Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025
ASEE
Paper ID #47854

Snackable Study: Boosting Micro-learning with Bite-Size Videos

Sri Krishna Chaitanya Velamakanni, Pennsylvania State University

Sri Krishna Chaitanya is a Software Engineer at Walmart, where he focuses on enterprise backend payment applications. He holds a Master's degree in Computer Science from The Pennsylvania State University. His research interests lie at the intersection of Natural Language Processing (NLP), financial technology (fintech), and the applications of Large Language Models (LLMs).

Suman Saha, Pennsylvania State University

Suman Saha received a Ph.D. degree in computer science from Pierre and Marie Curie University, Paris, France, in 2013.

He is an Assistant Teaching Professor at Pennsylvania State University, University Park, PA, USA. Since 2016, he has been involved in academia. Before his current role with Pennsylvania State University, he taught at Illinois Institute of Technology, Chicago, IL, USA, and Illinois State University, Normal, IL, USA.

Dr. Saha received the distinguished William C. Carter Award for his substantial contributions to dependable and secure computing during his doctoral studies. He has held positions at several prestigious National and International Research Labs, including Microsoft, Cambridge, U.K., Harvard University, Cambridge, USA, and the National Institute for Research in Digital Science and Technology (Inria), Paris, France.

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Abstract

Post-COVID, university class attendance has dropped to historic lows, with similar patterns seen in certain classes, where only 40% of students attend by the first month of the semester. Despite efforts to improve attendance, many students rely on recorded lectures and notes, often avoiding the lengthy 50 to 75-minute videos. As a result, students frequently seek help during office hours for concepts already covered in these lectures, increasing the pressure on instructors and negatively impacting student performance.

Research shows that students prefer shorter video formats, like those popularized by YouTube and TikTok, which improve memory retention and learning outcomes. Videos under five minutes engage students more effectively by delivering concise, targeted content, helping them retain knowledge and focus on task-relevant activities.

We propose an AI-driven solution that automatically extracts video segments from recorded lectures based on student queries to address the time-consuming nature of creating these short videos. The system uses advanced natural language processing and context-aware retrieval to match student questions with relevant lecture content, extracting personalized, bite-sized video clips. This creates a scalable, personalized learning environment that enhances student engagement and alleviates pressure on educators, paving the way for a more efficient teaching method across other courses.

Introduction

The rapid shift to online and hybrid learning models, accelerated by the COVID-19 pandemic, has significantly altered student engagement patterns in higher education. Traditional classroom attendance has declined as students increasingly rely on recorded lectures, digital forums, and supplemental online resources to engage with course content [17]. While recorded lectures provide flexibility, students often face challenges navigating lengthy videos. Research highlights that students frequently lose interest in lengthy recorded lectures, typically lasting 50 to 75 minutes, as extended video durations significantly increase dropout rates [21]. Conventional educational resources often do not align with the unique requirements of online learners. Additionally, studies emphasize the importance of providing students with content that can be accessed in a non-linear, step-by-step manner, eliminating the need for manual searches to locate specific information [21],[22],[23]. These challenges highlight the need for innovative educational strategies that offer efficient, targeted access to learning materials.

One promising approach to addressing these challenges is microlearning, an innovative pedagogy involving the delivery of content in small, well-planned learning units and short-term learning activities. Microlearning aligns with cognitive learning theories, suggesting that shorter, focused content enhances memory retention and helps maintain attention on specific learning tasks [20]. A systematic review and meta-analysis [11] demonstrated that microlearning significantly improves academic performance in higher education compared to traditional macro-learning approaches [1]. The study attributes this improvement to reduced cognitive load, flexible learning environments, promotion of ‘self-directed learning, and timely feedback.

The widespread popularity of platforms such as YouTube and TikTok underscores the effectiveness of delivering bite-sized content, reflecting a growing preference for concise and accessible information dissemination. TikTok, in particular, has been studied within the framework of *Technology Acceptance Theory*, demonstrating that short, engaging videos can enhance learning experiences and outcomes [2]. These insights highlight the potential of integrating microlearning strategies into higher education to bridge the divide between formal and informal learning while addressing the shifting preferences of contemporary students.

Advancements in Artificial Intelligence (AI), especially in Generative AI and Large Language Models (LLMs), have opened new avenues for implementing microlearning in educational contexts [14]. AI-driven tools can personalize and adapt learning experiences, fostering more autonomous, collaborative, and interactive learning environments. For instance, LLMs like GPT-4 have been instrumental in generating diverse and context-relevant content, which can be tailored to individual learner needs [25]. The integration of generative AI in microlearning settings enhances micro-content creation, optimizes learner engagement, and improves learning outcomes by providing personalized, adaptive learning experiences.

Building upon these trends, this study proposes a novel solution that leverages AI-driven techniques to enhance student learning through personalized, bite-sized video content. By utilizing LLMs and Natural Language Processing (NLP), our tool automatically extracts relevant segments from recorded lectures in response to student queries. Unlike conventional video segmentation methods requiring manual editing and timestamping, this AI-based approach offers dynamic, query-driven video retrieval. The primary objective of this research is to address students’ specific queries by providing precise and easily digestible video clips. This approach is designed to facilitate a more interactive and customized learning experience, seamlessly integrating into students’ study routines and enhancing their overall engagement with the material.

To systematically investigate the impact of an AI-driven microlearning approach, this study addresses the following research questions:

- **RQ1:** How do students perceive the effectiveness of bite-sized videos compared to traditional lengthy videos?
- **RQ2:** How can AI-driven solutions be integrated into the classroom to deliver personalized bite-sized videos?

The remainder of this paper is structured as follows: we first discuss the challenges of lengthy recorded videos and explore answers to RQ1. We then propose and design a practical solution to address RQ2, review related work, and provide an in-depth discussion of the implications of our findings. Finally, we conclude the study by summarizing key insights and recommendations for future research.

Challenges in Student Engagement

Students often show disinterest in watching longer lecture videos [21]. However, research consistently shows active participation correlates with improved comprehension and performance [24]. To further investigate this, we studied a class of approximately 381 students at Pennsylvania State University, USA. Our findings align with existing research, revealing that students show limited interest in engaging with traditional recorded lectures of around 50 minutes when learning new topics.

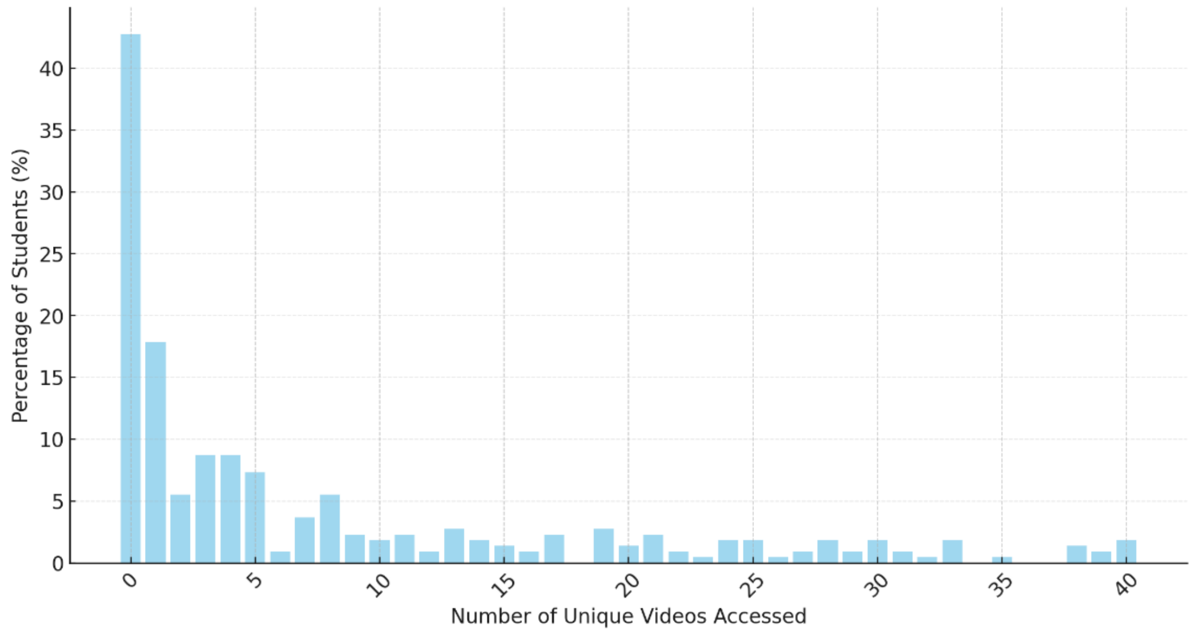

Figure 1: Percentage of Students accessed the number of videos

Figure 1 illustrates the distribution of unique 50-minute recorded lecture videos accessed by students in the class. Remarkably, over 40% of students did not access any videos during the course, while only 2% viewed all 40 videos, highlighting minimal engagement with the complete set of recorded content. This trend underscores the challenges of maintaining student engagement with lengthy recorded lectures and suggests a preference for more concise or alternative learning formats. Figure 2 illustrates the distribution of average video completion rates among students who accessed at least one video. Approximately 35% of students completed only 0-20% of the videos they accessed, while over 30% fell within the 21-40% completion range, reflecting partial engagement. Fewer than 5% of students completed 81-100% of the videos. This trend highlights a lack of sustained engagement with lengthy video content, suggesting a need for more engaging and efficient learning strategies.

Figure 3 depicts the count of video plays, total time spent (in minutes), and the number of unique users accessing videos over time. Three prominent spikes are observed, corresponding to periods leading up to Midterm 1, Midterm 2, and the Final Exam. These spikes indicate that students significantly increased their video usage when exams were approaching, reflecting a pattern of concentrated engagement during high-stakes assessment periods. Outside these peaks, video engagement remained relatively low, highlighting a tendency for students to prioritize video resources primarily for exam preparation rather than consistent learning throughout the semester.

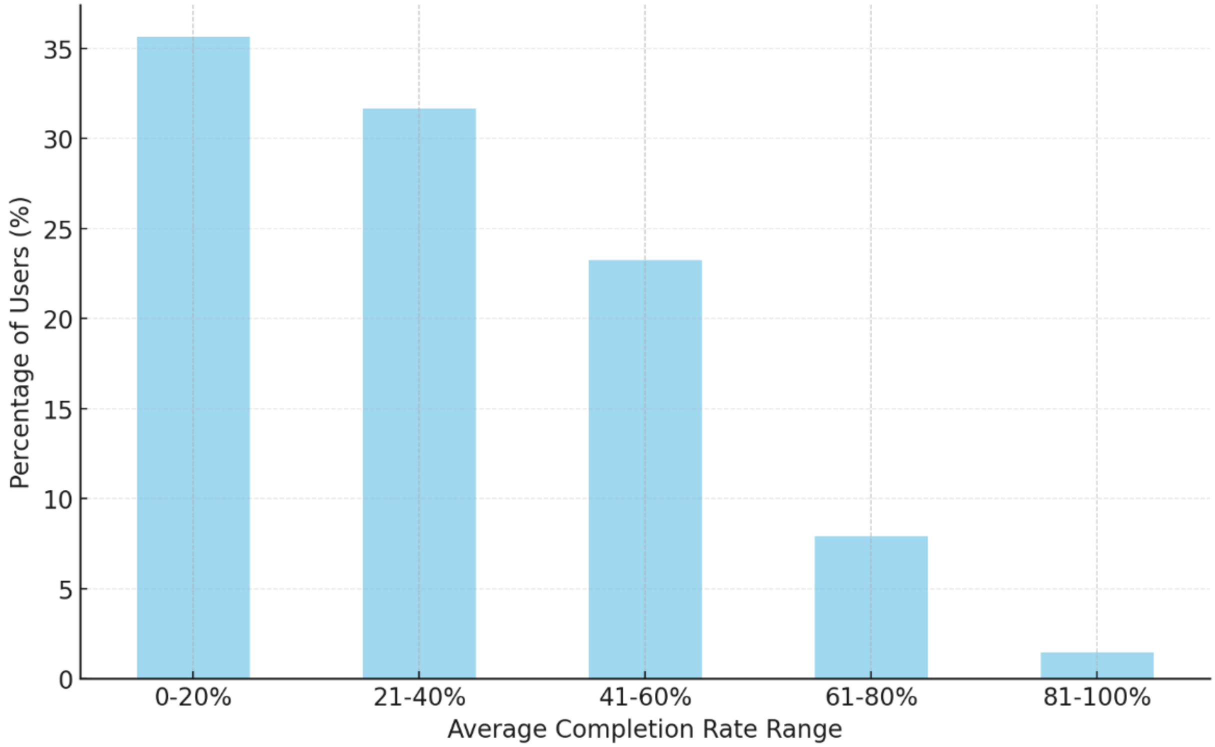

Figure 2: Average completion rate by percentage of students who accessed at least one video

RQ1: How do students perceive the effectiveness of bite-sized videos compared to traditional lengthy videos?

To assess students' preferences and perceptions regarding bite-sized video content, we conducted a survey among undergraduate students enrolled in senior-level computer science courses at Pennsylvania State University, USA.

1) Participants: The survey was distributed to approximately 381 students enrolled in a senior level computer science undergraduate course. The students involved in the study, though not from extensively diverse academic backgrounds or study levels, provided meaningful perspectives on the potential acceptance and impact of the proposed micro-learning tool.

2) Survey Design: The survey aimed to gather quantitative data on students' learning preferences, engagement levels, and perceptions of the effectiveness of short video content for learning and exam preparation. It consisted of five multiple choice questions designed to be completed within approximately 5 minutes.

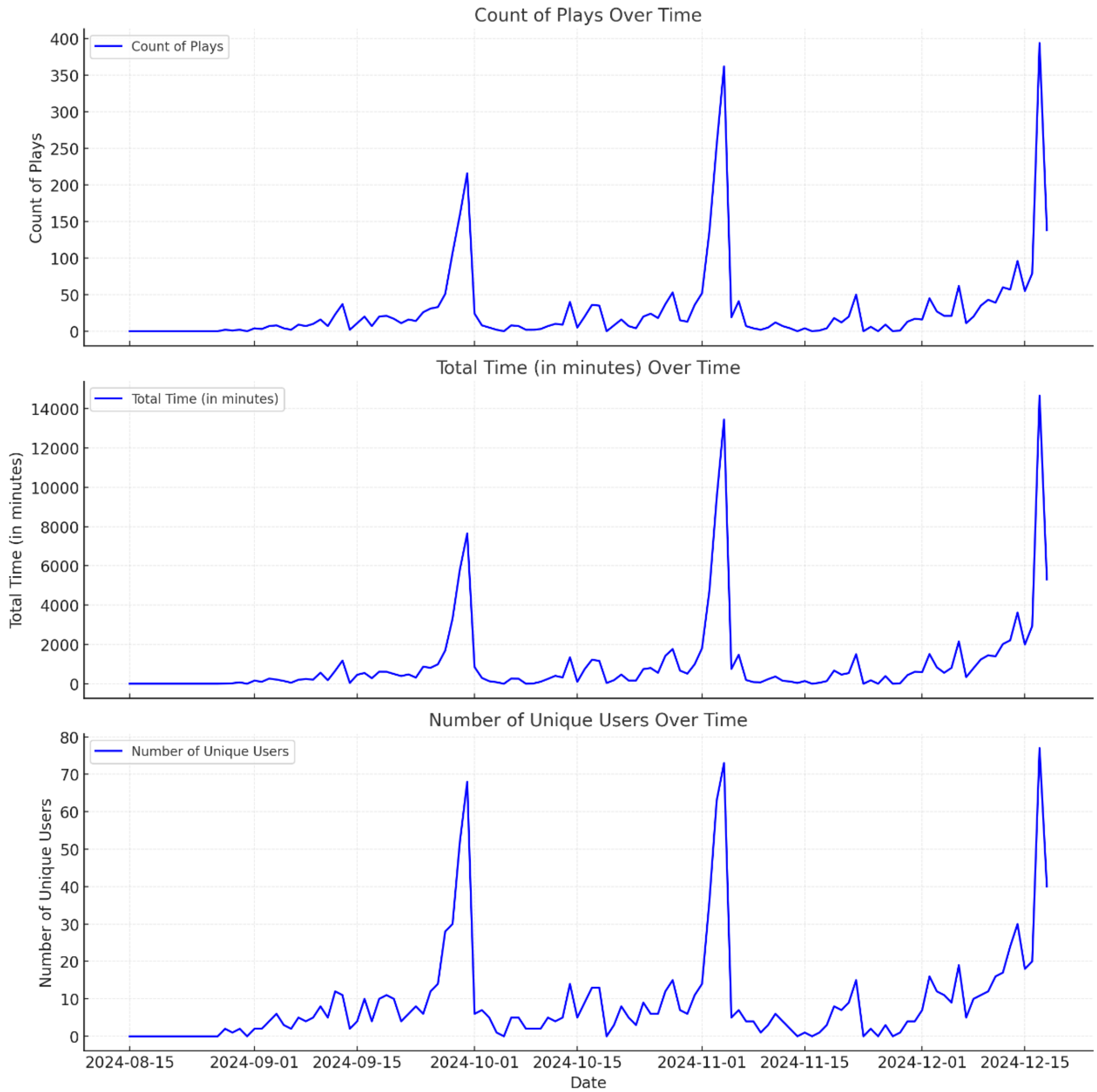

Figure 3: count of video plays, total time spent (in minutes), and the number of unique users accessing videos over time

The key areas addressed in the survey included:

- *Preference for Video Length*: Preferred length of video content for learning course material.
- *Impact on Learning Retention*: Perceptions of whether short videos are more effective for retaining information compared to long lectures.
- *Engagement Level*: Agreement with statements regarding the engagement offered by shorter, topic-focused videos versus longer lecture videos.
- *Accessibility and Flexibility*: Likelihood of choosing short videos over full-length lectures when having limited time to study.

- *Effectiveness for Exam Preparation*: Rating the effectiveness of short videos in helping prepare for exams compared to traditional full-length videos.

3) Procedure: The survey was administered online using Microsoft Forms. Participants received an invitation via their university email addresses and were given a 15-day period to complete the survey at their convenience. Participation was entirely voluntary. To encourage participation, students were offered an optional extra credit opportunity, approved by the course instructor and in accordance with university policies.

4) Ethical Considerations: This study received approval from the Institutional Review Board (IRB) at the University. All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments. Informed consent was obtained from all individual participants included in the study. Strict guidelines were followed during the survey to protect participants' confidentiality and data privacy.

Analysis of Results

Out of the 381 students invited, a total of 279 responses were received, resulting in a response rate of 73%.

1) Survey Results: The key results from the survey are summarized in Table 1.

Survey Aspect	Most Selected Option
Preference for Video Length	Short videos (10 to 20 Minutes) [51.6%]
Impact on Learning Retention	Significantly better [48%]
Engagement Level	Agree or Strongly Agree [86.8%]
Accessibility and Flexibility	Very Likely [67%]
Effectiveness for Exam Preparation	Very Effective [49.8%]

Table 1: Summary of survey results to address RQ1

The analysis of Figures 4 through 8 collectively highlights a strong preference among students for bite-sized videos as an effective and engaging educational tool. Figure 4 demonstrates that most students, actively participating in their learning, prefer shorter videos, with 40.1% favoring videos of 5 minutes or less and 51.6% preferring videos of 10–20 minutes. Full-length lecture videos (50+ minutes) received minimal preference (8.2%), indicating an apparent inclination toward concise formats. Figure 5 reinforces this preference, showing that 48% of students find shorter videos significantly better for retaining information, and an additional 39.8% rate them as somewhat better than longer lectures.

Figure 6 underscores engagement as a key advantage of short videos, with 48.4% of respondents strongly agreeing and 38.4% agreeing that shorter, topic-focused videos are more engaging than traditional lectures. Similarly, Figure 7 highlights the practicality and flexibility of short videos, with 67% of students indicating they are 'very likely' to watch short videos when study time is limited and another 24.7% stating they are 'somewhat likely' to do so. These findings illustrate how short videos effectively meet students' time constraints, making them a practical choice for educators.

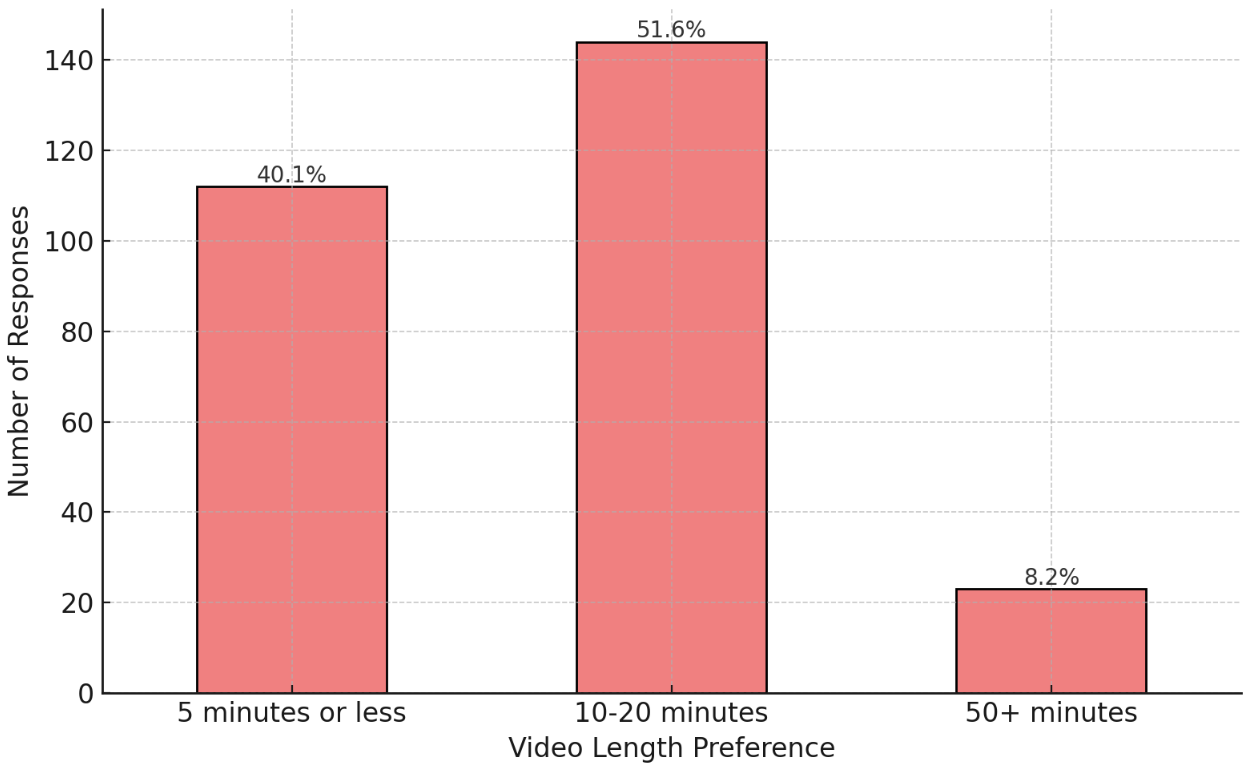

Figure 4: Students' preferences regarding lecture video length

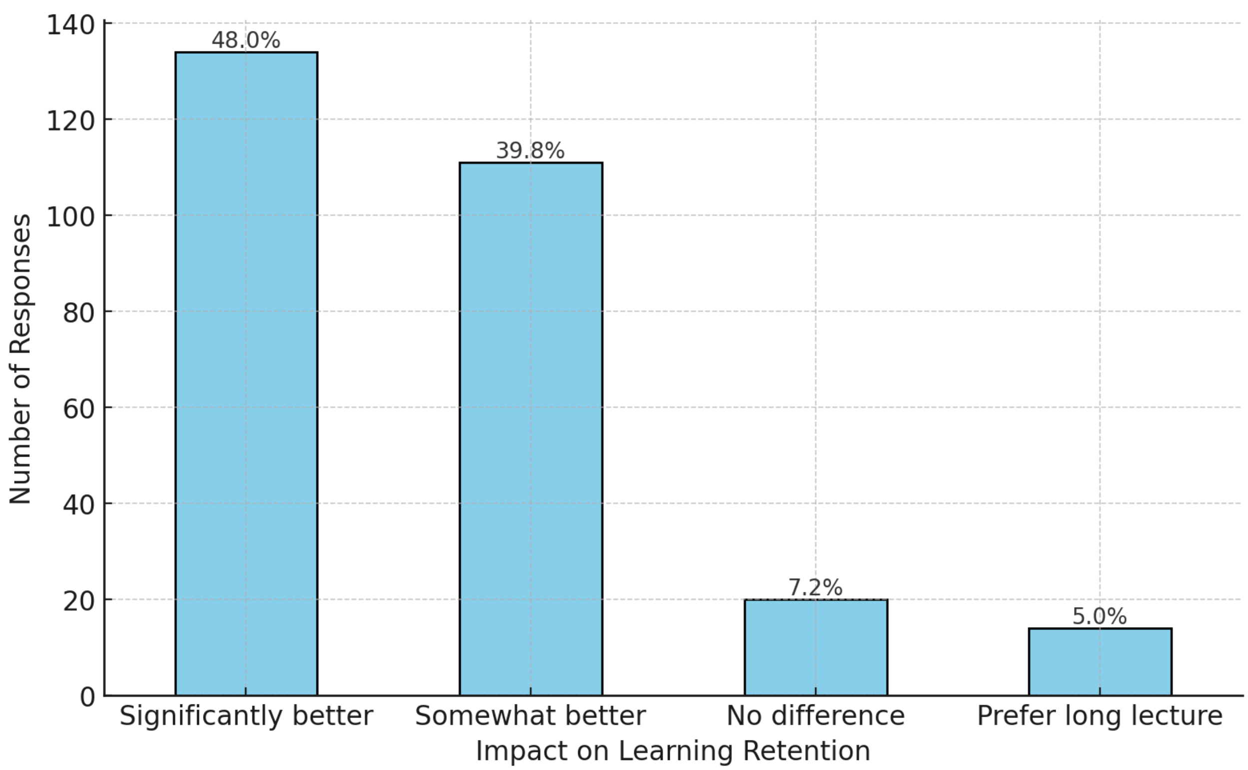

Figure 5: Students' perceptions of the impact of short videos on learning retention

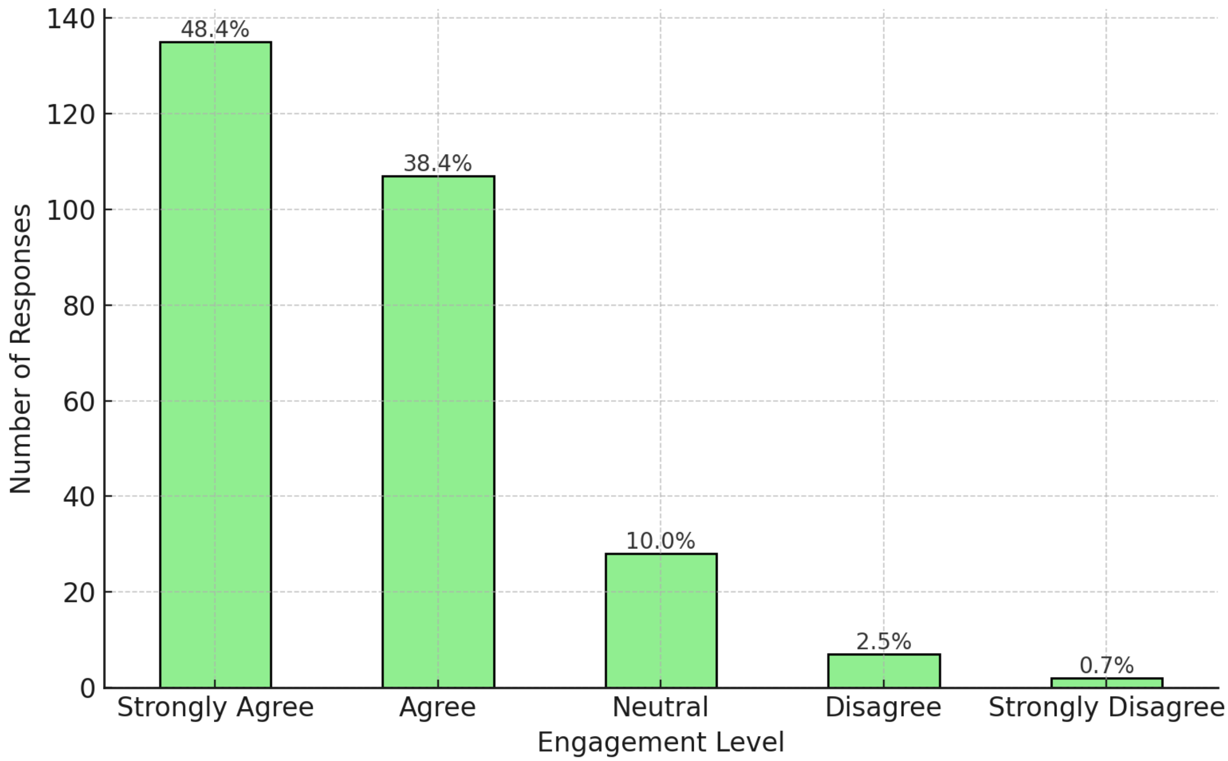

Figure 6: Students' feedback on the role of bite-size videos in improving engagement

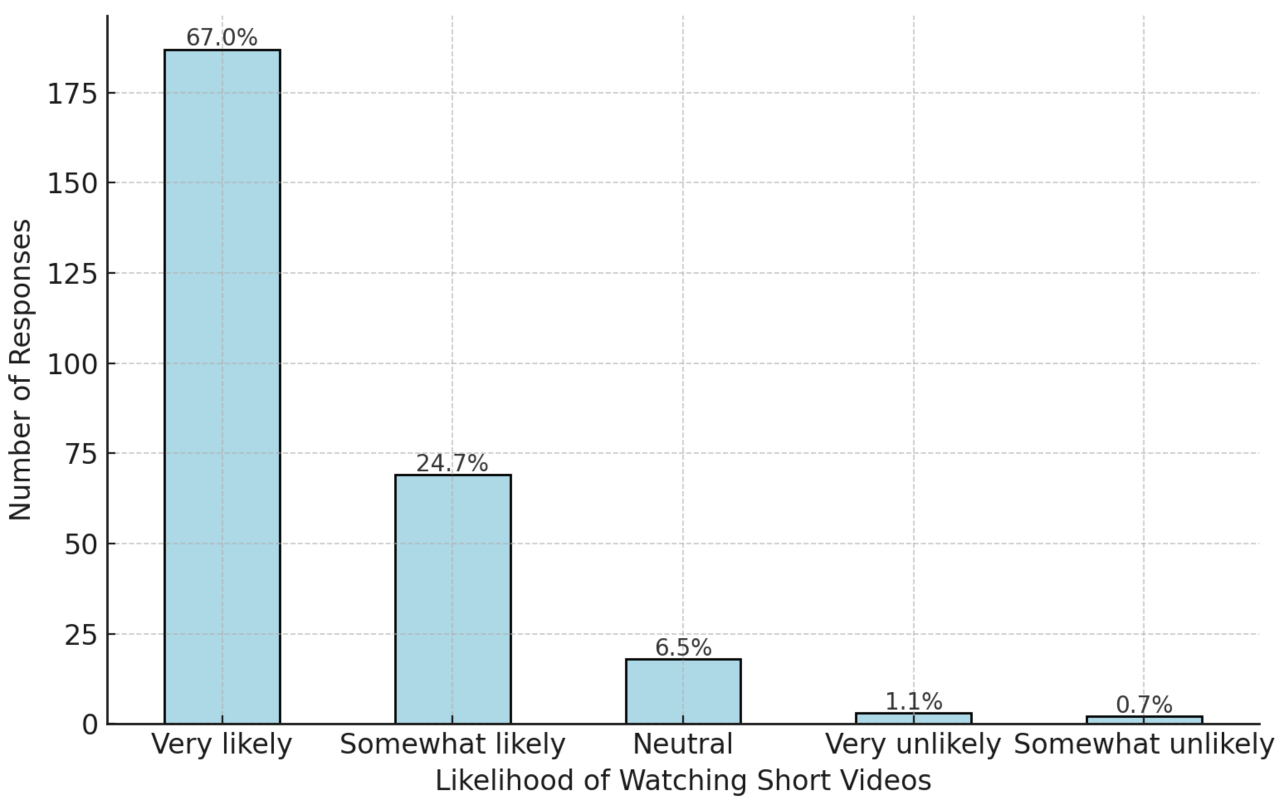

Figure 7: Students watch short videos compared to full-length lectures when you have limited time to study

Finally, Figure 8 establishes that short videos are highly effective for exam preparation, with nearly 90% of respondents rating them as "very effective" or "somewhat effective." Together, these findings make a compelling case for integrating bite-sized videos into course design, as they align with student preferences for engagement, accessibility, retention, and exam readiness. This evidence strongly supports the argument that bite-sized videos enhance the learning experience compared to traditional long-form lecture formats.

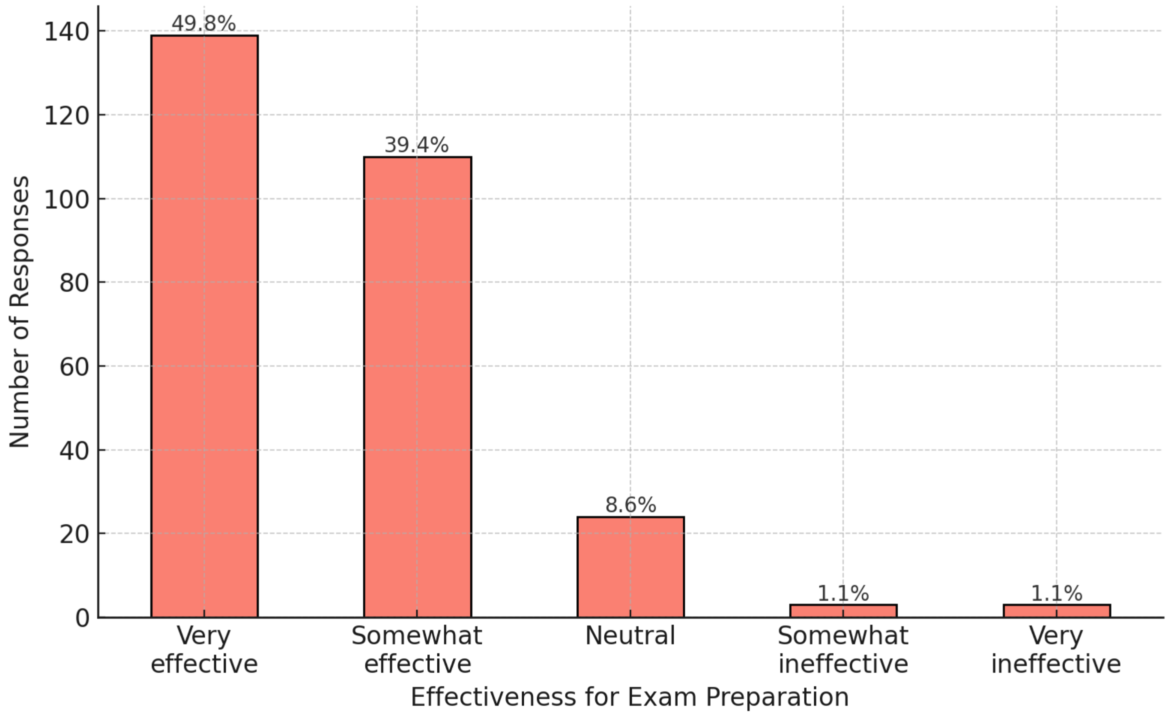

Figure 8: Students find short videos are effective in helping you prepare for exams compared to traditional full-length videos

These findings support the potential value of implementing an AI driven solution to generate bite-size video automatically. The preference for shorter videos suggests that such a tool could enhance engagement, improve retention, and offer greater flexibility in students’ study routines.

RQ2: How can AI-driven solutions be integrated into the classroom to deliver personalized bite-sized videos?

In this study, we propose a system that leverages advanced Artificial Intelligence (AI) and Natural Language Processing (NLP) technologies to transform lengthy lecture videos into a personalized bite-size video. The system processes a student’s query and retrieves a specific video segment from a lengthy recorded lecture to provide a targeted response. The proposed system aims to tackle challenges like reduced student engagement and retention associated with long-form educational content, as highlighted in the *Challenges in Student Engagement* section. This section provides a detailed overview of the system architecture, and the methodologies employed and also addresses our RQ2.

Architecture and Workflow

The system architecture comprises several sequential stages, as illustrated in Figure 9. Each stage utilizes specific technologies and algorithms to process and transform the lecture videos into bite-sized educational content. The proposed system operates in two distinct phases: video processing and query processing. In the first phase, the system processes a video to prepare and store metadata, which is the foundation for addressing students' queries. Video processing is performed only once per video; once completed, it does not need to be repeated for the same video. The processing time depends on the chosen model and configuration parameters. During our experiments, we utilized the *tiny transcription model* with the following parameters: *chunk_length_ms* = 30000, *retry_attempts* = 5, and *retry_delay* = 60. Transcriptions were generated using GPT-4o. Under these settings, processing a 50-minute video required approximately 20 minutes, demonstrating the system's efficiency and scalability in handling video content. The second phase involves query processing, which is triggered whenever a student submits a query. The system processes the query and delivers a personalized video segment tailored to the request. The entire query processing workflow—from receiving the query to delivering the output—typically takes 20 to 30 seconds. The detailed steps of video processing and query processing are described below.

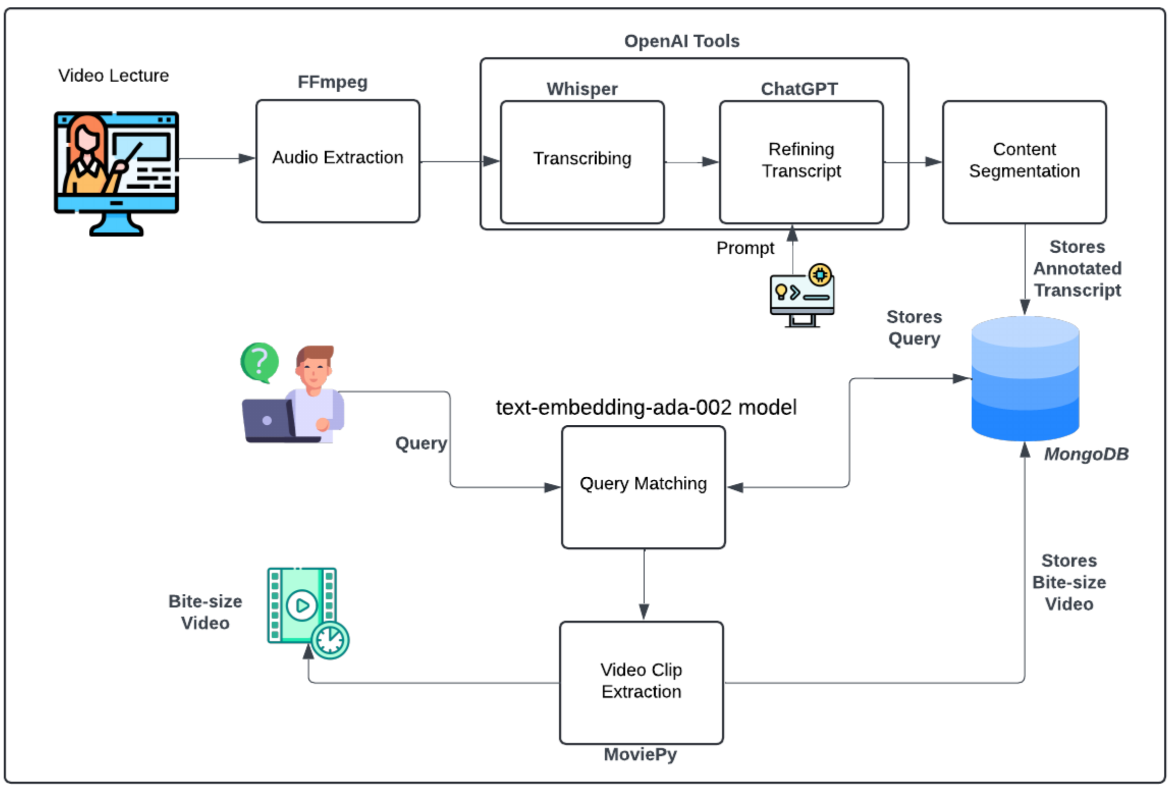

Figure 9: Core Architecture of the System

Video Processing

Input Lecture Videos: The process begins with the collection of recorded lecture videos, which serve as the primary source of educational content. These videos are typically sourced from course recordings and encompass a wide range of subjects and teaching styles.

Audio Extraction: To isolate the spoken content, the audio tracks are extracted from the lecture videos using multimedia processing tools such as FFmpeg [3]. This step is crucial for enabling accurate transcription and subsequent text-based analysis.

Transcribing: The extracted audio is transcribed into text using state-of-the-art speech recognition models. Specifically, we employ OpenAI's Whisper model, renowned for its robustness and high accuracy across diverse languages and accents. This ensures that the transcriptions capture the nuances of the lecturer's speech, including technical terminology and context-specific language.

Refining Transcript: Post-transcription, the raw textual data may contain errors or lack coherence due to background noise or speech disfluencies. To refine the transcripts, we utilize the GPT-4 language model [5]. Techniques such as in-context learning and prompt engineering are applied to correct transcription errors, enhance grammatical structures, and improve overall readability.

Content Segmentation: The refined transcripts are segmented into coherent, topic-based sections using advanced Natural Language Processing (NLP) techniques such as Latent Semantic Analysis (LSA) and keyword extraction. Libraries like the Natural Language Toolkit (NLTK) and spaCy are employed to identify thematic breaks and extract key concepts, enabling the division of content into meaningful and pedagogically effective segments. To optimize storage, the processed videos themselves are not stored in the database; instead, only the file paths to these video files are retained.

Query Processing

The system processes students' queries and compares them with transcript segments to identify and extract the corresponding video segment.

Query Matching: Semantic similarity between student queries and transcript segments is calculated using embeddings generated through OpenAI's text-embedding-ada-002 model. These embeddings encode the semantic structure of the text in a high-dimensional space, enabling precise relevance scoring. Cosine similarity measures the alignment between query and transcript embeddings, ensuring that the most relevant segments are identified and matched to the student's query. MongoDB facilitates efficient storage and retrieval of both student queries and transcript embeddings.

Video Clip Generation: Based on the matched transcript segments, corresponding video clips are extracted from the original lecture videos using precise timestamps to ensure contextually complete and coherent clips. Video processing libraries, such as MoviePy [8], are utilized to extract and compile these segments into bite-sized videos. The system dynamically adjusts the clips to meet the desired duration limits, ensuring the content remains relevant to the student's query. These video clips, along with their associated metadata, are stored in MongoDB for later retrieval, enabling efficient access to matched video segments upon request. Additionally, the system stores detailed match information, such as similarity scores, for future reference and analysis. This method ensures that students can easily access content tailored to their specific queries, enhancing their learning experience by addressing individual knowledge gaps.

Literature Review

The integration of microlearning, particularly video-based microlearning, has been widely investigated due to its potential to enhance student engagement and improve learning outcomes in digital education environments. This section reviews existing literature on video-based microlearning, AI-driven personalized content delivery, and the broader implications of Large Language Models (LLMs) in education.

A. Video-Based Microlearning and Learning Outcomes

Video-based microlearning has demonstrated significant potential in enhancing student performance and engagement, particularly in skill-intensive disciplines. Alshammari explored the effects of video-based microlearning on programming skills and technology acceptance among intermediate school students [13]. Using a quasi-experimental design, the study revealed that microlearning improved programming skills and increased technology acceptance when compared to traditional instruction. These findings highlight the effectiveness of concise and structured video content in achieving specific learning objectives.

Similarly, Zhu examined the impact of short video segments in a flipped engineering course. The study found that shorter videos (5–8 minutes) increased video viewing time by 24.7% and improved final exam scores by 9%, compared to longer videos [2]. These findings underscore the importance of brevity and focus in video content for improving comprehension and fostering engagement.

B. Microlearning and Engagement in Higher Education

The shift to online education during the COVID-19 pandemic amplified interest in microlearning as a strategy to maintain student engagement. McKee investigated the use of segmented lecture recordings in higher education, particularly in computer games courses. Their findings identified an optimal video length of 6–12 minutes for first-year students and under 8 minutes for upper-year students, indicating that content segmentation should account for students' academic level and familiarity with the subject matter [9]. The study also employed diagnostic measures, such as Likert-scale surveys, to evaluate student confidence and engagement before and after viewing video content. Results demonstrated significant improvements in confidence levels, aligning with the broader consensus that focused and adaptable microlearning strategies can meet diverse learner needs effectively.

C. AI-Driven Microlearning and Personalized Content Delivery

Recent advancements in Artificial Intelligence (AI) and Natural Language Processing (NLP) have expanded the capabilities of microlearning through personalized content delivery. AI-driven tools can dynamically generate concise, context-specific content tailored to learners' individual needs. Boumalek highlighted the role of generative AI in transforming microlearning by creating personalized micro-content, thereby promoting self-directed learning and resource efficiency [14].

Pelaez-Sánchez emphasized the application of LLMs in personalized education within the framework of Education 4.0. LLMs enable real-time, adaptive learning experiences by tailoring video segmentation and other materials to individual learning gaps [16]. These technologies have proven particularly valuable in online and hybrid education environments, where timely and targeted interventions are critical for engagement.

D. Large Language Models in Education

Large Language Models (LLMs) have garnered attention for their transformative role in education, offering applications that span personalized learning, intelligent tutoring, and adaptive assessment. Gan illustrated how LLMs enhance education by generating lesson plans, quizzes, and feedback, thereby reducing teacher workload while improving instructional quality [26]. These models also support scalable educational interventions, such as real-time feedback mechanisms, enabling adaptive and autonomous learning experiences.

The survey by Ivanov categorized LLMs' educational applications into three areas: student assistance, teacher assistance, and adaptive learning [27]. For students, LLMs provide query resolution, error correction, and targeted clarification, addressing specific knowledge gaps. For teachers, they generate instructional materials, automate grading, and support adaptive content creation. However, the study also highlighted challenges such as ethical concerns, biases, and over-reliance on AI, which could undermine critical thinking and equitable access to education.

E. Microlearning, AI-Driven Feedback, and Student Engagement

AI-generated feedback has also emerged as a key enabler of personalized education. Escalante demonstrated that AI tools provide concise, actionable guidance, aligning with the principles of bite-sized learning [28]. Similarly, studies such as KOGI's application in programming education and insights from ChatGPT in first-year engineering courses emphasize the value of modular, on-demand support in enhancing educational outcomes [29]. These works collectively reinforce the importance of tailored educational resources, such as microlearning videos, in addressing the specific needs of diverse student populations.

Discussion

This study underscores the student-focused approach of using bite-sized video content as an effective microlearning tool. It effectively enhances student engagement, retention, and accessibility, meeting the evolving needs of learners in modern educational environments. The interaction patterns of students with longer videos, coupled with survey results, offer strong support for this approach. Below, we delve into the implications of the findings in detail:

Figures 1 and 2 highlight significant challenges associated with traditional long-form lecture videos. Over 40% of students did not access any lecture videos, and among those who did, a large majority completed only a small fraction (0–40%) of the content. These patterns point to a lack of sustained engagement and emphasize the need for alternative approaches to content delivery that align better with student behaviors and preferences.

The survey revealed a strong preference for shorter video formats. Nearly 90% of participants rated bite-sized videos as either 'very effective' or 'somewhat effective' for exam preparation (Figure 8). Furthermore, 48% of students found short videos significantly better for retaining information, while another 39.8% found them somewhat better than lengthy lectures (Figure 5). These findings underscore the potential of bite-sized videos in significantly enhancing learning outcomes, particularly in contexts where retention and comprehension are critical.

Figures 6 and 7 demonstrate the advantages of short videos in fostering student engagement and addressing time constraints. Approximately 86.8% of respondents either agreed or strongly agreed that shorter, topic-focused videos are more engaging than traditional lectures (Figure 6). Additionally, when faced with limited study time, 91.7% of students indicated they were 'very likely' or 'somewhat likely' to watch bite-sized videos over full-length lectures (Figure 7). These insights underscore the adaptability and accessibility of short videos, making them a practical and versatile solution for diverse learning scenarios.

Research indicates that microlearning can improve retention of information by 22% over traditional learning methods. Improved Retention and Interactive Learning exhibit tighter distributions, confirming consistent positive feedback regarding retention and engagement. The targeted nature of bite-size video allows students to focus on particular concepts without the cognitive overload of lengthy lectures. These videos cater to diverse needs, including exam preparation, quick conceptual clarifications, and efficient content review. Integrating these videos with AI-driven personalization makes the approach even more impactful, offering tailored learning experiences that further enhance comprehension and retention.

The findings strongly support integrating AI-driven solutions for generating personalized bite-sized videos, addressing the needs identified in challenges in student engagement with lengthy lecture videos and Research Question 1. The proposed tool leverages AI to take student queries—whether specific topics, concepts, or examples—and matches them with relevant segments of recorded lectures. By analyzing the query and mapping it to corresponding audio transcripts, or metadata, the tool automatically extracts concise, contextually accurate video clips tailored to the student's request. This functionality not only enhances accessibility but also aligns directly with the preference for bite-sized videos highlighted in the survey.

Moreover, this approach bridges the gap between formal and informal learning by offering on-demand resources that cater to students' immediate needs. For example, a student preparing for an exam could ask the tool for a refresher on a specific topic. Instead of navigating through an hour-long lecture, they would receive a targeted video segment. This streamlined, query-driven retrieval process saves time and ensures high engagement and retention as students receive content directly relevant to their learning goals. Educators can meet students' evolving expectations by embedding this tool into the course ecosystem while fostering a more efficient, personalized, and adaptive learning environment.

In conclusion, implementing AI-generated bite-sized videos offers key benefits for enhancing education in the post-COVID-19 era. Short, focused videos increase student engagement by aligning with their preferences for digital media consumption [9]. Concise content reduces cognitive overload, improving retention by breaking complex topics into manageable segments [1], [19]. Personalized learning is fostered by tailoring video content to individual queries, addressing specific learning gaps, and boosting satisfaction [2]. Additionally, the system enhances time efficiency, allowing students to access precise information quickly, which is especially beneficial during exam preparation [16]. Its scalability ensures applicability across various courses while reducing educator workload by automating content creation, enabling instructors to focus on pedagogy and direct interaction [14], [26]. While instructor-curated segments offer pedagogical precision, they require significant manual effort, which is often infeasible in large-scale or multi-course deployments. Our AI-driven approach provides a scalable alternative by generating segments dynamically based on student needs. This facilitates personalization without imposing additional workload on educators. These advantages highlight the transformative potential of AI-driven microlearning, a system that is adaptable and effective in diverse educational settings.

Threats to Validity

The study assumes that the proposed AI-driven tool functions optimally in extracting relevant, bite-sized videos based on student queries. However, the accuracy and relevance of the video clips generated by the tool were not independently evaluated. Errors in the tool's query interpretation or video extraction could negatively impact student experiences and skew perceptions of effectiveness. Future research should assess the tool's performance in real-world scenarios to ensure its robustness and alignment with student needs. Another limitation is the absence of a formal evaluation of the quality and pedagogical value of the AI-generated segments. Although preliminary use suggests student satisfaction with short content, future studies should include expert instructor assessments and student learning outcome measures to validate segment accuracy and helpfulness.

Conclusion

This study demonstrates the potential of bite-sized videos as a powerful tool to enhance student learning experiences, engagement, and retention in higher education. Through surveys conducted with 279 students and analysis of interaction patterns, we found a clear preference for short, topic-focused videos over traditional lengthy lectures. Bite-sized videos were rated highly effective for exam preparation, fostering engagement, and supporting learning retention, particularly when study time was limited. These findings underline the importance of adapting educational content delivery methods to align with the evolving preferences of modern learners.

Furthermore, the proposed AI-driven tool offers a scalable, personalized solution to these preferences. The tool directly addresses the challenges in student engagement with any longer video and the students' preferences identified by Research Question 1 by processing student queries and extracting relevant video segments. It empowers students to access tailored content quickly and efficiently, bridging the gap between formal and informal learning. Importantly, our system is not limited to indexing for post-viewing reference. Instead, it delivers semantically relevant and context-rich segments that can stand alone to answer specific student queries. This approach ensures that even students unfamiliar with the full lecture can access coherent, digestible explanations tailored to their needs, mimicking the personalized assistance typically sought during office hours.

While this research provides strong evidence for the benefits of bite-sized videos, it also highlights areas for further exploration, such as evaluating the tool's real-world performance and examining long-term trends in student preferences. By integrating such technologies into the learning ecosystem, educators can create a more adaptive, accessible, and effective educational experience, paving the way for innovation in teaching and learning practices.

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