

# Is Argumentation the to Mathematics Education?

## Yes!

Research suggests that **if students use viable argumentation** in their middle school classes, then they will **increase their complex mathematical reasoning and mathematics achievement.**

Existence

Counter-example

Exhaustion

Direct

Indirect

### Success Story: 2016



In a pre-LLAMA pilot study, one teacher fully implemented viable argumentation into her lessons throughout the 2015-2016 school year and saw **significant increases** in her students' SBAC scores.

13 Grade 8 Students

pre  
54%

Proficient or Above on SBAC

A Year of Viable Argumentation



post  
69%

Proficient or Above on SBAC

### Success Story: 2018



One LLAMA teacher fully implemented viable argumentation into her lessons throughout the 2017-2018 school year and saw **significant increases** in her students' SBAC preparation scores.

9 Grade 7-8 Students

pre  
22%

Proficient or Above on SBAC

A Year of Viable Argumentation



post  
44%

Proficient or Above on SBAC

*"I wanted everyone to know that I appreciate the struggle of those that started the year with students that were not prepared for Grade 8 mathematics, and to let them know that I did find some ways to engage students in the deep learning in the LLAMA lessons while attending to students' developmental needs."*

# Is Argumentation the to Mathematics Education?

The LLAMA project frames argumentation with the **5 argument types**: existence, counterexample, exhaustion, direct, and indirect.

## Existence

Claim uses the phrase “there exists.” Arguer provides a candidate (example) in the domain of the claim and shows that the candidate has the desired properties (or proves at least one conforming case must exist).

## Counter-example

Claim reports that a generalization is false or states “there exists a counterexample to the generalization.” Provides an example that satisfies the conditions and/or does not have the properties of the conclusion. Shows that the provided example has these two properties.

## Exhaustion

Claim is a generalization with a finite domain. Arguer tests every case in the domain and includes these tests in the argument, which shows that both the conditions and conclusion of the claim are satisfied for every case, in an organized, explicit, and complete foundation, perhaps using an organized list.

## Direct

Claim is a generalization. Arguer leverages representations, prior knowledge (results), and logical necessity to demonstrate that every case of the conditions has the conclusion. This proves there are no counterexamples to the claim.

## Indirect

Claim is a generalization. Arguer leverages representations, prior knowledge (results), and logical necessity to demonstrate that every case of not the conclusion has the property not the conditions. This proves there are no counterexamples to the claim and can take the form of a contrapositive argumentation or contradiction argumentation.



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