Proposal for a Cognitive Study of Interdisciplinary Learning

By
Laura Malcolm
Anuja Dharkar
Introduction of Learning Problem:

At Clemente High School in inner city Chicago, the principal has implemented many innovations to foster collaboration among teachers and between subject areas. In 1998 the principal introduced the concept of core teaching for the 9th grade. In this construct a set of four teachers work together with the same group of students during a school year. This structure was put in place in response to the statistic that 78% of 9th graders failed at least one class during the year and 53% did not earn enough credits to be considered sophomores the following year. The stated purpose for the teams is to allow teachers to collaborate on interdisciplinary lessons, share insights concerning students, and create a “school within a school atmosphere” where students and teachers would know each other well. After two years of teaching with the “Core Team” construct, teachers are finding that students are not able to make links in understanding between subjects. They retain a domain specific knowledge even though teachers are teaching an interdisciplinary curriculum. In order to research this learning problem we propose completing a needs analysis study of the teaching methods and mental models students have concerning two of their core subjects: history and science. We plan to conduct this study for the duration of a six-week term at the end of the school year, after which we will report our findings to the principal and core team teachers.

Goal of this study:

Our goal is to study the classroom teaching methods and cognitive models that students have concerning interdisciplinary learning in History and Science. The data we collect will then inform the design of new teaching methods and activities to aid in student understanding and to enhance achievement. We will be examining the practices within two core areas, history and science and the cognitive links that are made between these domains. Questions we are interested in answering are:

- If students are being taught an interdisciplinary curriculum, why are they unable to create connections between subjects?
- Are students learning parallel content in order to build a complete schema?
• What are the students’ conceptual models of the teacher’s role in each class? Do they see their teachers as experts who can teach between domains?
• What type of cognitive understanding do students’ have concerning the links between history and science? Is student knowledge at a content or concept level?
• Do students see themselves as active and capable participants in the learning process?

**Design of Needs Analysis:**

A needs analysis study is the primary step in the investigation of our questions. For purposes of this study we will analyze the learning problem from a cognitive perspective, this will provide insight into the mental models related to the learning process. It will help us gain information regarding the development of concepts in student learning and the barriers that limit cross-curricular connections. Our purpose is to observe and record teaching methods and students’ cognitive modeling. In order to collect information in these areas, our study will be comprised of observations, interviews, surveys, and an assessment exercise.

**Observations:**

We suggest observations concerning question and answer protocol currently in place within the two classrooms. These observations will give us insight into:

• Teaching at content or concept level.
• Agency level students exhibit in the classroom community.

Field notes and videotaping will be used to study the type of questions being asked between teacher and students. The questioning patterns in a classroom can be a strong indicator of the level of conceptual understanding students have concerning the subject. If students are asking low-level content questions, they are not exhibiting a strong understanding of the concepts that can make the link between subject areas. While Science and History can sometimes be linked on a content level, it is on the conceptual level that students create flexible mental models that allow for the generalization between subject areas.

Observations can also give insight into the zone of proximal development that exists within the classroom. Is the student an active participant in the questioning
process, or do they respond only to teacher prompting? Our observations would categorize the types of questions students ask to assess the roles that they adopt in the learning process. Do teachers use the reciprocal teaching method to break the traditional role of teacher-student, and give students more control in the questioning process? Allowing a student more control over their learning process can aide in fostering ownership over knowledge to build expanded schemas of subject areas.

*Interviews:*

A second method of assessment we propose is the use of interviews. The interviews will be used to gauge student perception of teacher expertise and student roles in the class. We are interested in learning if students see their teachers as capable of teaching outside their specific content area. If the mental models the students have limits the role of the teacher to one area it may inhibit their ability to see the validity of making connections between subject material.

Interviews would also be a helpful tool in understanding student perceptions of ownership regarding the material. If a teacher makes the connections between subjects for the students, instead of allowing students to discover the links through exploration, they may not be willing to adopt the relationship. Student opinions concerning the teaching of interdisciplinary material would be valuable to the research process. Possible questions would be:

- How much History do you think your Science teacher knows? (and the reciprocal question)
- Do you see a relationship between Science and History?
- Does it help you to learn Science when your Science teacher relates the material to History?

*Surveys:*

Surveys will measure student perception of interdisciplinary teaching between two subject areas. They will help us measure the extent of integration of the two subject areas. Are students aware of the interdisciplinary teaching process in their core team? Is
it part of their mental model regarding History and Science class? An example of a survey question addressed to students could be:

<table>
<thead>
<tr>
<th></th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Seldom</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>My science teacher teaches us about more than just science:</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>What I learn in my science class helps me understand history:</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Assessment Exercises:**

We propose the use of a written exercise to assess cognitive links made between subject areas. Student will be given an example of a Venn diagram where two spheres do not intersect and an example where they do intersect. Such as follows:

Example 1.

Example 2.

Students will then be asked to choose which diagram illustrates the domains of history and science. Do they choose the linked spheres? If they choose the linked spheres, what ideas or concepts do they see as shared between subjects? Students will be asked to list the concepts that support their model of the interaction between History and Science.

**Conclusion:**

Through this needs analysis we hope to discover the source of the learning problem at Clemente High School. The information taken from the interviews,
observations, surveys, and assessment exercise will work together to create a picture of the mental models and teaching methods that contribute to the retention of domain specific knowledge. Some possible explanations of this learning problem could be that:

- While teachers present interdisciplinary material, they control the learning process to a point that students aren’t enhancing their schema of the class. Teachers use scaffolding method of teaching but do “fade” or shift control to students. Students end up with domain specific knowledge and context specific knowledge due to their reliance on the teacher.

- Teachers are teaching interdisciplinary content instead of interdisciplinary concepts. (If a student has an understanding of concepts in one area, they may be better able to generalize to another area.)

- Students’ prior mental models of classroom instruction and teacher and student roles are so strong they inhibit the ability of the students to accept a new interdisciplinary model.

This information, gathered from our needs analysis, can be used to inform the design of new teaching methods and activities. With an understanding of the cognitive processes in place we can propose a solution to the problem of domain specific knowledge within this interdisciplinary team.