

Appendix A. Illustrative Boundary Cases (with cues and mitigation notes)

All examples are anonymized and lightly edited for brevity. “Context” shows the immediately preceding tutor turn when relevant. These instances were sampled from the evaluation set and reflect typical success/failure modes rather than outliers.

A.1 Clarification Request vs. Question Asking

A.1.1

- **Context (Tutor):** “Next, divide the total by 3.”
- **Utterance:** “So we divide by 3 here, right?”
- **Gold:** Clarification Request
- **Model (miss):** Question Asking
- **Cues:** confirmation-tail (“right?”) + local reference to prior step (“divide by 3”).
- **Note/Mitigation:** Up-weight confirmation markers when they co-occur with explicit reference to the preceding tutor directive.

A.1.2

- **Context (Tutor):** “Use the slope formula.”
- **Utterance:** “Is the slope $(y_2 - y_1)/(x_2 - x_1)$, or am I mixing it up?”
- **Gold:** Clarification Request
- **Model (correct):** Clarification Request
- **Cues:** self-doubt tail (“am I mixing it up?”) tied to a concrete formula; alternatives enumerated → clarifying the instruction, not opening a new topic.

A.1.3

- **Context (Tutor):** “Now compute the unit rate.”
- **Utterance:** “What is a unit rate again?”

- **Gold:** Question Asking
- **Model (miss):** Clarification Request
- **Cues:** no confirmation-tail; scope broadens to a definition-level request.
- **Note/Mitigation:** Penalize “definition-seeking” wh-forms without anaphora to the immediate step.

A.2 Confirmation vs. Self-Explanation

A.2.1

- **Utterance:** “It’s 12 because it’s 3 groups of 4, right?”
- **Gold:** Self-Explanation
- **Model (miss):** Confirmation
- **Cues:** causal connective (“because”) + partitive reasoning; trailing confirmation-tail may dominate when rationale is short.
- **Note/Mitigation:** Require a minimal rationale-span (cause + numeric structure) before allowing Confirmation to override.

A.2.2

- **Utterance:** “Because both sides increase by 5, the difference stays the same.”
- **Gold:** Self-Explanation
- **Model (correct):** Self-Explanation
- **Cues:** explicit causal logic; no confirmation-tail.

A.2.3

- **Utterance:** “So 0.5 is the slope because rise is 1 and run is 2... I think.”
- **Gold:** Self-Explanation

- **Model (miss):** Confirmation
- **Cues:** reasoning present but weakened by hedging (“I think”).
- **Note/Mitigation:** Treat hedges as *confidence* modifiers, not as behavior switches, when a complete causal span is present.

A.3 Confusion vs. Frustration

A.3.1

- **Utterance:** “I don’t get step 3.”
- **Gold:** Confusion
- **Model (correct):** Confusion
- **Cues:** neutral uncertainty; no negative evaluation or persistence lexemes.

A.3.2

- **Utterance:** “I keep messing this up—this is annoying.”
- **Gold:** Frustration
- **Model (correct):** Frustration
- **Cues:** persistence (“keep messing this up”) + negative evaluation (“annoying”).

A.3.3

- **Utterance:** “This isn’t working... ugh.”
- **Gold:** Frustration
- **Model (miss):** Confusion
- **Cues:** implicit intensity (interjection) without explicit negative evaluation verb/adjective.
- **Note/Mitigation:** Add a small lexicon for exclamations/interjections and treat repetition/ellipsis as weak frustration evidence when co-occurring with failure predicates.

A.4 Engaged Concentration vs. Neutral

A.4.1

- **Utterance:** “Okay, let me try that step.”
- **Gold:** Engaged Concentration
- **Model (correct):** Engaged Concentration
- **Cues:** first-person volitional verb (“let me try”) indicating immediate action.

A.4.2

- **Utterance:** “I’ll check the units and recalc.”
- **Gold:** Engaged Concentration
- **Model (correct):** Engaged Concentration
- **Cues:** explicit plan (“I’ll check... recalc”) with task verbs.

A.4.3

- **Utterance:** “Ok.”
- **Gold:** Neutral
- **Model (correct):** Neutral
- **Cues:** bare acknowledgment; no action/intent verb.

A.4.4

- **Utterance:** “Ok, I guess.”
- **Gold:** Neutral
- **Model (miss):** Engaged Concentration
- **Cues:** acknowledgment plus hedge (“I guess”)—no plan.

- **Note/Mitigation:** Down-weight sentence-initial “Ok” unless followed by an intent/action verb.

A.5 Cross-case summary (actionable cues)

- **Confirmation markers & proximity:** “right?”, “correct?”, “is that it?” are stronger when adjacent to a tutor step.
- **Reasoning spans:** causal connectives (*because, so, therefore*) + justification tokens signal self-explanation even with hedges.
- **Negative evaluation & persistence:** “annoying, stuck, keep failing” separate frustration from confusion.
- **Intent/volition verbs:** “let me try, I will, I’ll check, plan to” distinguish engaged concentration from neutral acknowledgments.

Implementation note: Most misses are reducible by (i) slightly wider context windows (± 1 tutor turn), and (ii) explicit feature weights for the cues above, without changing the overall architecture.

The **priority star system** (★★★★★ to ★☆☆☆☆) is designed to guide **label selection** when a student response seems to **fit more than one label within the same category** — either affective or behavioral.

Affective Labels Priority Guideline

Affective Label	Priority	Example from Data	Interpretation
Frustration	★★★★★	<p><i>"Ugh, history is so boring."</i> (edu_conv_6566)</p> <p><i>"I'm not really sure I like activities. Can you just tell me about her?"</i> (edu_conv_6774)</p> <p><i>"I don't really care. Can you just tell me what I need to know?"</i> (edu_conv_4878)</p>	Indicates strong negative emotions, such as irritation, resistance, or avoidance. The student may seem fed up or disengaged due to repeated difficulty or dislike.

Confusion	★★★★☆	<p><i>"I'm not sure I understand."</i> (edu_conv_5683)</p> <p><i>"I'm not really sure. I know they're like the building blocks of everything, but I don't know much else."</i> (edu_conv_6026)</p> <p><i>"I'm not sure what I'm supposed to do."</i> (edu_conv_2368)</p>	Shows cognitive uncertainty or mental blockage. Students are unsure how to proceed, often paired with requests for help or clarification.
Boredom	★★★☆☆	<p><i>"I'm not really interested in history or art."</i> (edu_conv_3650)</p> <p><i>"Sounds boring. How does it apply to anything I care about?"</i> (edu_conv_3722)</p> <p><i>"Ugh, boring."</i> (edu_conv_7188)</p>	Indicates a lack of engagement or emotional investment. Students may want to change the learning mode or express a preference for more interactive methods.
Delight	★★☆☆☆	<p><i>"That sounds interesting! What was his art style like?"</i> (edu_conv_5174)</p> <p><i>"Cool! Can we have a class discussion about him?"</i> (edu_conv_6032)</p> <p><i>"Interesting! Can we discuss the history behind it?"</i> (edu_conv_5331)</p>	Reflects genuine interest or excitement. Often paired with curiosity or motivation to explore more.
Engaged Concentration	★★☆☆☆	<p><i>"What are we going to do with it?"</i> (edu_conv_4373)</p> <p><i>"Why is it called a civil war?"</i> (edu_conv_7546)</p> <p><i>"Can we have a class discussion about it? I learn better that way."</i> (edu_conv_1832)</p>	Indicates thoughtful attention to content or task. Students may not express emotion explicitly but demonstrate cognitive focus and goal orientation.

Neutral	★☆☆☆☆	<p>"Okay." (edu_conv_2315, edu_conv_5081)</p> <p>"No, I haven't." (edu_conv_1526)</p> <p>"I'm not sure I've heard of him. Can you tell me a little bit about him?" (edu_conv_7627)</p>	Displays neither clear positive nor negative affect. Often brief, context-dependent responses with little emotional tone.
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Behavioral Labels Priority Guideline

Behavioral Label	Priority	Example from Data	Interpretation
Self-Explanation	★★★★★	<p>"I've always wondered how living things are put together." (edu_conv_3043)</p> <p>"So, if Daisy has 3 dogs..." (not in dataset, template)</p>	Students verbalize reasoning, draw conclusions, or build on content to explain their understanding. Often includes cause-effect, inference, or steps.
Question Asking	★★★★☆	<p>"Can you tell me more about him?" (edu_conv_3113)</p> <p>"How are we going to learn about him?" (edu_conv_4408)</p> <p>"Is there a way to make it more interesting?" (edu_conv_6742)</p>	Indicates a desire to acquire new information, clarify gaps, or change learning conditions. Often curious or participatory in tone.
Clarification Request	★★★☆☆	<p>"Can you just explain it to me directly?" (edu_conv_7283)</p> <p>"Can you explain it in a way that's easy to understand?" (edu_conv_2856)</p> <p>"Are we supposed to write this down?" (hypothetical example)</p>	Focused on resolving ambiguity or lack of clarity. Often more passive or focused on task logistics rather than deeper learning.

Confirmation	★ ★ ☆ ☆ ☆	<i>"Okay."</i> (edu_conv_2315, edu_conv_5047) <i>"Sure."</i> or <i>"Not really."</i> (edu_conv_3962) <i>"No, I haven't."</i> (edu_conv_1526)	Indicates minimal engagement, agreement, or acknowledgment. Typically a short, reactive statement with no new information or learning behavior expressed.
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Student Dialogue Label Explanation Table

Label	Example	Definition
Confusion	1. I'm not sure I understand. Can we talk about it first? 2. I'm not really sure. I know they're like the building blocks of everything, but I don't know much else. 3. I'm not sure what I'm supposed to do.	The learner expresses uncertainty, lack of understanding, or difficulty in processing content or expectations.
Frustration	1. Ugh, history is so boring. 2. I don't really care. Can you just tell me what I need to know? 3. I'm not really sure I like activities. Can you just tell me about her?	The learner conveys negative feelings such as annoyance, emotional resistance, or distress, often due to repeated difficulty or dislike of method/topic.
Boredom	1. I'm not really interested in history or art. 2. Ugh, boring. 3. Sounds boring. How does it apply to anything I care about?	The learner shows disinterest or disengagement, often preferring alternative formats and expressing lack of motivation.
Delight	1. That sounds interesting! What was his art style like? 2. Interesting! Can we discuss the history behind it? 3. Cool! Can we have a class discussion about him?	The learner expresses excitement, positive emotional involvement, or genuine interest in the topic or learning activity.
Engaged Concentration	1. What are we going to do with it? 2. Why is it called a civil war? 3. Can we have a class discussion about it? I learn better that way.	The learner demonstrates focused, sustained attention to the learning task and asks purposeful, content-related questions.
Neutral	1. Okay. 2. Not really. I just know he sailed somewhere. 3. No, I haven't.	The learner responds without evident emotional involvement; no clear positive or negative tone, often context-dependent and minimalistic.

Student Dialogue Label Explanation Table

Label	Example	Definition
Self-Explanation	1. I learn better that way. (edu_conv_6186) 2. I prefer to learn through games or stories. (edu_conv_259) 3. I've always wondered how living things are put together. (edu_conv_3043)	The learner articulates their own reasoning, thought process, or personal learning preferences, often explaining choices or cognitive strategies.
Question Asking	1. Can we discuss it instead of just listening? (edu_conv_2663) 2. Is there a way we can make this more interesting? (edu_conv_6742) 3. What are we going to do? (edu_conv_798)	The learner initiates a question to seek new information, suggest a change in learning approach, or engage in dialogue.
Clarification Request	1. What is a metaphor? (edu_conv_7686) 2. Can you explain it in a way that's easy to understand? (edu_conv_2856) 3. Can you just explain it to me directly? (edu_conv_7283)	The learner explicitly asks for explanation or clarification of a concept, term, or instruction given by the teacher.
Confirmation	1. Okay. (edu_conv_2315, edu_conv_5047) 2. Sure, I'd like to learn about him. (edu_conv_2315) 3. No, I haven't. (edu_conv_1526)	The learner acknowledges, agrees with, or minimally affirms the teacher's input without adding new content or elaboration. Often used as procedural confirmation.

Note:

Label Pair	logistics
Self-Explanation vs. Confirmation	If the student explains <i>why</i> they like or dislike something → Self-Explanation . If they only respond with agreement (e.g., "Sure.", "Okay.") → Confirmation .

Question Asking vs.
Clarification Request

If the question is about **a concept/term the teacher mentioned**, label as **Clarification Request**. If it's about learning method or preference, use **Question Asking**.