**Math Argumentation and Reasoning Tool**

**DRAFT**(Do not cite without permission. | Classroom use permitted)

The following formative assessment tool is meant to help you gather examples of how students argue, reason, justify, and explain their thinking in math. This tool is most useful when a student is describing his or her thinking after or during working through a problem. As a student answers, you can use this tool to consider the strengths of a student’s arguments and reasoning, as well as the linguistic clarity of the explanation. A generic teacher question could be: *“Can you tell me and show me what you did to solve this problem?”* This tool is focuses on what one student says to describe his or her argumentation and reasoning, such as when a student is asked to explain his or her thinking in solving a problem. (There is another tool for assessing math conversation skills.) As a student talks, you can use this tool to notice and record what he or she is doing or saying and consider strengths and needs on the road to formal argument and reasoning.  While many different disagreement situations exist in math (e.g., which solution method is most efficient or which units to use in setting up a graph), this tool focuses on the deeper mathematical truth value of a claim; that is, explaining how you know that what you are saying is right, based on formal reasoning. (e.g., We need to try 0 because…, the ) and the reasoning used to solve a problem. Remember that students need substantive time alone (~5 minutes) to read, interpret, and work on the problem. You can use this tool as you directly work with a student or as you listen in on collaborative work with others.

**Dimension 1 – ARGUE: Makes a claim and supports its mathematical truth value**

 Claim(s):

|  |  |  |
| --- | --- | --- |
| **External Authority** | **Pre-formal****Reasoning** | **Formal Reasoning** |
| * **Teacher**
* **Peer**
* **Text**
* **Rote procedure**
 | * **Non-strategic examples** (e.g., says that 1 or 5 or 10 examples is “enough”)
* **Symbols, objects, movements, and visual examples** (tables, graphs, diagrams, drawings) **without formal explanation**
 | * **Principles, properties, definitions, axioms, theorems, and/or previously established results**
* **Counter-examples**
* **Strategic examples**
* **Constraints**
* **Verification of results**
* **Structure, regularity, patterns**
* **Symbols, objects, movements, and visuals** (tables, graphs, diagrams, drawings) **with solid explanation**
 |

***Scoring*** *(optional)* (Note: If student uses a combination, make a note of it. You can also use + and – signs)

3    Student uses **formal** reasoning to support the claim(s)

2    Student uses **pre-formal** reasoning to support the claim(s)

1   Student uses an **external authority** tosupport a claim(s)

0   Student **does not attempt** to support claims, or attempt is **unclear**

*RATIONALE:*

**DIMENSION 2 – DECONTEXTUALIZE: Uses representations** (symbols, objects, drawings, tables, graphs, equations, etc.) **to describe the mathematical situation**

*Sample teacher question to prompt Dimension 2 responses:*

 “Can you use (a picture, numbers, table, objects, etc.) to show me what you did? Explain how and why.”

3 Student effectively creates and uses representation(s) to clearly describe the mathematical situation of a problem and/or the reasoning (thinking) for solving it

2 Student creates and uses representations to describe the mathematical situation of a problem and/or the reasoning (thinking) for solving it, *but there is some lack of clarity.*

1. Student attempts to use representations to describe the mathematical situation of a problem and/or the reasoning (thinking) for solving it, *but there is significant lack of clarity and/or relevance to the problem.*

0 Student does not attempt to create or use representations to describe the mathematical situation.

*RATIONALE*:

**DIMENSION 3 – CONTEXTUALIZE: Keeps track of the meanings of the representations and their units**

*Sample teacher question to prompt Dimension 3 responses:*

“Can you tell me what this number, (drawing, symbol, result, label) means?”

3 Student clearly and strategically attends to what the representations refer to throughout the problem solving process

2 Student attends to what the representations refer to during the problem solving process, *but misses some opportunities or lacks some clarity in what the representations mean*

1 Student *attempts to* attend to what the representations refer to during the problem solving process, *but there is significant lack of clarity in what the representations mean*

1. Student *does not attempt to* attend to what the representations refer to during the problem solving process.

*RATIONALE:*

**DIMENSION 4 – EXPLAIN: Uses language to clearly explain argumentation and reasoning**

*Sample teacher questions to prompt Dimension 4 responses:*

“Can you tell me what your thinking was when you …? Why did you…?”
“Can you (slowly, clearly, etc.) describe each step and how one leads to the next?”

3 Student effectively uses logically organized and connected language (sentences, clauses, phrases, words) to explain argumentation and/or reasoning

2 Student used organized and connected statements to partially explain argumentation and/or reasoning

1 Student attempts to use organized and connected language to explain argumentation and/or reasoning, but idea(s) are unclear, disjointed, illogical, and/or irrelevant.

0 Student does not attempt to use language, uses only single sentences, or does not attempt to organize and connect sentences to explain argumentation and/or reasoning.

*RATIONALE:*