Scaffolding scientific explanation in Chemistry through language-specific support

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Overview

- Background context

- Focus of study

- Theoretical underpinnings

- Methodology

- Mediating the task

- Mediating the talk

- Students' feedback

- Pedagogical implications

Focus of study

Key research Q:

How can teachers support students to meet the demands of scientific explanation in Chemistry?

Focus:

1. How mediating the task was realised in pedagogic practice to support the construction of explanations

2. How mediating the talk could open up classroom discourse to support students' learning, and sharpen accuracy and precision

3. What the pedagogical implications were for classroom practitioners

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Scientific explanation

- Purpose of Science is to explain phenomena (Stefani & Tsaparlis, 2009)
- Considered one of the essential features of scientific inquiry (MOE, 2012, p.7)
- Involves drawing connections between and among pieces of information (Bateson, 1979)
- To explain - To map the thing onto a logical system of causality (Bateson, 1979)

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Theoretical underpinnings

- Socioconstructivist perspectives (Applebee, 2002; Vygotsky, 1978, 1986) grounded in Vygotskyan (1978) internalization of social experiences in school mediated by tools such as language

- How language functions as a key mediating tool in learning activity and as a task-enabling support (Michell & Sharpe, 2005) to develop students' understanding and construct knowledge through instructional scaffolding (Wood, Bruner & Ross, 1976)

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Methodology

- Interpretive approach to qualitative data analysis

- How language used at particular moment in time and space in the flow of a social situation (Bloome & Clark, 2006)

- Naturalistic nature of the data provided groundedness:

  authenticity and complexity of discourse and nature of tasks as they unfolded (Miles & Huberman, 1994)

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Methodology

- Subjects:

-Upper Secondary Chemistry students in 2 classes:

Secondary 3 (Grade 9) Express – 28

Secondary 5 (Grade 11) Normal (Academic) – 14

Mainstream school, average to low socioeconomic background

-2 teachers with … years' experience each

- Data sources:

Teachers' instructional materials

Students' written work

Transcripts of recorded lessons

Students' feedback from survey forms

Mediating the talk for learning

-Mediating the talk to open up classroom talk is critical

- to support students' learning, and

- for sharpening accuracy and precision in explanations

-Need for reinforcing students' learning with verbalizing explicitly what students need to be made aware of at different stages of learning

- Talk moves -Strategic ways of asking questions and inviting participation in classroom conversations' (Chapin, O'Connor & Anderson, 2013)

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Mediating the talk for accuracy and precision

So there was a comment just now, that when we increase the temperature, your particles expand.

…Ok listen, it is not accurate for us to say that when temperature increase, your particles expand.

The object will expand when we increase temperature. But the individual particles inside it does not expand. You see the object expand because the particles can move further apart. That's why they expand.

Understand? So please do not tell me that your particles expand when your temperature increase.

Your particles are moving faster, they can be further apart from each other. Therefore the actual object expands.

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Students' feedback

How support scaffolds helped students	Student response
Enhance content understanding	*Useful as we know more about the topic*
Remember key content vocabulary	*Helps us understand the words better and using them in explanations*
Ensure clarity of explanation	*And you get a better clarity of explanation by breaking down the text*
Internalize, process and transfer understanding of content to another form	*It was very strongly useful. I find it a good use for notes. And it is also very easy to understand as it is broken down*
Support content recall and reinforcement	*Useful because it is easier to remember than reading and reading everything all over again*
Motivate students in content learning	*It made the class more interesting*

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Pedagogical implications

- Nature and purpose of visual resources and graphic representations to meet specific purposes in particular learning contexts

- Support scaffolds could aim to focus and draw attention, scaffold thinking, and/or identify, select and organize information

- How resources could be further amplified with relevant language support - content-specific terminology

- Interplay of different types of scaffolding at various levels to meet targeted outcome(s)

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Pedagogical implications

How learning resources with in-built support mechanisms are used to enhance students' learning:

- **Complementary** teaching resources to guide students in the initial stages of learning
- **Supplementary** resources to reinforce students' learning in the process of unpacking a complex topic/concept
- **Enrichment** resources to further extend students' learning

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Pedagogical implications

- Strategic use of scaffolding with supportive structures in place through a staged, step-by-step process that is systematic and purposeful

- Need for gradual release of scaffolds for students to internalize and process content specifics for the construction of the explanation

- Mediating the talk to align the visual with the textual in learning tasks and resources for purposeful meaning-making

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Pedagogical implications

- Talk enables students to make sense of visual resource (graphic organizer, template) to structure thinking along specific lines, organize the content and/or express the logical relations in the given context
- Talk making explicit procedural steps to reinforce links or connections across stages in the process of unpacking concepts
- Professional development of subject teachers broaden teachers' repertoire of questioning strategies and incorporate relevant talk moves targeted for different purposes

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Pedagogical implications

- How students can be supported through relevant and appropriate prompts for responding

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