Name Edward Auttonberry **EDCI 301: Knowing and Learning in Math and Science**

Directions - **Select 10 of the 15 test items**. Each question you answer is worth up to 10 points. Answers should be around 150-300 words.

1. The authors of *How People Learn*: *Brain, Mind, Experience, and School* (chapter 2) detail several key principles of how experts differ from novices. Describe 3 from the text or use your own interviews to describe 3 major differences between experts and novices.

From my interviews with the expert, DocX, and the novice, JS, I was able to identify many contrasts between their knowledge and understanding of the topic, complexity classes. The first difference I noticed was that the expert was able to more quickly and continuously recall information relevant to the question I asked him. The novice took long pauses before answering and stuttered a lot. The second difference is probably the most obvious one, in that the expert knew the questions and gave correct answers, whereas the novice needed assistance in understanding the question and still gave wrong answers on some occasions. The third difference was one that I noticed myself and found other evidence for, which is that the expert saw the application of the topic in a much more abstract way than the novice. What I mean is that the novice was only able to give specific examples of work involving the topic, whereas the expert’s application examples were about applying to whole fields and having an algorithmic understanding on the level of the individual.

2. Haberman in *The Pedagogy of Poverty vs. Good Teaching* (1991) claimed “the pedagogy of poverty does not work.”

* What arguments did Haberman use to support his claim?
* He also described “good teaching” as being a big key to reform. How does Haberman define good teaching?

Haberman claims that the pedagogy of poverty does not work because of how it affects the parties involved and how it changes the nature of the learning environment. He states that the type of constant direction that is seen through in such an environment will cause kids to resent the instructor and the classroom due to somewhat of a prisoner-like feeling. He also states that because the style involves constant direction, the instructor will run out of energy, which can affect the lesson in any number of bad ways.

According to Haberman, good teaching involves allowing the students to find their own direction within a lesson. He states that the instructor may “seem like an observer,” which means that the teacher would play a much less integral role in the actual lesson. He also suggests that good teaching would involve teaching kids to an end of some more permanent goal, as opposed to the end being standardized tests.

3. Why is it important to know students’ prior knowledge? What are some strategies to assess this knowledge and how can it be used in teaching?

The most obvious reason for why it is important to know students’ prior knowledge is because it would be a waste of time to try and teach the student a topic that requires some prerequisite understanding. Imaging trying to teach integration-by-parts to someone who does not know what a limit is. When teaching in a topic area, it is important to know at what fundamental you need to start teaching at. The most common way of figuring out where to start is by administering pretests. The idea of administering pretests is that the teacher will get a good idea of what material students are currently familiar with, but that is not always the case. Sometimes pretests can give invalid data, like if an unqualified student is motivated to guess and gets the question right. To resolve this, another approach would be to have an early group working session where each group does a presentation on a topic in the subject area. This would give reasonably obvious feedback to the teacher about who knows what in the class.

4. Describe the four levels of inquiry instruction and how teachers can scaffold their inquiry approaches to effectively impact students.

Inquiry based instruction is a pedagogical paradigm in which entails the instructor leaving certain portions of a lesson ambiguous or undefined, or simply undirected, for the student(s) to interpret as they see fit. Implementation of this paradigm is not completely on or off, nor is it completely analogue. It is more of a digital spectrum of degrees of ambiguity. A sample from J. Schwab provides four levels of inquiry instruction that can be implemented in lab-based lessons. Each level is an enumeration of the progression, or lack thereof, of instructor validation in the lesson. The four levels are:

* Level 0: Verification – Entirely validated by instructor; nothing is left up to interpretation
* Level 1: Structured – Student is free to interpret lab results
* Level 2: Guided – Student is also free to select the tools to perform the lab as he or she sees fit
* Level 3: Open – Student develops a unique question to confront, as well as the previous ambiguities

These levels allow the instructor of the lab-based inquiry instruction to determine how much control he or she will have over the pacing of the students’ lesson, as well as how much of the material needs to be left to the students to interpret, in order for the lesson to have the most positive impact on the growth of the students.

5. Educators hope that students will transfer learning from one problem to another within a course, from one year in school to another, between school and home, and from school to workplace. Explain **3 factors that influence transfer**.

Transfer is a very delicate attribute of a learned topic, and there are a lot of factors that affect the ability of the student to transfer. Three factors necessary for successful transfer are:

* The student must understand the topic being learned. He or she cannot simply memorize the terminology of the topic and be expected to apply it anywhere else or carry it with them in the future. The mind is not equipped well to hold superficial knowledge of definitions and processes, therefor such things get easily lost with time.
* The topic must be given a clear context. If student is not provided with a context to assign to the topic, the student will be unable to organize the knowledge he or she is provided with, even if a deep understanding is achieved. This will lead to the student being unable to associate the topic with any future problem, and the understanding will likely decay with other brain-junk over time.
* Representations of the topic should be abstract in order to allow the student to associate the topic with a variety of problems. If the topic is presented with a specific problem in a particular subject area when it is applicable to many types of problems, the student may not realize the variety of applications, and he or she may be doomed to associate the topic exclusively with the problem shown. Giving abstract representations will contrarily allow the student to associate the topic with any inheriting problems.

6. Define metacognition and why teaching metacognitive skills is so important.

The term “metacognition” refers to the act of one thinking about the way in which he or she goes about thinking. Metacognition is important because it is really easy and quite common for people to think in a single kind of way – from only one limited perspective. This is what we would call narrowmindedness. For a lot of the sciences and the near entirety of mathematics, especially as it gets more abstract and complicated, the ability to think with multiple wider perspectives is really important. For this reason, teaching students at a young age to be able to start “thinking outside the box” as we call it is very important. According to Piaget, kids do not develop the ability to be aware of metacognition until about the age of 11, but once the child reaches this level, teaching it should be made a high priority.

7. We’ve discussed PISA and NAEP data at length in class. What are these and why are they important for U.S. education? If you think they are not important, please explain.

## PISA, The Programme for International Student Assessment, and NAEP, the National Assessment of Educational Progress, are standardized test for ascertaining the academic achievement level of students by region. PISA tests are issues on the international level, and NAEP assessments are issued within the United States on the state level. The PISA test is important for education in the United States because those results show exactly which countries more consistently produce better educated children. Based on of the performance of a country’s students, the results can be used as research material to determine which country’s approach to education works the best. These results can provide insight into how the United States can improve its education approach. The NAEP can provide a similar insight, however limited to the boundaries of the spectrum of American education. This test’s results can be better used as material to determine which state’s education legislation is best for fostering the production of well-educated individuals, because the teaching method between the states is going to be very similar.

8. List the strands **of both** mathematical and scientific proficiencies. Select **3 from either** math or science and explain why they are important for students.

Within the mathematical proficiencies, the five strands are adaptive reasoning, strategic competence, conceptual understanding, productive disposition, and procedural fluency. The four strands of scientific proficiency are as follows:

* Know, use, and interpret scientific explanations of the natural world.
* Generate and evaluate scientific evidence and explanations.
* Understand the nature and development of scientific knowledge.
* Participate productively in scientific practices and discourse.

In my opinion, the most important three strands in the math proficiencies are adaptive reasoning, procedural fluency, and strategic competence. I say this because these three strands stand hand-in-hand (did you like that?) in the sense that one being strong in one of the proficiencies makes the other two stronger. Adaptive reasoning is the ability to identify patterns and relationships, procedural fluency is the ability to utilize mathematical methods efficiently and at the right times, and strategic competence is the ability to problem-solve. Let’s say if one is strong with adaptive reasoning. Then he or she would likely be able to relate certain procedures with certain patters, strengthening procedural fluency. These two abilities – finding patterns and applying methods – are key for solving problems in math, strengthening strategic competence. An individual that strengthens these three proficiencies well will be really successful as they will all improve each other.

9. Popham (2003) detailed five attributes of an “instructionally useful test.” List and describe those five attributes. How and why does Popham describe nationally standardized tests as missing the “mark dramatically with respect to three of the attributes?”

I think we can all agree that our standardized tests are generally all-around bad tests in all areas. However, Popham’s argument was specifically about the data that teachers get from our standardized tests, and why that data is “bad.” He says that data is bad because it is not useful. Why is it not useful? Well, an “instructionally useful test” contains five attributes:

* Significance: the test makes sure the student has learned important and practical information
* Teachability: the test’s content is composed of material that is teachable in that the material will not require more time than possible to teach and that it is within the student’s ability based on their background
* Describability: the test addresses distinct and well-detailed individual skills that can allow the teacher to alter future lessons with regard to very specific topics
* Reportability: the data returned by the assessment is specific enough to inform the teacher of his or her effectiveness at teaching the topic at hand
* Nonintrusiveness: the test does not take up a lot of precious classroom time to be administered and completed

Standardized tests in the United States miss three of these attributes by miles according to Popham. These three attributes are:

* Describability, because our standardized test topic descriptions are made ambiguous to look attractive to potential buyers as opposed to educators
* Teachability, because many of the questions asked on standardized tests are insensitive to students of certain socioeconomic statuses, making it difficult to teach those students the specific material
* Reportability: because these tests do not define well enough the teacher’s achievement in having the students learn the material.

14. (Topic 18) - Gresalfi and Cobb (2006)argued that the content of mathematics (and science) needs to be broadened to include not only ideas, skills, and proficiencies students acquire, but also the disposition toward the subject.

* Do you think it is important to include students’ disposition toward the subject as one of the goals of being proficient in the subject (for example, productive disposition in mathematics)? Explain.

I do think it is important to consider the opinions of the student in reference to the subject as one of the subject proficiencies. In both the proficiencies of mathematics and scientific study, one of the strands is how often the student participates in the subject/feels about the subject. If the student does not have a positive attitude towards the subject, he or she will not be motivated to contribute, and therefore will not be a cause of progress in that field. Those who are highly motivated to pursue progress in a subject are often those who turn the most results, as they are content with putting the time into doing so.