Beyond Bloom's *Taxonomy*: Rethinking Knowledge for the Knowledge Age

Developing Higher-Level Approaches to Knowledge

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Introduction

Constructivist thinking convinces us that students need to be more than willing workers. They should be agents, but what are they to be agents of? Surely, the answer for a three-year-old cannot be quite the same as the answer for a thirteen-year-old, but what is supposed to change? Taking a cue from the history of knowledge, we can speculate that there should be developmental changes in how students approach knowledge itself.

Here we present a provisional scheme of levels of working with knowledge. The levels may be thought of as levels of objectification, which start with viewing knowledge as a mental state and extend to viewing it as consisting of abstract objects. Objectification means the prying loose of knowledge from individual mental states and collective practices, making it an object of constructive activity in its own right. Historically, objectification emerged over the course of many centuries. For individuals, we have sketched a series of seven levels or stages that represent increasing ability to deal with knowledge as such--to construct it, view it from different perspectives, criticize it, improve it. Thus, progression through these levels represents an educational objective of particular significance to a knowledge society.

Levels of Approach to Knowledge

LEVEL 0. Knowledge as equivalent to "the way things are." Thoughts are distinguished from things, but thoughts about things are not distinguished from the way things are; hence, the possibility of false belief is not recognized.

LEVEL 1. Knowledge as individuated mental states. Children realize that one person may know something that another does not. Thus, implicitly, there is some entity--a fact--which a person may or may not know.

LEVEL 2. Knowledge as itemizable mental content. Children can relate things they know about a topic, and often delight in doing so. Thus, implicitly, knowledge consists of sortable items .

LEVEL 3. Knowledge as representable. In trying to communicate what they know to a reader, students take into account what the reader already knows and is in a position to understand. Thus knowledge is no longer just something in the head to be expressed but is something to be represented, shared, interpreted by others.

LEVEL 4. Knowledge as viewable from different perspectives. Students see that the same knowledge can appear in different contexts and can be viewed from different perspectives. This is an important step toward objectification.

LEVEL 5. Knowledge as personal artifacts. Although constructivism is widely endorsed by teachers, it is not common for young students to view themselves as constructors of knowledge. Viewing oneself as constructing knowledge is a large step beyond viewing oneself as constructing knowledge representations (Level 3).

LEVEL 6. Knowledge as improvable personal artifacts. A theory or other knowledge object is viewed in terms of what it can and cannot do, what its virtues are and where it is in need of improvement , although still viewed as a personal possession.

LEVEL 7. Knowledge as semi-autonomous artifacts. Students recognize that knowledge objects, like other constructed objects, can take on a life of their own and may be considered independently of their personal relevance. Thus, at this level, knowledge objects become things that one can relate to, use, manipulate, judge in various ways, and have feelings about--just like other things in the real world.

Example of Level 0

Three-year-old's protocol, reported in Astington (1993, p. 116):

JWA: Look, here's a box.

Child: Smarties! [small candies]

JWA: Let's look inside.

Child: Okay.

JWA: Let's open it and look inside.

Child: Oh... holy moly... pencils!

JWA: Now I'm going to put them back and close it up again. (Does so) Now...when you first saw the box, before we opened it, what did you think was inside it?

Child: Pencils.

JWA: Nicky (child's friend) hasn't seen inside this box. When Nicky comes in and sees it... When Nicky sees the box, what will he think is inside it?

Child: Pencils.

Example of Level 1

From Astington (1993, p. 105):

In one study, two stuffed animals made of the same gray material, say an elephant and a rabbit, were hidden in separate boxes, each with a little hole in the lid. Only the gray material and nothing else that would identify the animal could be seen through the hole. The experimeter pointed to one box and said, "Do you know it's the elephant in here?" and also asked whether someone else would know. A good number of four-year-olds and most five-year-olds recognize that if you saw the animals being put into the boxes you would know, but if you weren't there and didn't see it, you can't know which animal it is if you see only the gray patch through the hole in the lid.

Example of Level 2

CSILE note from a grade 5/6 database:

Yesterday we talked about the human eye. It was very complicated but it was also fun. I learned that the human eye is protected by three layers of tissue. I also learned the different parts on the eye like the Cornea, Lens, Pupil, Iris, Fovea, Vitreaous, Aqueous, Ciliary, Retina and Conjunctiva. The Vitreous humour and the aqueous humour is like the jelly in your eyes and it protects everything behind them. I also learned that your eyes are one of the most complex organ of our body. The Aqueous humour is transparent, and the Vitreous humour is transparent. I also learned... [and so on for another 100 words].

Example of Level 3

Another CSILE note from the same class database:

Don't you wonder how you see things? Well it works like this: When you look at something, the light (white light) bounces into your eyes which forms a picture in the back of the eye. The picture (upside down) travels into your brain. In one part of your brain the shape and colour are put together. In another part of the brain adds the movement and depth. Then it flips the picture over. The white light that goes into your eye is made from the primary colours, red green and blue. It's hard to believe that three colours, makes you see all the colours in the world.

Example of Level 4

In a classroom experiment by Ward and Thiessen (19xx), third-graders, studying endangered species, each produced a CSILE note describing a different endangered species in their region, its habitat, source of endangerment, and so on--a fairly common activity up to this point. However, using CSILE's note-linking capabilities, the students all linked their notes to appropriate points on a map of a region, thus allowing students to see what species were near each other or shared the same habitat. They also linked their notes to a phylogenetic tree, allowing them to see biological relationships among their species. Finally, the students themselves worked out a set of reasons for endangerment, and linked their notes to appropriate boxes in a diagram of these reasons, thus affording a third perspective on the same body of knowledge.

Example of Level 5

An 11-year-old CSILE student, when asked how she would know when she had learned something, replied:

I think that I can tell if I've learned something when I'm able to form substantial theories that seem to fit in with the information that I've already got; so it's not necessarily that I have everything, that I have all the information, but that I'm able to piece things in that make sense and then to form theories on the questions that would all fit together. Although this was the most articulate response, the responses of other students in the class were consistent with it.

Example of Level 6

A middle-school CSILE student was asked to consider his earliest theories about why trees don't grow in the tundra and to say what he had learned.

I've learned a lot. My theory wasn't even close to right. So I thought it was because a tree would freeze, but then I realized that a tree probably couldn't freeze. I don't know about that because me and the kid that's working are still kind of writing. But I thought it was probably just because of the water would freeze and now I realize that its not--its definitely not just the water. There's the wind, nutrients, and the permafrost, and the daylight and everything basically plays a factor in it so...

There's a speaker that came to talk about tundra. And so Brian got to go to that because he had studied tundra and he asked.... Actually, we don't really agree with the speaker on some of the things. He said that the roots weren't very deep. And I figured this didn't make sense because so what if roots aren't deep? Because if the roots are very shallow in the rain forest because there's not any nutrients deep down in the rain forest. So there's not many roots. And then I asked several tundra people.

We kind of think that he's partially right but we don't understand why that would be true. We believe in that there isn't much water there, but we don't understand why it's for the tree, because obviously the tree needs water to grow. But there's not much water in the desert.

Example Approaching Level 7

CSILE note from grade 5/6 database:

I think that Newton's theory is agreeable, but if the particles in space were attracted to each other the whole solar system would have been moving in all directions so it would be torn apart. OOPS! I just thought of something, The sun is holding the solar system together.

Caveat

Functioning at a high level does not imply either a high level of understanding of subject matter or a high level of skill in working with knowledge. It implies, rather, that students are in a position to take a sophisticated, constructive role in the pursuit of understanding and to engage in the kinds of purposeful activities that develop knowledge-processing skills. The work of actually achieving deep understanding in a domain and competence in working with knowledge in that domain remains to be done; the hierarchy sketched here pertains to the level at which students can participate in that work.

Fostering Progression to Higher Levels

Research over the past decade has explored the potential of the CSILE learning environment to promote higher levels of approach to knowledge (Scardamalia, Bereiter, & Lamon, 1994; Scardamalia & Bereiter, 1996; Scardamalia, Bereiter, Hewitt, & Webb, in press). Among upper elementary and middle school students we have seen clear evidences of levels 4 through 6. Level 7, which is characteristic of mature scholars and scientists, may not be attainable until late adolescence; but a school population functioning at level 6 would amaze the world.

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