Asking Questions Across the Knowledge Domains

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Since the dawn of civilization, human beings have been fueled with the quest to discover, to move beyond the boundaries of the familiar and into the world of the unknown. *Metaphysics*, written by Aristotle in 350 B.C.E begins with the statement: "All men by nature desire to know." We ventured out of our caves and off of our planet seeking answers to questions such as (a) What is the big idea of a problem or situation?, (b) What tools can be used or invented to help solve the problem?, and (c) What patterns exist in this problem that can aide in future solutions? Although the Common Core State Standards (2010) provide a framework for the knowledge and skills students should acquire in their journey towards intellectual discovery, educational theorists have (and will continue) to debate the essential question: What does it really mean "to know"?

Content knowledge proficiency is dependent upon the development of four distinct knowledge domains: factual, procedural, conceptual, and metacognitive. The means in which we develop content knowledge proficiency during instruction is through the development and dissemination of questions. Therefore, a specific syntax which frames a question encourages a specific type of content knowledge development. Questions then become more than just "those things" we ask students to check for understanding after a class discussion or to complete at the end of a chapter or lesson. The asking of questions becomes the vehicle for differentiating the learning experience for students based on needs, interests, and abilities. Teachers' knowledge and understanding of the art of questions (their types and uses) is paramount to their ability to apply them as a strategy for differentiating both curriculum and instruction. This article will address factual, procedural, conceptual, and metacognitive knowledge development and questioning, using Aristotle as the topic.

The Factual Knowledge Domain

Factual knowledge development relies on viewing details in terms of facts, producing a correct or incorrect answer. Factual knowledge domain questions can also be defined as "convergent" or closed-ended questions, due to the fact that the answers to these questions demand a right answer or series of right answers. "Where was Aristotle born?" is a factual question that prompts a true or false response. Aristotle was born in Stagira, Chalcidice, which is around 55km east of modern-day Thessaloniki (McLeisch, 1999). That answer cannot be changed, altered, or debated. It can and must be substantiated, validated, supported, and justified with citations and references. The question posed above is fixed, substantiated by details, and not

subject to variability, personal interpretation, or theory. Other questions that fall into the factual knowledge domain include:

- How old was Aristotle at his death?
- When was Aristotle born?
- Which future world leader was under his tutelage?

The Procedural Knowledge Domain

Procedural knowledge emphasizes the process, algorithms, and rules within a domain to perform a task. A process can be further defined as the series of steps necessary to accomplish an action or complete a task. The teaching and learning of procedural knowledge requires an analysis of the process to determine its static or fluid nature. The sequence or procedure for most processes exist on a continuum between a fixed versus flexible set of steps. The rigidity or malleability of the nature of the process directly impacts the activation and application of procedural knowledge. Take for example, the difference between cooking and baking. The process needed to make a homemade marinara sauce is much more flexible and forgiving then the explicit and exacting sequence necessary to bake a triple chocolate cake. Both require ingredients and recipes, but the degree to which they need to be followed in order to create an edible product varies greatly.

Aristotle developed a procedure for developing a logical system:

Every C is B
Every C is A
So, some A is B

Another example of an Aristotelian logical procedure is:

No C is B
Every A is C
So, some A is not B

Examples of procedures that surface in the Common Core Content standards include this list below. It becomes incumbent on the part of the teacher as well as the student to examine the types of processes embedded in the content area domains. Order of Operations for example might require an explicit set of steps formulated into a fixed set of procedures. Conversely, the writing of a complex sentence can be fluid in nature, accounting for things such as author's tone, word selection, interpretation, and meaning. The identification and nature of a process directly impacts one's ability to successfully engage with the process. Asking students

questions that trigger a metacognitive conversation about the structure and needs of a process is a great way to develop and sustain procedural knowledge.

- The Order of Operations
- Writing a complex sentence
- Ordering fractions from least to greatest
- Writing an iambic pentameter poem

To facilitate the development of procedural content knowledge, Plato may have asked Aristotle questions such as:

- How would you deconstruct the process you took to solve the problem? Would you argue that the process was fixed or flexible?
- When would you translate the procedure you used to another situation or scenario?
- What impact does this step have on the process? What would happen if we modified or removed the step? How much leeway did you have to alter the steps or the order of the steps?

The Conceptual Knowledge Domain

Conceptual knowledge development requires the learner to investigate and examine according to parts, categories, or relationships. Often, the answer must be proved with evidence and allows for a degree of theory and personal interpretation. Conceptual knowledge questions are divergent and open-ended in design. They require the respondents to synthesize key pieces of information, summarize facts into generalizations and thesis statements, and substantiate these arguments and claims with evidence from credible and reliable sources. For example, questions such as, “What impact did Aristotle have on Alexander the Great’s motives?” or “What was the origin of Aristotle’s development of virtue ethics?” are all questions that require analysis, synthesis, or evaluation. The teaching of conceptual knowledge requires an understanding of (a) part-whole relationships, (b) universal concepts, (c) big ideas, and (d) differences between abstract and concrete information. The development of conceptual knowledge may generate more questions from the learner, as conceptual knowledge development has the potential to be abstract as opposed to factual knowledge development, which is concrete. The formation of a series of follow-up questions can emerge from the response to conceptual knowledge domain questions. This question chain can serve as a catalyst for student independent study, self-directed inquiry, and extension opportunities.

The Metacognitive Knowledge Domain

The root word 'meta' means beyond, therefore, metacognition references the process of "knowing about knowing" (Mecalfe & Shimamura, 1994). The asking of metacognitive questions falls under the "novelty" domain of the Gifted and Talented Education Standards in the state of California. Strategies such as developing a self-identity, recognizing and capitalizing on abilities, and engaging in the intellectual struggle are all part of developing metacognitive knowledge. The explicit teaching of these strategies is known as Learning-to-Learn, and focuses on having students ask questions about their application of content knowledge and thinking processes. If we were to ask Aristotle about *how* he used particular strategies for learning and *when* he applied those strategies, we would be engaging in a conversation with him about his metacognition (Schraw, 1998).

Questions that address *how* Aristotle used learning strategies may include:

- Describe the process you used to solve the problem?
- How would you translate the steps you took to cognitively address this topic to another colleague?
- What would you alter in your process to make improvements to the solution?

Questions that address *when* Aristotle used particular learning strategies may include:

- What motive did you have for making that specific decision while solving the problem?
- What are the origins that contributed to your thinking process?
- When could you use the knowledge gained from this process in another situation?

As you can see, the topic of Aristotle has been addressed from a variety of proficiency perspectives, allowing the learner to have different pathways to access the content to develop knowledge. The more knowledge domains targeted in the planning and execution of a learning experience of lesson plan, the more differentiated the experience becomes. This is due to the fact that asking strategic questions across the knowledge domains provides teachers with the opportunity to target questions based on the needs, interests, abilities, and readiness levels of the students in the class. The inclusion of each knowledge domain into the lesson plan also provides for an extension of the core content standards that tantalizes students' interest and provides opportunities for curiosity and independent inquiry. This type of differentiated planning and lesson plan development can occur using a table. Think about how your knowledge of Aristotle is increased as we move beyond the factual knowledge domain.

TOPIC: *Aristotle*	**CONTENT**	**QUESTIONS**
FACTUAL KNOWLEDGE	*Aristotle's Life*	
PROCEDURAL KNOWLEDGE	*Aristotelian Logic*	
CONCEPTUAL KNOWLEDGE	*Aristotle's Impact*	
METACOGNITIVE KNOWLEDGE	*Aristotle's thinking process*	

The same process can be applied to any content area you are teaching as a means to develop knowledge proficiency and expertise in a topic. For example, let's address multiplication using the same method. As lessons are constructed using a cross-domain approach, several factors occur: (a) the notion of what it means "to know" expands, (b) content becomes accessible to all learners, and (c) student interest, motivation, and personal connections to the core content increase.

TOPIC: *Multiplication*	**CONTENT**	**QUESTIONS**
FACTUAL KNOWLEDGE	*Multiplication facts*	*"What is 4x2?"*
PROCEDURAL KNOWLEDGE	*Multiplying two digit numbers*	*"What steps do we have to take if we multiply 4x22? How do the steps change from when we multiply 4x2?"*
CONCEPTUAL KNOWLEDGE	*The relationship multiplication has to division*	*"How does multiplication relate to division? What paradoxes exist between the two processes?"*
METACOGNITIVE KNOWLEDGE	*Thinking about the process of multiplying*	*"When did you know to regroup when multiplying? Would you describe your thinking process as a whole to part process or a part to whole process?"*

Now it's time to transfer theory into practice! Select a core content standard(s) related to an upcoming unit of study. Deconstruct the topic from your grade level, using the table below, to include the factual, procedural, conceptual, and metacognitive domains. Think about the additional resources and materials that you will need in order to execute the learning experience.

TOPIC:	CONTENT	QUESTIONS
FACTUAL KNOWLEDGE		
PROCEDURAL KNOWLEDGE		
CONCEPTUAL KNOWLEDGE		
METACOGNITIVE KNOWLEDGE		

Seminal as well as contemporary theorists continue to question what it means “to know” or to become expert like in a subject area or discipline. Educators, in any grade level or content area, can promote equal access to content, academic rigor, and sophisticated levels of understanding by making connections across the knowledge domains. The art of questioning is a skill that can be demonstrated and modeled on the part of the teacher as the means of digging into content and processes. When teachers foster opportunities within the classroom for students to engage in asking questions across the knowledge domains, self-regulated, self-engaged, and independent thinkers are born.

References

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