Understanding and Scaffolding Constructive Collaboration

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Collaborative situations

- ...as promising knowledge-building environments in learning science research.
- Cases with radical gains are rare
- Style and nature of learning and teaching changes.
In this talk...

• identify a case of strong effects of collaboration,
• propose an explanation of the gain,
• report a case study of a learning environment with technology support to test the explanation.
Task

\[ \frac{3}{4} \times \frac{2}{3} = \frac{1}{2} \]

“Shade 2/3 of 3/4 of the origami paper with oblique lines.”

(Shirouzu, Miyake, & Masukawa, 2002 Cognitive Science, 26, (4))

People do not calculate, they tend to use origami to find the answer.
Sequential trials?

First trial: \( \frac{2}{3} \) of \( \frac{3}{4} \)

\[ \downarrow \]

Second trial: \( \frac{3}{4} \) of \( \frac{2}{3} \)
Solo subjects

First trial
2/3 of 3/4
14
1

Second trial
3/4 of 2/3
11
4

Non-arithmetic
Arithmetic

First       Second
2/3 of 3/4    3/4 of 2/3
Paired subjects

First
2/3 of 3/4

Second
3/4 of 2/3

- Non-arithmetic
- Arithmetic

13
4
2
11
What happens in pairs??

What do *solos* do, in the first place??
What do solos do?

• Would $\frac{2}{3}$ of $\frac{3}{4}$ be different from $\frac{3}{4}$ of $\frac{2}{3}$?
• What if not origami paper but thick construction paper, or acrylic board?
• When they fold, how do they use origami?
• Do they notice that the answer is one-half after shading?
Less than 10% calculate

Not blindly react to what’s out there.
Process analysis

They open the paper in the middle ...to confirm?
When asked “What’s the answer?” they do not always answer “One-half.”
What could this all mean?

• People are active users of external resources, with a proto-plan to first take care of the first fraction, confirm, and then proceed.

• So far as this works, there is no need to change.
In a paired situation?

- Each individual is an active solver.
- They take turns: while one solves the problem as a **task-doer**, the other **monitors**.
- The monitor does not share the doer’s proto-plan, but interprets the situation from somewhat a broader perspective.
Getting 2/3 of 3/4 (1)

Person 1

Task-doing

\[
\begin{array}{c}
\hline \\
\hline \\
\hline \\
\hline \\
\end{array}
\quad \rightarrow \quad
\begin{array}{c}
\hline \\
\hline \\
\hline \\
\hline \\
\end{array}
\]

3/4

i) Original

ii) 1st Re-interpretation

Monitoring

Person 2
Getting 2/3 of 3/4 (2)

Person 1

Task-doing

Person 2

Monitoring

i) Original

ii) 1st Re-interpretation
Getting $\frac{2}{3}$ of $\frac{3}{4}$ (3)

Person 1

Task-doing $\rightarrow$ Monitoring

\[\begin{array}{c}
\text{i) Original} \\
\begin{array}{c}
\text{3/4} \\
\{\text{Thirds}\} \\
\text{2/3} \\
\end{array}
\end{array}\]

Person 2

Monitoring $\rightarrow$ Task-doing
Getting 2/3 of 3/4 (4)

**Person 1**

Task-doing → Monitoring

- Original
- 1st Re-interpretation

**Person 2**

Monitoring → Task-doing

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Getting 2/3 of 3/4 (5)

Person 1

Task-doing → Monitoring → Task-doing

3/4 → 2/3 → 3/4 x 2/3

i) Original  ii) 1st Re-interpretation  iii) 2nd Re-interpretation  iv) Calculation

Person 2

Monitoring → Task-doing → Monitoring
Collaboration works because...

• Variations of solutions differing in the degree of abstraction, *which could create a “ladder” for subjects to climb up the levels.*

• Abstraction process involves language use (for a conceptual schema formation).
Designing collaboration for fostering understanding

1) Encourage externalization
2) Solicit multiple re-interpretations
3) Iterate re-interpretation efforts
4) Support integration of different solutions/re-interpretations.
Context

• Teaching cognitive and learning sciences to undergraduates

• Goal: Have them integrate different research findings to come up with theory-like understanding, “applicable” to their real life.
All the notes are linkable, Commentable, revisable, Sharable, and kept.
Integration of research results

Integrated summary

Summarize relationships

Group 1

Group 2

Group 3
Iteration of making summaries

e.g. “What could we make out of series of research done on the ‘Wason selection task’?”

- Seven groups of 4 to 5 students work on seven pieces of research
- “Theorize” and explain varying results.
- Iterate presentation for three times.
Interactive Query Raiser
CMS—Commentable Movie Sheet
MDS--Multimedia Document System
From basic research to application

• Real classrooms are a rich test-bed for many cognitive theories.
• Some theories are starting to have impacts on classrooms.

There is a lot more we can do...