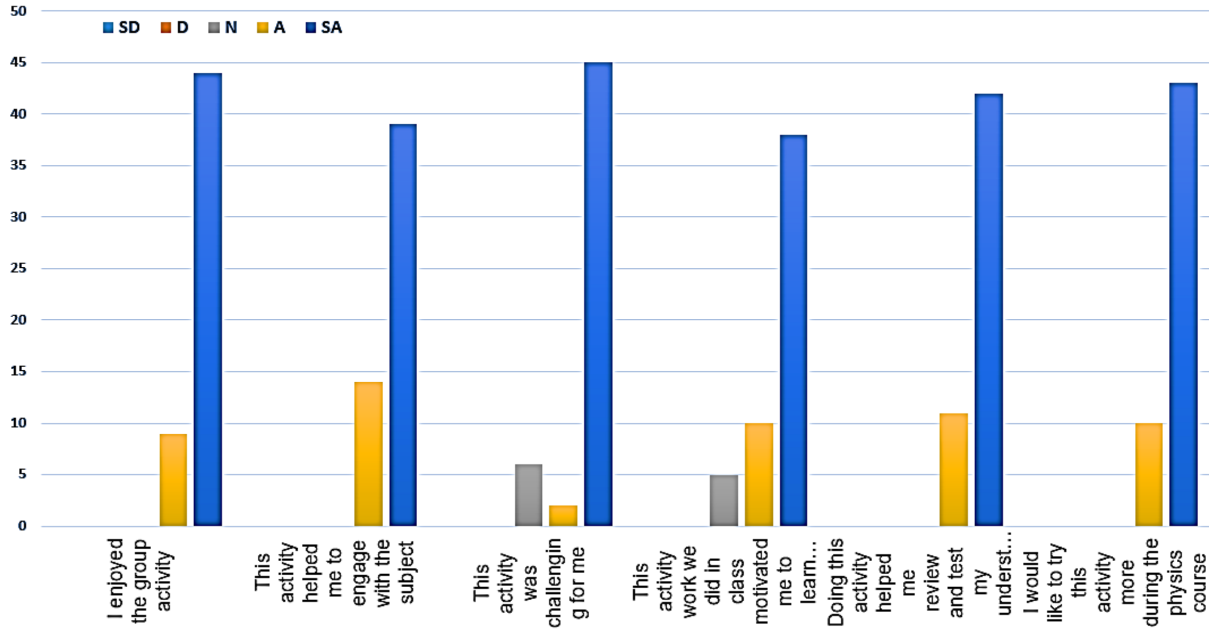


Figure 1. KU Student Feedback on Vevox

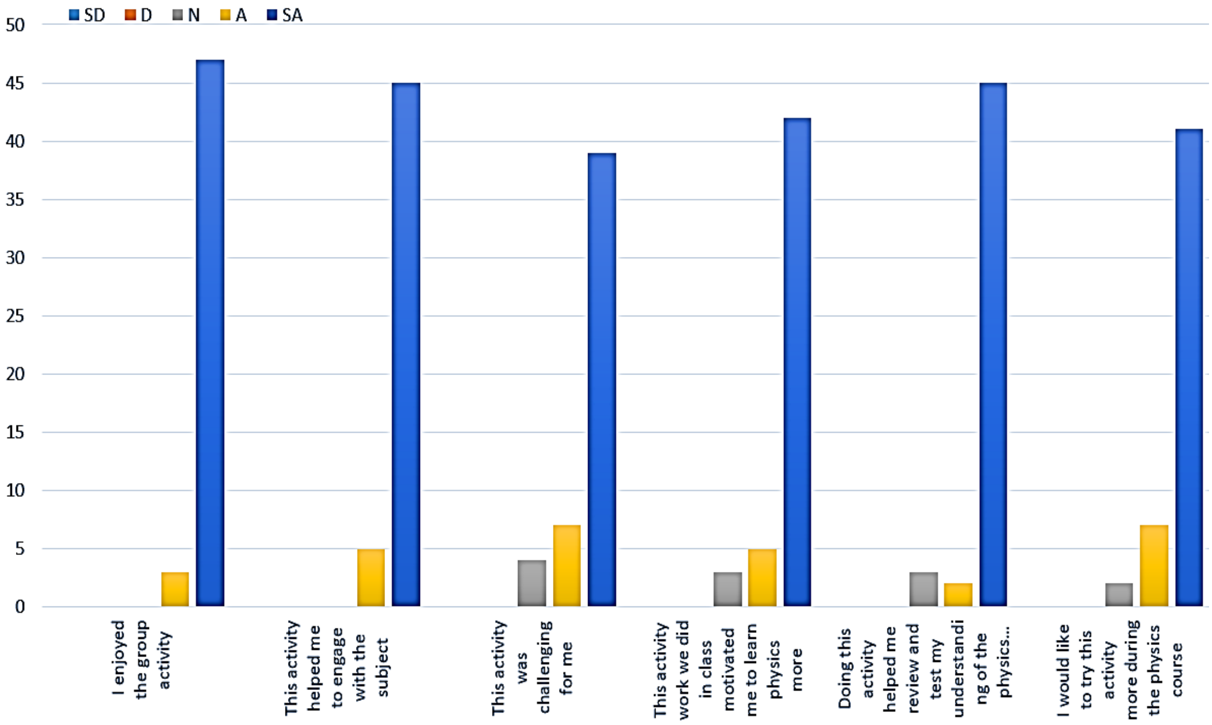


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Figure 2. HCT Student Feedback on Vevox

### 3.2. Group Work

The survey data feedback shown in Figures 3 and 4 appears to indicate that students enjoyed working collaboratively. They felt engaged by the experience and believed it facilitated both reviewing and testing physics knowledge.

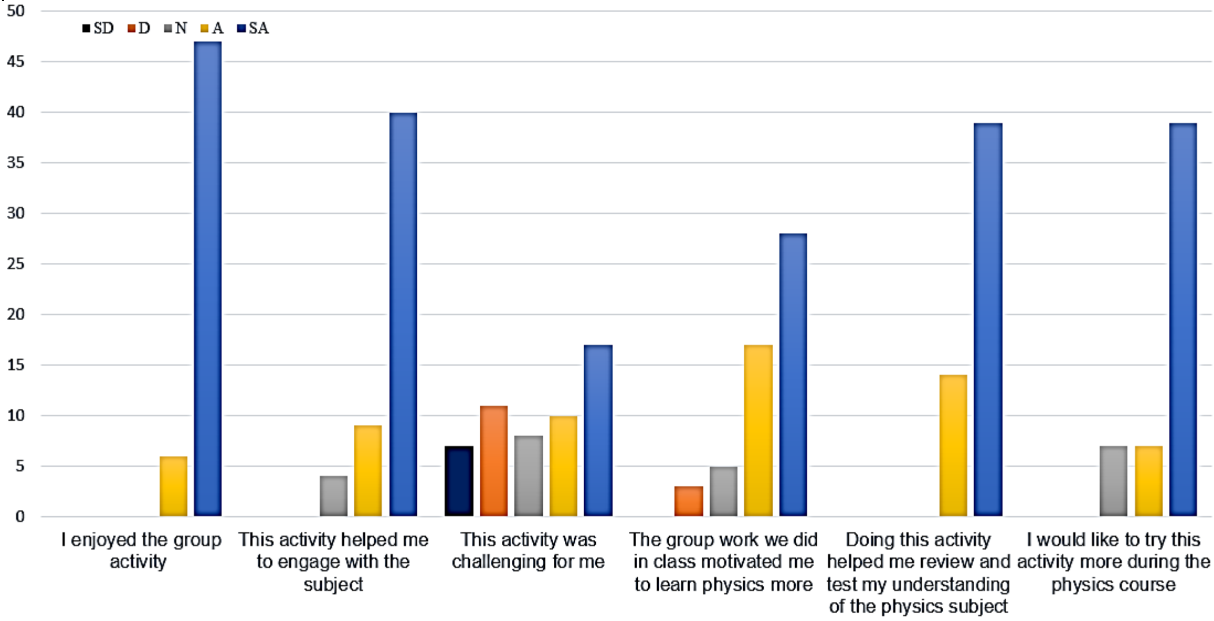


Figure 3. KU Student Feedback on Peer Work

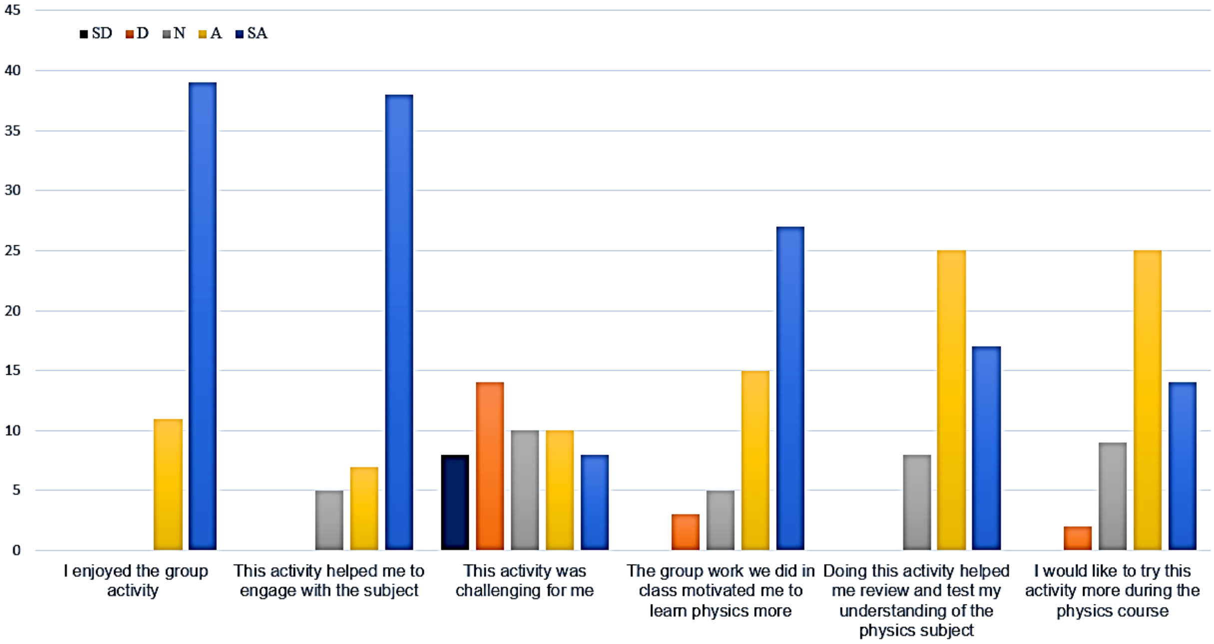


Figure 4. HCT Student Feedback on Peer Work

### 3.3. Educational Physics Videos

In Figure 5 and Figure 6, students exhibited a range of opinions regarding the use of educational physics videos. While some enjoyed this use of media, others did not find it challenging. This could be related to the skills they have in accessing and learning from videos on social media. However, there were a few students who voted for 'disagree' and 'strongly disagree' for reviewing and understanding the subject. This could be based on their perceived need for face-to-face guidance in solving problems. Notably, this was not the case in the previous two activities.

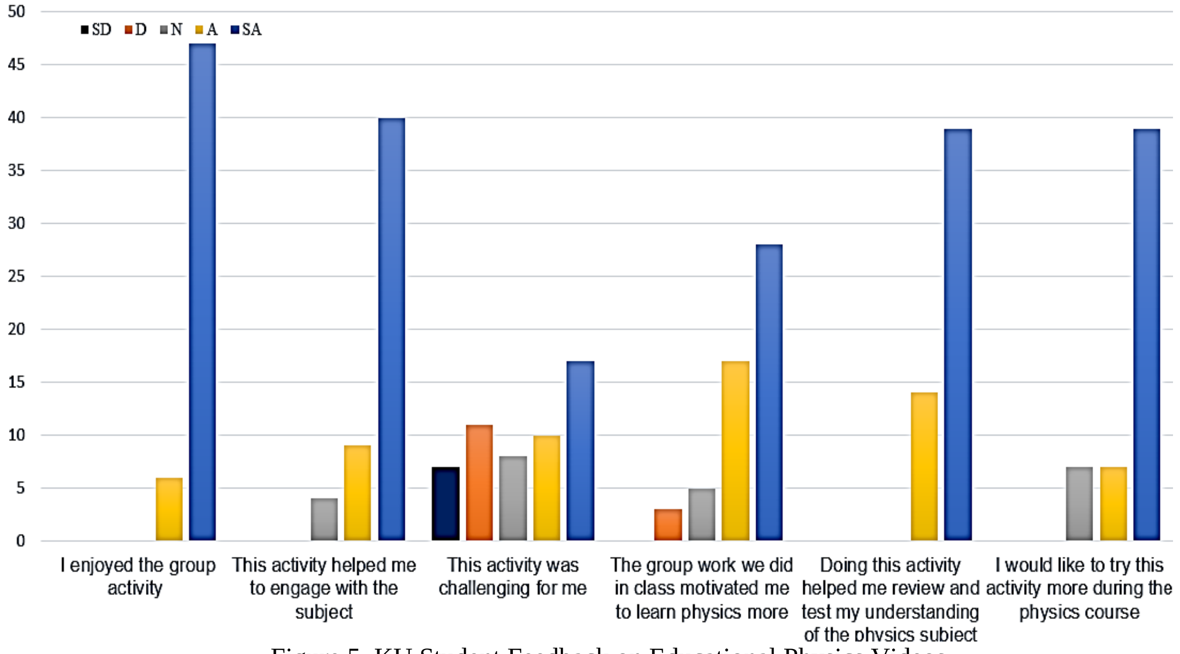


Figure 5. KU Student Feedback on Educational Physics Videos

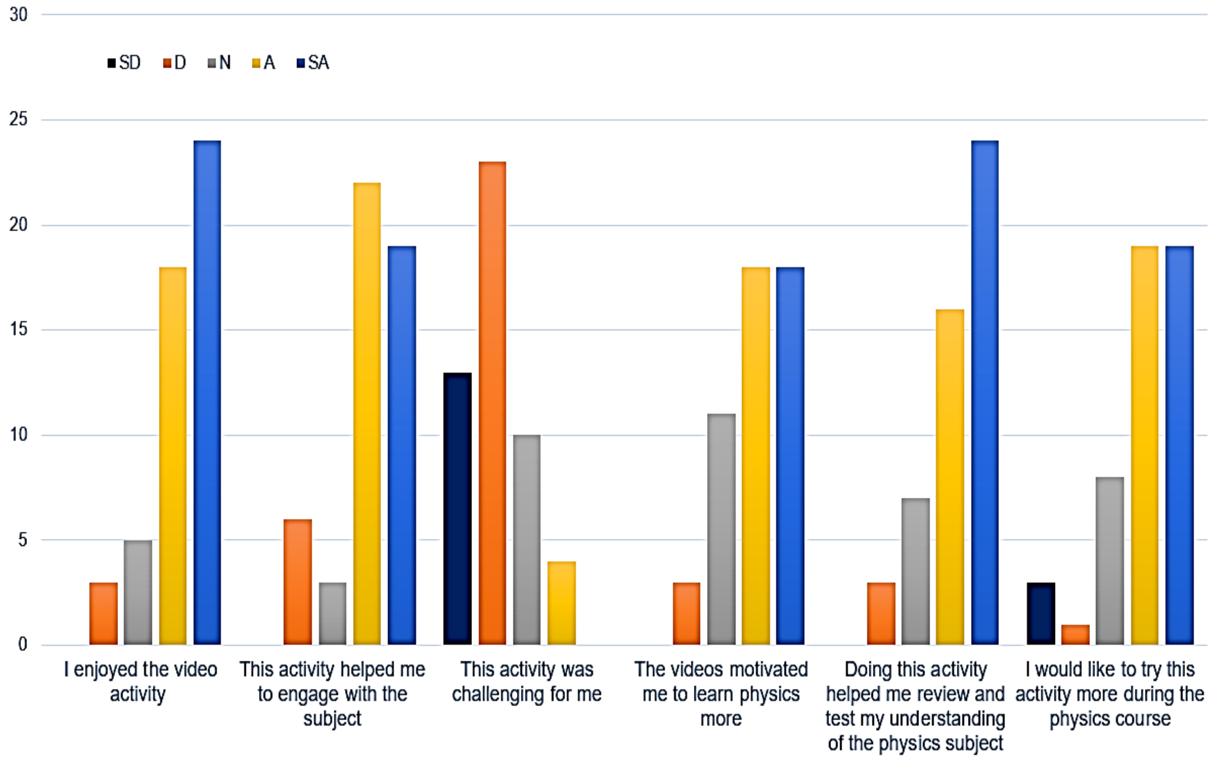


Figure 6. HCT Student Feedback on Educational Physics Videos

### 3.4. Physics Simulation

Students found the simulation activity engaging, enjoyable, and useful, as evidenced in Figure 7 and 8. They felt the activity facilitated their learning, which could be due to the in-built freedom to change the parameters of the question (scenarios) and receive instant results. The facility of changing the parameters of the question is one of advantages the simulation has. However, almost 50% of the students found it challenging because of the need for more time to learn how to use the simulator or the anxiety of being not sure how to manipulate the simulator parameters.

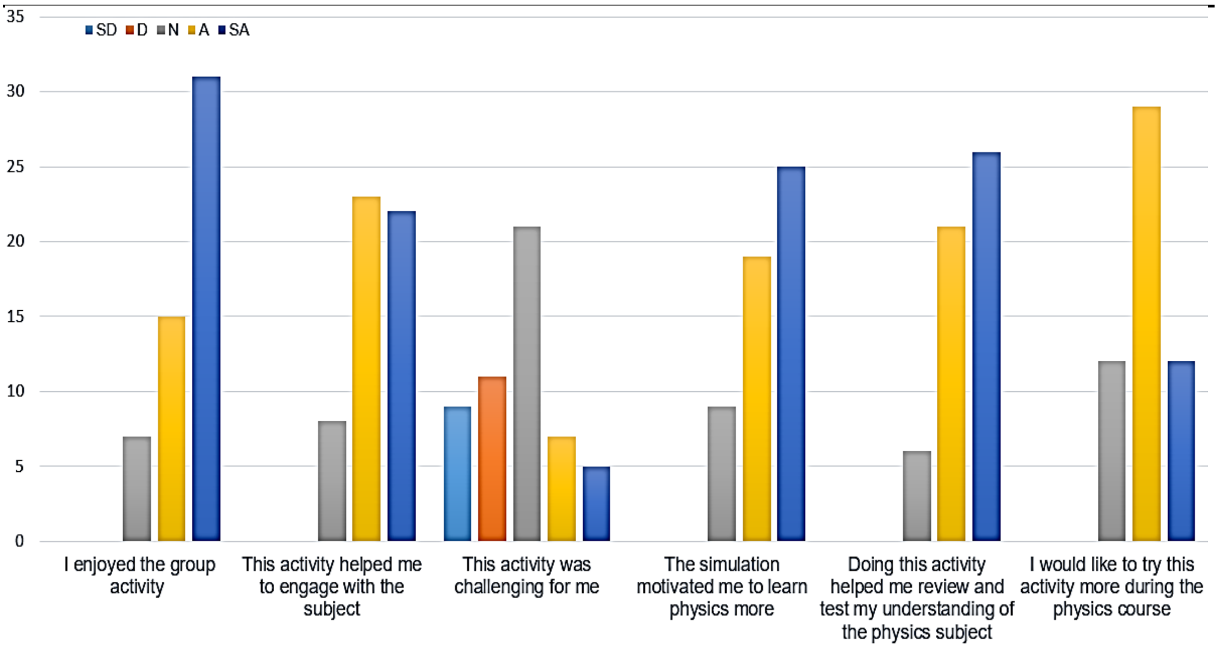


Figure 7. KU Student Feedback on Physics Simulation

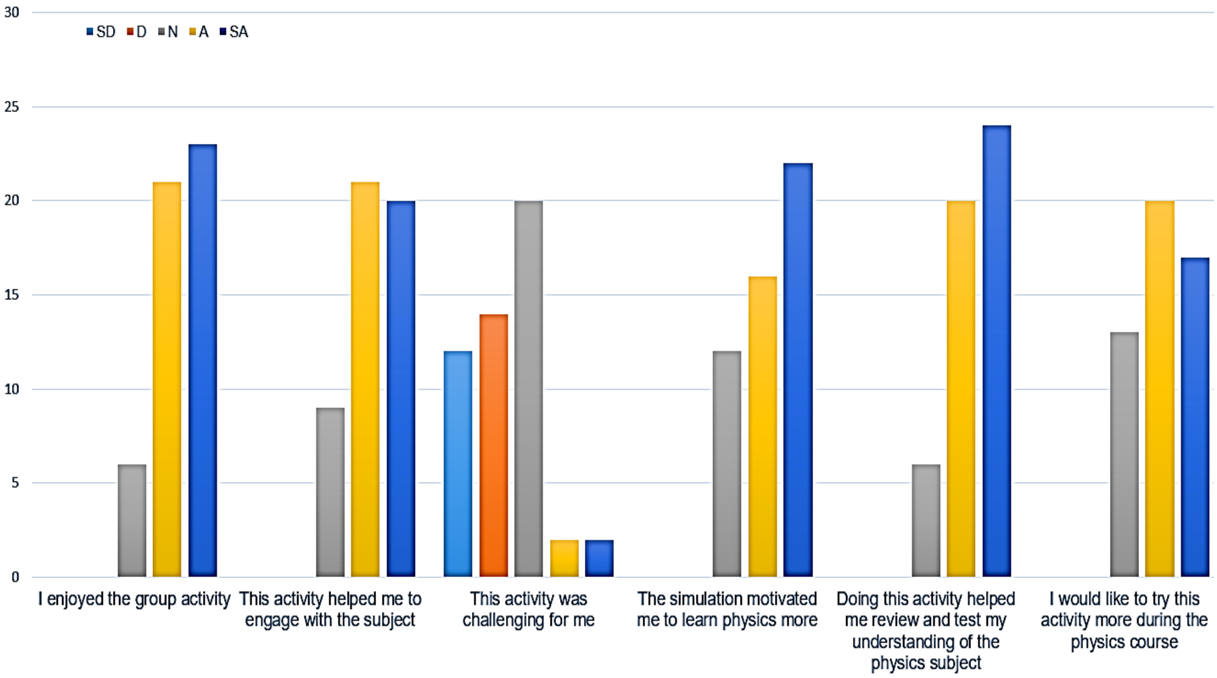


Figure 8. HCT Student Feedback on Physics Simulation

Engaging and interactive teaching methods, such as hands-on activities, simulations, educational videos, group work, can help students stay interested and motivated in any discipline [2], [14]. These methods help to make the material more concrete, understandable, and can also break up the monotony of traditional lectures. Hands-on activities and simulations allow students to apply the concepts they are learning in a more tangible way and can foster a sense of curiosity and engagement [3], [10], [16]. Educational videos and animations can also be effective in illustrating complex concepts, while group work and discussions tend to encourage a sense of collaboration and community in the classroom [17], [24], [25]. Furthermore, teachers can create opportunities for students to actively participate in the class, for example through interactive/formative quizzes or class debates [1], [11], [13]. All these methods typically make the class more dynamic, which maintains student engagement and motivation in their learning.

Using Vevox in the physics classroom is clearly one of the favorite intervention tools, according to the survey data. It offers quizzes, and generates discussions by creating an engaging environment where students have the chance to express their opinions and collaborate with their peers. By using this platform, every student has the facility to contribute and thus have their voice heard, which enhances inclusivity and engagement [19], [26]. Students can instantly gauge their comprehension of the material through the platform's real-time feedback and assessment features. The live polling feature, for instance, allows the instructor to pose questions related to the topic at hand and obtain immediate responses from the entire class. This provides valuable feedback to the instructor and enables students to assess their understanding and identify areas that require further clarification [26]. Consequently, students are empowered to actively address their knowledge gaps and enhance their understanding of physics concepts.

Students have expressed strong satisfaction in having their peers' work as one of the interventions in the classroom. By engaging in collaborative activities with their peers, students have found that they can grasp challenging concepts more effectively. Peer work allows them to benefit from diverse perspectives, exchange ideas, and clarify misunderstandings, ultimately leading to a deeper comprehension of physics principles [21], [22]. The other impact on student motivation through this activity is to ignite a sense of enthusiasm and curiosity among students. Students feel the responsibility towards their classmates and feel ownership for their learning. It is important to note that student motivation naturally fluctuates during semesters; therefore, ongoing monitoring, updating, adapting, and coaching are needed throughout the learning journey [2], [9], [13], [14], [15].

The novelty of this study lies in the integrated approach that combines various intervention strategies, such as the use of the Vevox interactive platform, group work, physics simulations, and physics educational videos, which are systematically implemented in one semester-long learning program. This approach provides a more comprehensive view than previous studies, by assessing the effectiveness of a combination of strategies in increasing student motivation and engagement in physics classes. The results provide strong empirical evidence to support the importance of diverse, technology-based, and collaborative teaching methods in creating a more dynamic and effective learning experience.

In the short term, these findings can be used by educators to immediately adopt innovative teaching tools and methods, such as Vevox and physics simulations, to increase student engagement during learning. This can directly improve student learning outcomes, especially in understanding complex physics concepts. In the long term, this study has the potential to influence the design of more inclusive and technology-based curricula in various educational institutions [27]-[29]. Sustained implementation of these strategies can contribute to improving the quality of physics education globally, encouraging innovation in cross-disciplinary teaching, and producing graduates who are better prepared for academic and professional challenges [30]-[32].

This study has several limitations, including the limited population coverage of first-year students from two institutions in the UAE, which may not be generalizable to other cultural or educational contexts. In addition, the study duration of only one semester may not be sufficient to evaluate the long-term impact of the intervention. Another limitation is the reliance on quantitative data through surveys, which may not fully capture the emotional and qualitative dimensions of students' learning experiences. Future research is recommended to expand the participant pool, extend the study period, and use mixed methods to gain deeper insights.

## 4. CONCLUSION

Motivation plays a fundamental role in the successful learning experience, by prompting individuals to seek out new experiences and challenges, and promoting personal growth and development, and thus providing a sense of direction, and purpose. Without it, we would lack the impetus to improve ourselves and the world around us. Early identification of students at risk during the transition to university is critical for enhancing their academic success and well-being. This can be achieved by implementing tools such as surveys, interviews, and focus groups to assess students' motivation, expectations, and adjustment to university life. Additionally, targeted classroom interventions—such as audience engagement platforms, collaborative activities, educational videos, and physics simulations—can enhance students' motivation and learning outcomes. Future applications of these findings could include integrating similar intervention strategies into other disciplines or tailoring these activities to diverse cultural and institutional contexts to explore their broader impact. Moreover, longitudinal studies could examine how sustained motivational support influences students' academic achievements and career readiness over time. These strategies can empower educators to design more inclusive, engaging, and effective learning environments, not only in physics education but across various fields of study.

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