Influence and Interpretation of Context in Complex Learning Environments

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INTRODUCTION

A couple of years ago, Larry started with a vexation about what constitutes learning when using your hands to manipulate objects. How do you characterize the effect of touching objects, measuring their temperature, or putting them in contact with one another and feeling the results on learning about heat transfer? Musicians talk about muscle memory. Is there such a thing as muscle learning? Puzzling about hands-on learning morphed into puzzling about the claim, that working with problems in the real world (e.g. hands-on environments) involves the use of knowledge that is "integrated" as opposed to knowledge that is segmented into disciplines such as science and mathematics. Untangling understandings about heat transfer in a real world context seems to involve thinking about materials and their uses (e.g. cooking with a cast iron skillet), physiology of senses and skin (e.g. I can't touch something without being touched), and intuitive ideas about 'hot' and 'cold' and related experiences (e.g. ovens and freezers). As educators, we think about how to turn these modes of thinking in knowledge rich contexts intended to improve learning. We want to tap into relevant prior knowledge. These two previous vexations concerned thinking more carefully about "hands-on" learning (e.g. what does a carpenter know about geometry that a mathematics teacher does not and visa versa?) and about integrated knowledge (e.g. how do math and science work together in one's mind while working on real a world problem?)

VEXATION

This past year Larry and Rebekah have been working with the teachers of high school freshmen in a "high needs" school to improve achievement in algebra. The teachers are working in several disciplines within an overall program of project-based learning. They design hands-on tasks derived from real world problems. Our project has teachers explicitly highlighting algebraic ideas in the context of projects in their own classes. The metals teacher had students examining gear ratios, the consumer and family studies teacher engaged students in scaling up a sports bag pattern, and the science teacher explored human performance through graphs of Olympic records. In each case, there was an explicit attempt to set a context that would be meaningful to students, stimulate relevant prior knowledge, and by relating algebraic ideas to that context, make the mathematics more meaningful as well. We were struck by students who were unaffected by these tasks. It was as if they were sitting at a desk doing just another worksheet. Did these students not perceive this as a novel and productive context for doing something interesting? Were they just seeing these efforts as just more of what they saw as "school"? We also wondered if they did not fully understand what was going on in this complex learning environment. If you are socialized to school, in particular algebra, as being textbooks, teacher talk, and chapter tests, then maybe they perceived task instructions as text, the projects as tests, and teachers promoting discussion as more talk to be listened to. In other words, they saw the classroom as the same context of talk and tasks.

The problem of thinking about context and its interpretation is problematic because of the many uses of the term 'context.' Context can be the physical place in which an activity occurs, as in home or school. Context may refer to the content of the task, as in math or science or both. It could refer to the function or meaning of the task, as in project or test or homework or inquiry-based investigation. Context can refer to the presence or absence of others, or the familiarity of the materials. Ultimately, we are concerned with the psychological representation of context. A teacher may design a classroom with several features that are conducive to project-based learning. To the student however, the most salient features of the context may be the traditional classroom structures and expectations that certain tasks be completed by a certain time according to the directions.

The perception of context has a significant impact on what one notices, experiences, and learns. My perception of context will affect what knowledge I will try to access, what tools or resources (psychological or physical) are relevant to the task, and even how I feel about my capabilities in participating. How I perceive the context will affect how I interact with the people around me to achieve common and individual goals. My social capital can change based on my perception of the norms and values in which I think I am working. The context influences the cognitive and social resources I can use and, in a classroom designed to be interactive with tasks requiring group effort, my social capital will affect my success.

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A teacher attempts to set a context for learning that will engage her students. This instructional design task is challenging because not all students are alike. They do not like the same things and they have different skills. However, a successful teacher establishes norms for social interaction that foster access to cognitive and social resources of the group as a whole. If a student has limited social skills, if there is ambiguity or misunderstanding of what is expected or valued, or negative conditioning from prior experience, then individual and group accomplishments are compromised.

There are many interesting research examples in the social sciences that make the effect of context more concrete. Consider this example involving the context of a street musician. Street musicians attempt to generate social capital by pleasing the passersby who offer payment for the performance. However, as they say in real estate, location is everything, or I would say context is everything. The world-renowned violinist, Joshua Bell, dressed in street clothes and performed Bach in the L'Enfant Metro Station in Washington DC. The setting was early morning as commuters were headed for work. He was hardly noticed. He made $32 and change in 43 minutes. The night before people paid an average of $100 a ticket to attend his concert. To Bell the experience was surprising and painful. He found himself getting a little nervous when he did not see people reacting as he was accustom. In the concert hall, his social capital was established before he set foot on stage. Here he had to find a way to earn it.

A change in context carries with it both cognitive and social consequences. A reading comprehension study compared student performance on reading sparsely written text versus text with more interesting and engaging detail covering the same information. Students reading the sparse text did better on an assessment of the content common to both reading tasks. Students were apparently sidetracked from the target information by the "seductive details." This raises questions about the complex environments we design for science and mathematics investigations and longer-term projects. How do students understand the purpose of these learning environments? In what ways do their interpretations change the social and cognitive dynamics? How do we best bridge the gap between the intended design of the environment and student perceptions? What can we learn from student perceptions that will allow us to design better contexts for working with highly meaningful yet complex ideas?

VENTURE

The psychology of education has been shaped by a psychometric view of learning that asks the question, how much does one know? I would like to investigate the design and perceptions of educational environments that foster a response to a different question: in what ways does one know?

I would like to interview students about their perceptions of learning environments within the high school program discussed above. In this program, students are presented with algebraic ideas across three different courses during their freshman year (algebra, science, and career technical education). Their language describing what is happening in different courses and what purposes they ascribe to these activities is likely to reveal a variety of contexts. Working from their point of view we would ask: Does the teacher provide opportunities for students to talk to each other about the class? Is it normal for you to ask another student for information about the class? Do students ever ask you for information? Do you ever express disagreement with the ideas of the teacher or another student? Are other students allowed or encouraged to respond during class?

We anticipate using an outside observer to focus on parts of the classroom. Do the "seductive details" of a context-rich environment sidetrack students? For example, are they more interested in playing with the temperature probe than they are in collecting data meaningful to the problem? Does a detailed observation reveal ways that the context-rich environment has supported the development of social capital that is turned toward productive inquiry? On the other hand, is this complex instructional environment working to the advantage of some while disadvantaging others? What are the aspects of the environment that seem to facilitate productive social interactions and the marshaling of resources both social and cognitive?