

POGIL

Student Argumentation and Participation Patterns in General Chemistry Peer-Led Sessions

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Introduction
to POGIL:
The Fundamentals

The POGIL Project 2013

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Background

Peer-Led Guided Inquiry (PLGI)
Once a week-50 minutes
Peer leaders receive weekly training
Small groups (3-4 students)
ChemActivities (Moog & Farrell, 2008)

Examine group processes
Group learning (Lewis & Lewis, 2008)
Student-student discourse

Kulatunga, U., Moog, R. S., & Lewis, J. E. (2013).
Argumentation and participation patterns in general
chemistry peer-led sessions. *Journal of Research in Science
Teaching*, 50(10), 1207-1231.

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Why Argumentation?

Argumentation

Understanding of science concepts
(Cole et. al, 2013; Jimenez-Aleixandre et al. 2000;
Zohar & Nemet, 2002)

Promotes scientific reasoning
(Becker et. al, 2013; Osborne, 2010)

Develops content knowledge
(Nussbaum, 2008)

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Toulmin's Argumentation Scheme Basic Argument

```

graph TD
    DATA([DATA  
supporting  
information]) --- WARRANT([WARRANT  
reasoning linking  
data to the claim])
    WARRANT --- CLAIM([CLAIM  
answer])
  
```

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An Example

Prompt: Which has more legs, a chicken or a horse?

Norb: I think it is the horse. But I would rather eat a chicken leg!

Pratibha: I know that a horse has four legs and a chicken has two legs.

Simon: Yes, and four is more than two!

Pratibha: So we did it! Good job team!

```

graph TD
    DATA([DATA  
4 legs]) --- WARRANT([WARRANT  
4 is more than 2])
    WARRANT --- CLAIM([CLAIM  
Horse])
  
```

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Another Example

Prompt: What is the significance of the atomic number, Z?

Norb: I am not sure. Does anyone have a chicken leg?

Pratibha: It is the number of protons in every atom of an element.

Simon: Sounds good to me.

Norb: I agree.

Pratibha: So we did it! Good job team!

This is not an argument. Only a claim is made.

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Toulmin's Argumentation Scheme Higher-level Argument

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Another Example

Prompt: Which has a larger atomic radius, F⁻ or Ne?

Norb: It must be neon. That's a gas, isn't it?

Pratibha: I thought it was fluoride. Maybe we should think about how many electrons and protons there are. I remember that F has 9 protons and Ne has 10.

Simon: They have the same number of electrons, don't they?

Norb: If they have the same number of electrons, then the one with more protons will pull harder on the electrons and will be smaller. I guess that means that neon is smaller so the answer is fluoride.

Simon: That makes sense. It's like the last one where K⁺ is smaller than Ar because it has more protons.

Pratibha: So we did it! Good job team!

DATA CLAIM WARRANT REBUTTAL BACKING

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Another Example

Prompt: Which has a larger atomic radius, F⁻ or Ne?

Norb: It must be neon. That's a gas, isn't it. Claim

Pratibha: I thought it was fluoride. Maybe we should think about how many electrons and protons there are. I remember that F has 9 protons and Ne has 10. Rebuttal

Simon: They have the same number of electrons, don't they? Data

Norb: If they have the same number of electrons, then the one with more protons will pull harder on the electrons and will be smaller. I guess that means that neon is smaller so the answer is fluoride. Warrant

Simon: That makes sense. It's like the last one where K⁺ is smaller than Ar because it has more protons. Backing

Pratibha: So we did it! Good job team!

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Analytic Framework

Condition	Level	Description
Individual Arguments	I1	Claim, data, warrant(s) provided by one student
	I2	Claim, data, warrant(s) provided by one student, backing(s) provided by the same student
Co-constructed Arguments	C1	Claim, data, warrant(s) provided by more than one student
	C2	Claim, data, warrant(s) and backing(s) provided by more than one student
	C3	Claim, data, warrant, and a rebuttal provided by more than one student (with or without backing)

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Data Source

Weekly peer-led sessions (50 minutes) videotaped in Spring 2008

Two small groups, each in a different session
A total of 24 videos, 12 from each session

All videos were transcribed; transcripts were coded while watching the videos

Codes were based on Toulmin's Argumentation Scheme and the analytic framework
Cohen's kappa 0.64 (substantial agreement)

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Research Questions

- How frequently are various levels of individual and co-constructed argumentation observed within small student groups?
- What patterns of participation in argumentation by individual students are observed in these groups?
- To what extent do students in small groups resolve originally incorrect claims?

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Sample Argument

PROMPT: QUESTION 4. What is the dipole moment of CCl_4 ?

[00:36:26.10] Joe: Yeah, what number are we on? [00:37:08.26] Joe: What? Why is it?

[00:36:26.17] Scott: Four.

[00:36:33.28] Mike: Oh yes [00:37:19.12] Mike: Just like the other...the CO_2 because there's no distance between the center of the charges. (**BACKING**)

[00:37:04.05] Mike: So it's zero (**CLAIM**) because of distance, right? (**DATA**)

[00:37:06.20] Scott: Because of distance between the center of charge is zero. Yeah. (**WARRANT**)

Argument Level: C2

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Distribution of Episodes

Group	Claims Only	Claims & Data	Arguments	Total	% Arguments
A	15	19	105	139	75%
B	21	33	96	150	64%

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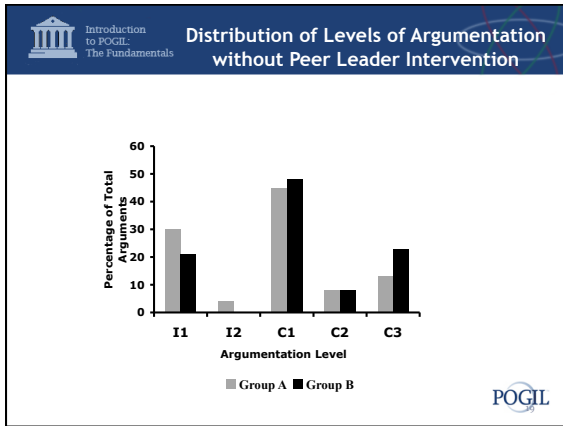
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Resolving Incorrect Claims

Group	Arguments	Incorrect Claims	Resolved Correctly
A	105	22	20
B	96	23	20

Overall, 97.5% of all arguments ended in a correct claim.

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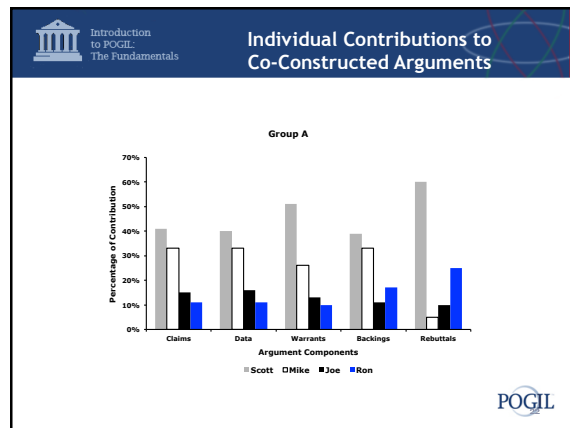
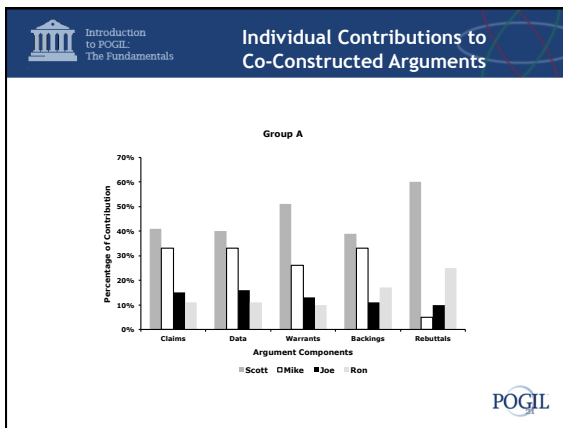
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Participation Patterns for Individual Arguments

Group A

Student	# of PL Sessions	Individual Arguments Offered	Percentage of Individual Arguments	Average per Session	Final Class Grade
Scott	12	22	61%	1.8	A-
Mike	12	8	22%	0.67	B
Joe	12	4	11%	0.33	B
Ron	12	2	6%	0.17	C

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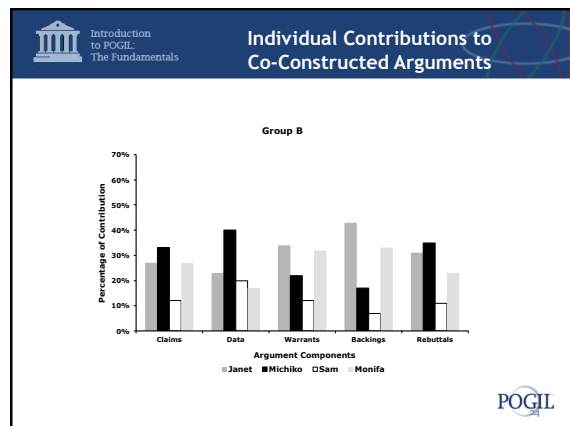
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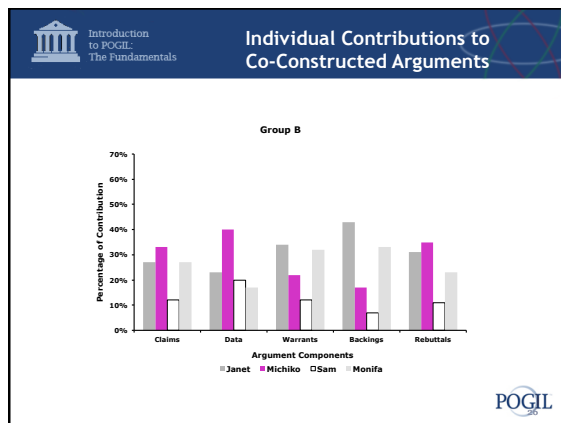
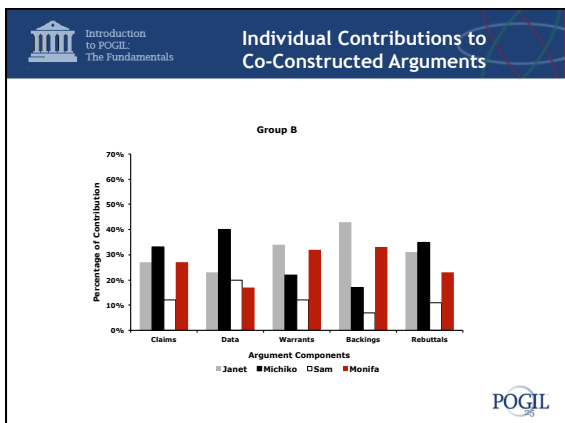
Participation Patterns for Individual Arguments

Group B

Student	# of PL Sessions	Individual Arguments Offered	Percentage of Individual Arguments	Average per Session	Final Class Grade
Janet	11	8	40%	0.72	C-
Michiko	12	8	40%	0.67	B-
Sam	8	2	10%	0.25	F
Monifa	12	2	10%	0.17	A-

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Findings

Level of Argumentation

- The majority of the argumentation is co-constructed
- Students support most of the claims with data and warrants
- Students rarely offer backings for arguments
- Students were able to resolve wrong claims: 91%-Group A, 87%-Group B

Findings

Participation Patterns

Participation patterns were different for the two groups

Group A

- Large discrepancy in participation
- Individual and co-constructed similar
- Relationship between individual arguments and achievement

Group B

- Discrepancy in the challenging components
- Contributed more for co-constructed arguments
- No relationship between individual arguments and achievement

Implications for Group Work

- A useful analytical framework
 - Argumentation
 - Participation patterns
- Students solve problems on their own
- Knowledge production as a group
- Stronger arguments collaboratively
- Not equal contribution to constructing arguments