Can we better understand educational video through Large Language Model?

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```
video_schema={'properties':{
        "video_topic": {"type": "string"},
        "skills_covered": {"type": "string"},
        "style_of_teaching": {"type": "string"},
        "pauses_for_reflection": {"type": "boolean"},
        "unanswered_question_for_viewers_reflection": {"type": "boolean"},
        "entertaining content irrelevant to video topic": {"type": "boolean"}}
```

```
'video_topic': 'solving word problems',
'skills_covered': 'addition, subtraction',
'style_of_teaching': 'using number families',
'pauses_for_reflection': True,
'unanswered_question_for_viewers_reflection'
: False, 'entertaining content irrelevant to
video topic': True
question topic': swim trunks,
'skill covered in question': addition,
'complete question': 'How many beams did the
crane deliver?',
'complete question context': "..",
'solution to complete question': 'The crane
delivered 11 beams.',
'start time of question': '1:00',
'end time of question': '1:04'
```

Research questions

- How do Large Language Models assist in extracting informative video features to enhance the understanding of content that optimizes learning outcomes?

Schema iterations

```
schema={‘properties’:{
        "topic": {"type": "string"},
        "questions_asked": {"type": "string"},
        "skills_covered": {"type": "string"},
        "start_time_of_skill": {"type": "string"},
        "end_time_of_skill": {"type": "string"}}
```

```
video_schema={‘properties’:{
        "video_topic": {"type": "string"},
        "skills_covered": {"type": "string"},
        "style_of_teaching": {"type": "string"},
        "pauses_for_reflection": {"type": "boolean"}}
```

```
question_schema={‘properties’:{
        "question_topic": {"type": "string"},
        "question_with_context": {"type": "string"},
        "skill_covered_in_question": {"type": "string"},
        "start_time_of_question": {"type": "string"},
        "end_time_of_question": {"type": "string"}}
```

```
video_schema={‘properties’:{
        "video_topic": {"type": "string"},
        "skills_covered": {"type": "string"},
        "style_of_teaching": {"type": "string"},
        "pauses_for_reflection": {"type": "boolean"},
        "unanswered_question_for_viewers_reflection": {"type":
"boolean"},
        "entertaining content irrelevant to video topic": {"type":
"boolean"}}
```

```
question_schema={‘properties’:{
        "question_topic": {"type": "string"},
        "question_with_context": {"type": "string"},
        "solution to complete question": {"type":
"string"},
        "skill_covered_in_question": {"type": "string"},
        "start_time_of_question": {"type": "string"},
        "end_time_of_question": {"type": "string"}}
```

Dataset: 10 videos from Youtube

Topic	**Sub-topics**	**Videos**
Math	Geometry Area	3
Math	Word Problems	2
Math	Solving two-step equations	3
Chemistry	Conversion of units	2

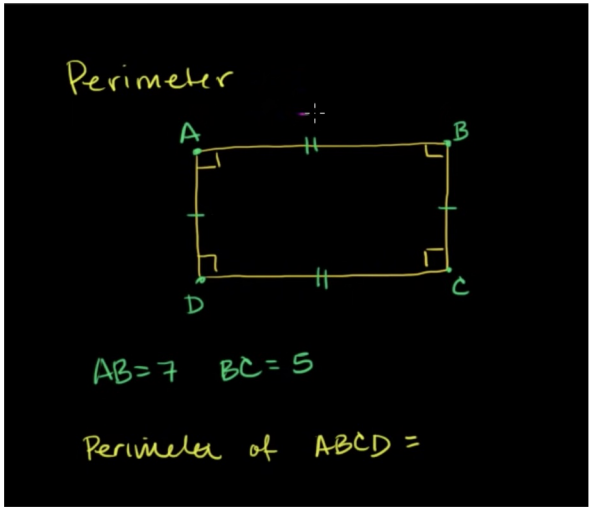
Reliability

- We identified the hardest feature extraction would be the extraction of questions or problems that the presenter is solving in the video.

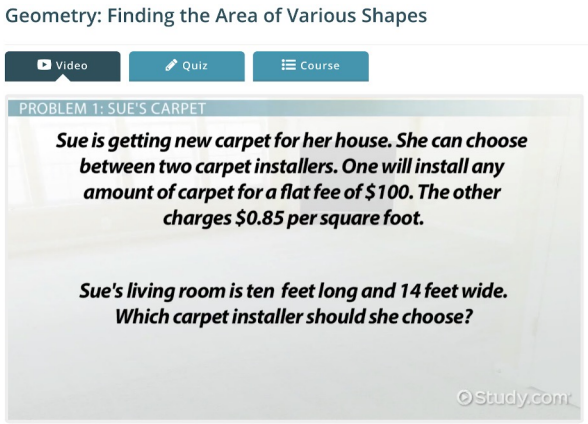
- To measure how reliable LLM generated questions from the video were, we manually tagged the “question” “context” and “solutions” properties returned by LLMs as either correct or incorrect.

- Based on Cohen’s Kappa coefficient, the inter-coder reliability for this coding showed $\kappa = 0.60$.

Findings context of questions are hard

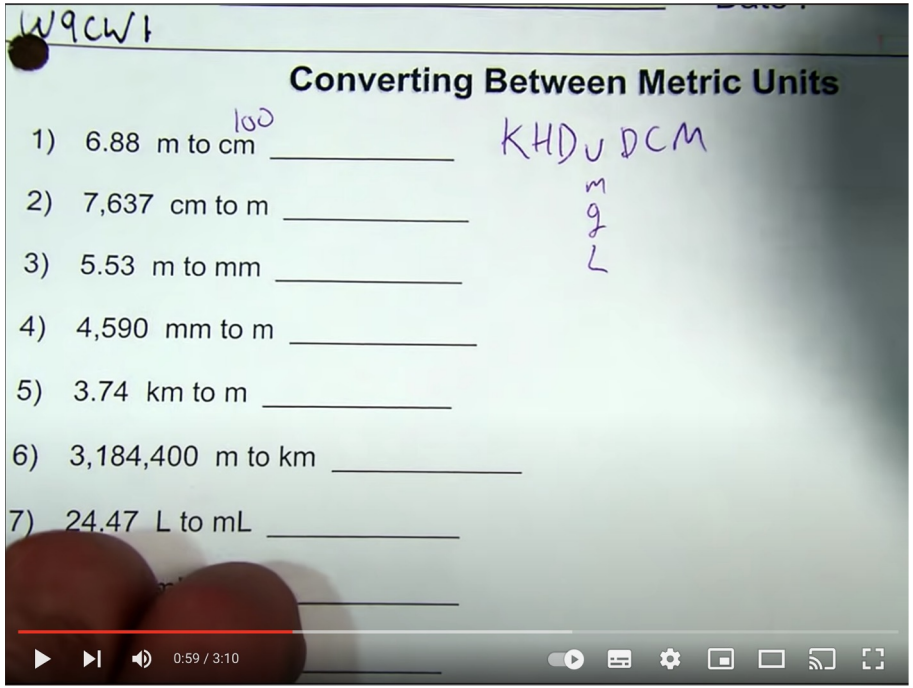


‘question topic': 'perimeter',
'skill covered in question': 'finding the perimeter of a rectangle',
'complete question': 'What is the perimeter of ABCD?',
'complete question context': 'And we want to know, what is the perimeter of ABCD?',
'solution to complete question': 'The perimeter of rectangle ABCD is just going to be equal to the sum of the lengths of the sides.',
'start time of question': '1:12',
'end time of question': '2:07'



‘question topic': 'area of shapes',
'skill covered in question': 'area of rectangle',
'complete question': 'Which carpet installer should she choose?,
'complete question context': 'Sue is getting .... feet wide',
'solution to complete question': 'Sue should choose the flat fee installer, which would save her $19',
'start time of question': '1:12',
'end time of question': '2:07'

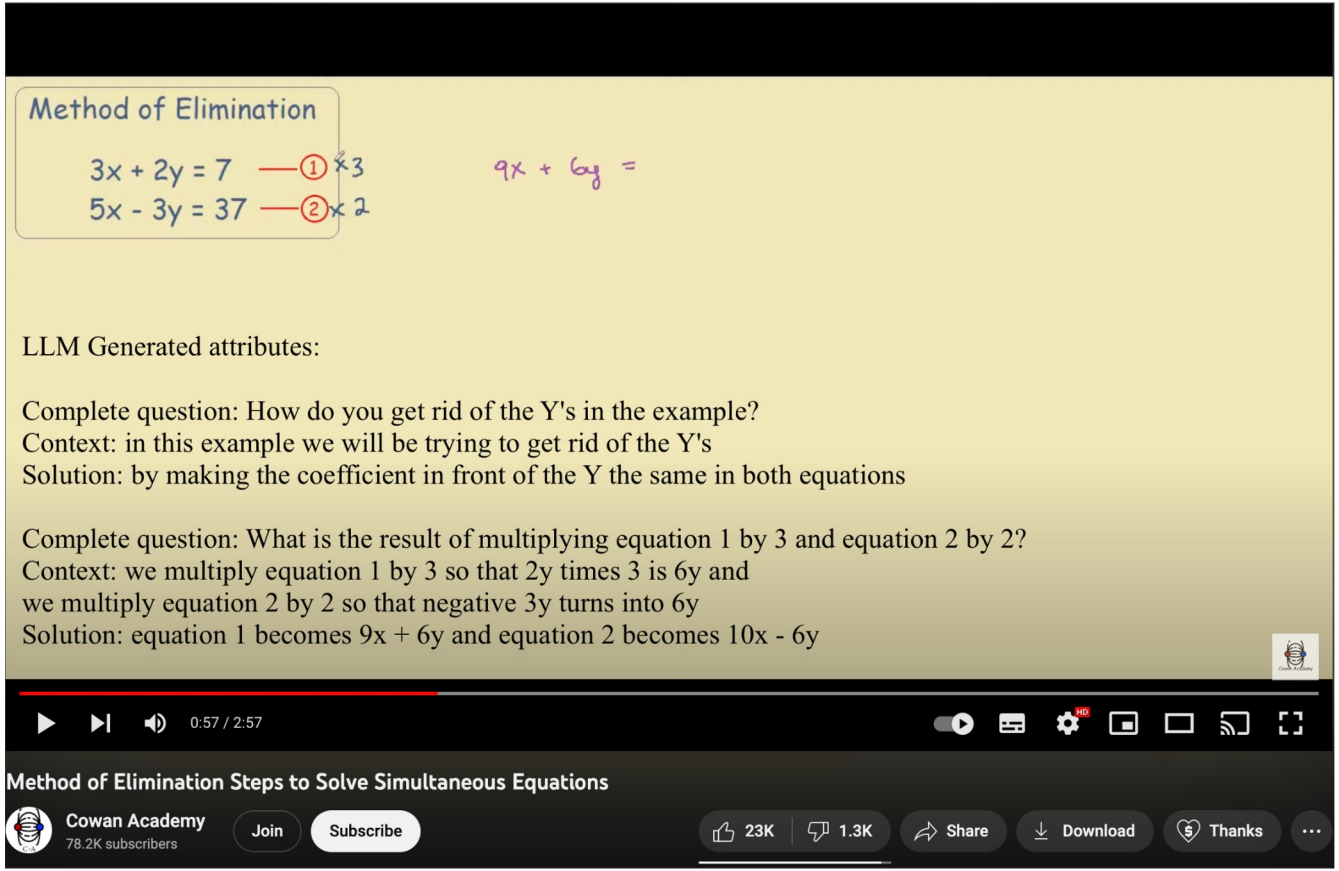
More Trouble with Context



LLM generated attributes:

question topic': 'converting between metric units',
'skill covered in question': 'converting from meters to centimeters', 'complete question': 'Convert 6.88 meters to centimeters.',
'complete question context': "entire video transcript",
'solution to complete question': '688 centimeters',
'start time of question': '0:00',
'end time of question': '3:06'

Impossible Context



Wrong solutions?
The sandwiches problem

[redacted] we want to know how many 1:08 slices of bread 1:09 are needed to make eight sandwiches

[redacted] 15 slices [redacted]

[redacted]

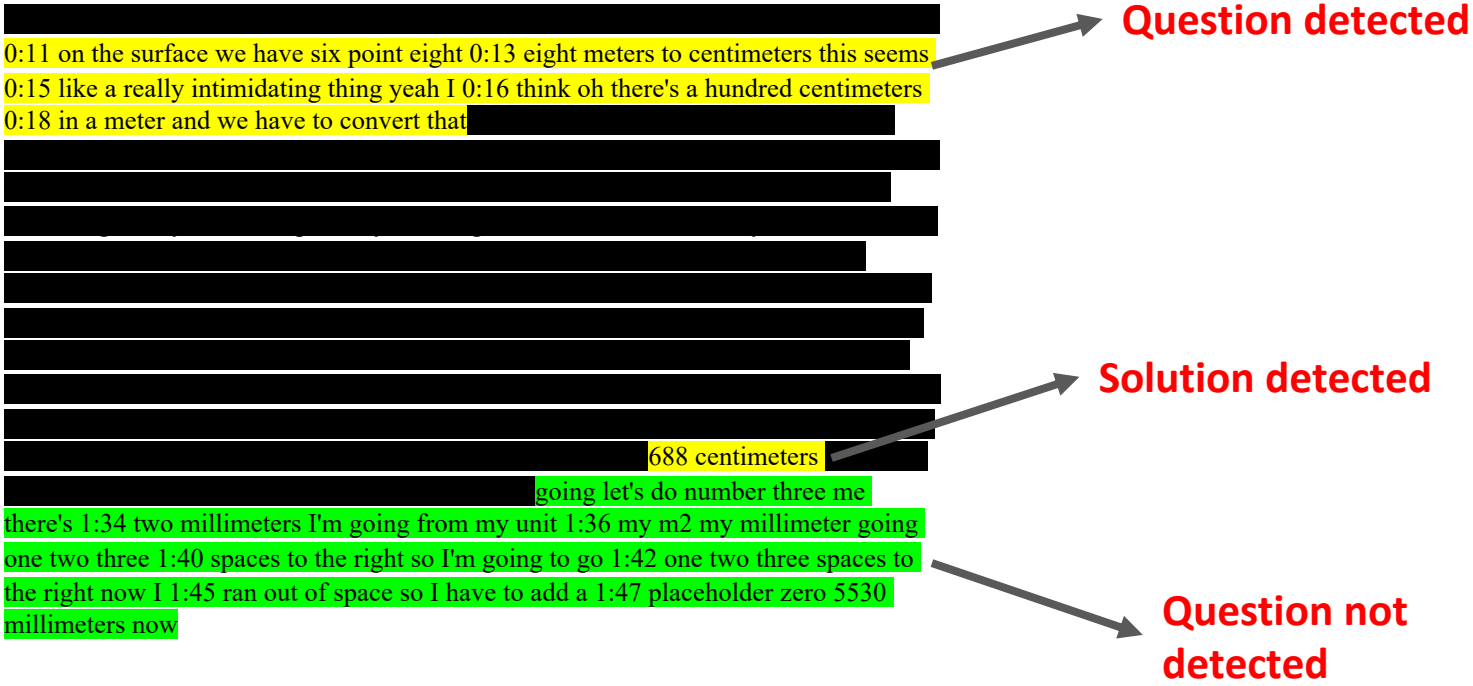
3:16 we need sixteen slices of bread

[redacted]

Wrong solution detected

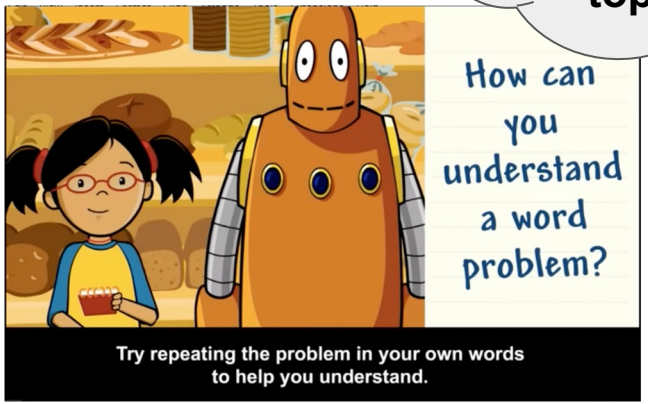
Correct answer - missed

Missed questions? -multiple short questions in unit conversion



Entertainment or Pause for Reflection?

Presenter Paused for viewers reflection and video has entertaining off topic contents



Presenter Paused for viewers reflection and NO entertaining off topic contents present