Context Matters: Peer-Aware Student Behavioral Engagement Measurement via VLM Action Parsing and LLM Sequence Classification

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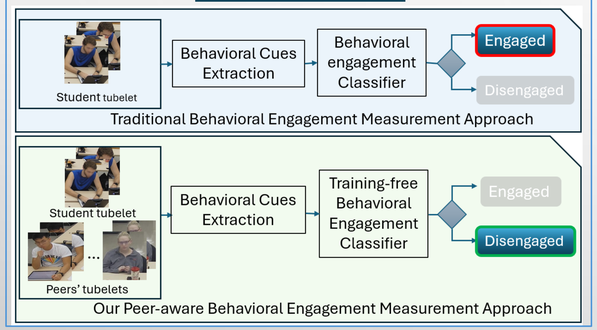
Motivation

Understanding student behavior in the classroom is essential to improving both pedagogical quality and student engagement.

Existing engagement measurement approaches:

- ❑ Require extensive annotated data
- ❑ Ignore classroom context:
- ❑ Ignore the temporal order of student actions and their duration.

Context Matters!



Action Dictionary

Acknowledgment

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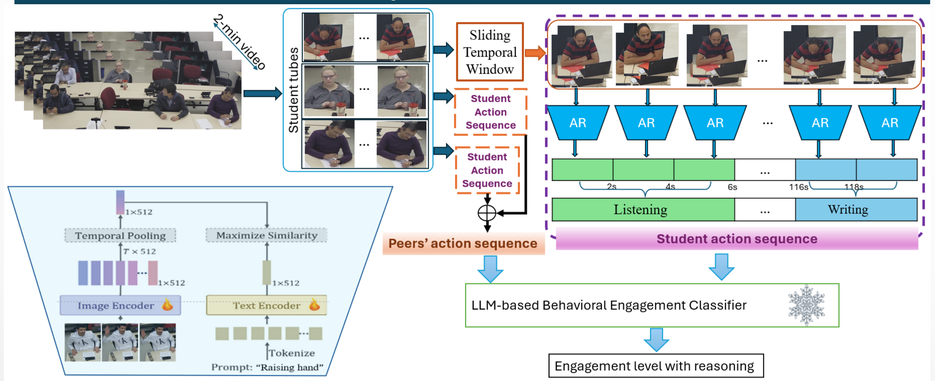
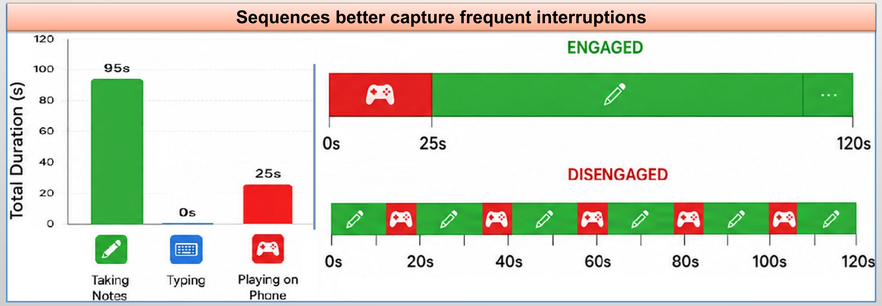
Proposed Framework



We propose a novel framework integrating Vision-Language Models & Large Language Models for student engagement classification. It consists of:

- ❑ Few-Shot VLM Action Recognition
- ❑ VLM-based Action Parsing
- ❑ Peer-Aware LLM –based Engagement Classification

Sequences better capture frequent interruptions



Experimental Results

We collected a behavioral engagement dataset with two subsets of annotated videos:

- ❑ Student actions -13 action categories: 208 training, 46 testing trimmed clips.
- ❑ Student engagement- 455 annotated two-minute student video clips with engagement and temporal action labels.

Table 1. Comparison of action recognition models (%).

Model	Student Action Dataset			
	K = 2	K = 4	K = 8	K = 16
XCLIP	43.2	79.6	88.6	**97.9**
VIFI-CLIP⁺	**47.3**	**81.8**	**93.2**	**97.9**

Table 2. Comparison of temporal action segmentation methods (%).

TAS	Accuracy	Edit Score	F1@[10,25,50]
Gemini-2.5-flash	57.2	37.4	[39.0, 34.5, 25.3]
Gemini-2.5-Pro	**69.8**	**51.8**	**[58.2, 55.2, 45.2]**
Our VLM-based	67.0	45.7	[48.3, 43.9, 31.4]

Engagement Classification: Key Comparisons (Gemma-2-9B)