THE ROLE OF DISCOURSE IN TEACHING SCIENTIFIC INQUIRY: A DESCRIPTIVE STUDY OF TWO STUDENT TEACHERS
Background – Inquiry-based instruction & discourse

- National Science Education Standards (NRC, 1996): science as inquiry
- Inquiry and the national science education standards (NRC, 2000)

Essential Features of Classroom Inquiry

1. Learner engages in scientifically oriented questions
2. Learner gives priority to evidence in responding to questions
3. Learner formulate explanations from evidence
4. Learner connects explanations to scientific knowledge
5. Learner communicates and justifies explanations
“fluent speaker of science” (Lemke, 1990)

A productive marriage of science and language as key to scientific literacy (Mercer et al., 2004; Lewis et al., 2008; Hackling et al., 2010)

Classroom discourse is mostly controlled by teachers and little of it is used for reasoning or developing ideas (Blanchard et al., 2008; Hackling et al., 2010)

The practice of inquiry-based instruction often takes on different forms (Crawford, 2007)
Research Questions

1. What does inquiry-based science instruction mean to preservice science teachers (PTSs)?

2. How do PTSs view the role of discourse in inquiry-based science instruction?

3. How do PTSs structure a classroom discourse that supports teaching scientific inquiry?
Methodology

- Participants
  Mary, 8th grade biology
  Jane, 12th grade anatomy & 10th grade biology, block

- Data collection
  - EQUIP instrument (Marshall, Smart & Horton, 2010)
  - Class video (45 min)
  - Semi-structured interview (45-60 min) with each participant
Theme 1: Teaching scientific inquiry

- “Doing science” through hands-on activities
- Understanding the nature of science (NOS)
  - Scientific knowledge is tentative
  - Scientific inquiry is a collaborative process
    * Students communicate about scientific concepts (Mary)
- Acquiring the scientific language, e.g. vocabulary, writing (Jane)
Theme 2: Limited role of classroom discourse in supporting scientific inquiry

<table>
<thead>
<tr>
<th>PST &amp; Topic</th>
<th>Class activities</th>
<th>Discourse type</th>
<th>Instructional purpose</th>
<th>Duration (minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mary: Arthropod</td>
<td>Graphic organizer</td>
<td>Small group</td>
<td>Review</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Arthropod quiz game</td>
<td>Whole class</td>
<td>Concepts/application</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Graphic organizer/drawing</td>
<td>Individual</td>
<td>Summary/review</td>
<td>10</td>
</tr>
<tr>
<td>Jane: Skeletal system</td>
<td>Board game</td>
<td>Small group</td>
<td>Prior knowledge</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Sharing questions</td>
<td>Whole class</td>
<td>Prior knowledge</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Mini-lecture</td>
<td>Whole class</td>
<td>Explanation</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Labeling the manikin</td>
<td>Small group</td>
<td>Concepts/review</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 3. Questions captured from the video lessons

Teacher-generated questions: Type, count and examples

<table>
<thead>
<tr>
<th>Type</th>
<th>Mary</th>
<th>Jane</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-answer</td>
<td>16</td>
<td>11</td>
<td>Where is the zygomatic bone? What type of arthropod is this?</td>
</tr>
<tr>
<td>Explanation</td>
<td>2</td>
<td>3</td>
<td>Why does it (sternum) has 3 parts? How did you know it’s a centipede?</td>
</tr>
<tr>
<td>Open-ended</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Student-generated questions: Type, count and examples

<table>
<thead>
<tr>
<th>Type</th>
<th>Mary</th>
<th>Jane</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Clarification | 2    | 4    | Is sacrum the tailbone? Do we need to draw all the legs of the centipede?
“You have to be careful not to get sidetracked with some of those questions because they are, it's like, you want to get into this whole area of medicine that really wasn't what we were talking about today. But it's a really good question, so you try to answer it, try to answer it but kind of not completely get off track... Sometimes we can get good discussions go on.” (Jane, interview)

“Kids have a lot to bring to the class.... to some extent, you have to limit that so that you have time to finish your lesson because they could sit and talk about their personal experience. So there's a real balancing act I'm trying to figure out between encouraging that on one hand but also using it to steer the ship in the direction that it needs to go at the same time.” (Mary, interview)
### Table 4. Factors identified by PTSs

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mary</th>
<th>Jane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperating teacher</td>
<td>Much involvement</td>
<td>Little involvement</td>
</tr>
<tr>
<td>Time</td>
<td>No time for inquiry</td>
<td>Adequate time for inquiry</td>
</tr>
<tr>
<td>Student (age)</td>
<td>Younger students easier to engage</td>
<td>Older students with higher level of maturity</td>
</tr>
<tr>
<td>Tests</td>
<td>Test questions do not test students’ ability to conduct scientific inquiry</td>
<td></td>
</tr>
</tbody>
</table>
Discussion

- **IRE model**
  “guessing game” vs. authentic dialogue (Deneroff et al., 2002)

- **Argumentation**
  a monolith of facts, an automotive discourse vs. an attempt to establish truth with a claim supported by data, warrants, backings, qualifiers (Osborne, 2010)

- **Cooperating teacher**
Limitations

- video
- data size
- written ?
Conclusion

This study finds that the meaning and the practice of teaching scientific inquiry could have a different emphasis due to PTSs’ own experience with inquiry and the nature of the class they teach. The two PTSs confirmed that discourse plays an important role in inquiry-based science classrooms, however, the degree to which they would like to have students talk about scientific ideas varies. Based on their video lessons, it is not difficult to conclude that teachers still do most of the classroom talking and oftentimes the talking is not supported by authentic inquiry experiences.
Questions and comments?
Thank you!

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