Table 3. Baxter Magolda’s (1992) levels of intellectual development. Patterns that are characterized by males and females at each level are also shown. As an example, views of science that characterize students at each developmental level are from Palmer and Marra (2004). Modified from Felder and Brent (2004).

|  |  |  |  |
| --- | --- | --- | --- |
| **Level** | **Pattern Characterized by More Men** | **Pattern Characterized by More Women** | **View of Science** |
| ***Absolute Knowing***  All knowledge that matters is certain, and positions are either “right” or “wrong”. Authorities have the truth. | ***Mastery***  Students raise questions to make sure their information is correct and challenge deviations from their view of the truth. | ***Receiving***  Students record information passively, without questioning or challenging. | Science is a collection of known facts. Students at this stage exhibit difficulty understanding the use of evidence for basis of judgments or decisions. |
| **T*ransitional Knowing***  Some knowledge is certain and some is not. Authorities communicate certainties, but students bear responsibility for making own judgments where uncertain. | ***Impersonal***  Make judgments using prescribed logical procedures. Perceptions that full credit is deserved for following the right procedure, regardless of clarity or quality of the supporting evidence. | ***Interpersonal***  Base judgments on intuition and personal “sense”; distrust logic, analysis, and abstract theories. | Science is a set of theories and facts with exceptions. |
| ***Independent Knowing***  Most knowledge is uncertain. Students are responsible for own learning and use; conclusions viewed as equally good with emphasis on use of objective procedures. | ***Individual***  Rely on objective logic, critical thinking, and adversarial challenging of their own and others’ positions to establish truth and make moral judgments. | ***Interindividual***  Rely more on caring and empathy as base for efforts to understand and judge. Listening to others as important as expressing ones own ideas. |
| ***Contextual Knowing***  All knowledge is uncertain, contextual, and individually constructed. Students take responsibility for making judgments, acknowledge the need to do so in the face of uncertainty and ambiguity. Use all possible sources of evidence and remain open to change in when faced with new evidence. No apparent gender differences at this level. | | | Science is collection of approximate models of reality; models are only as good as available data. Willingness to challenge what is known, question underlying assumptions, and tolerate ambiguity. |

**Critical Thinking: A Tool for Everyone**

Critical thinking is so central to sound reasoning that it deserves special attention. No doubt, you have encountered this term previously, but what does it mean? The tradition of critical thinking goes back at least 2,500 years to the time of Socrates who established the importance of evidence, questioning, and analysis utilizing “Socratic questioning.” Since then, many others (including Plato, Aristotle, Thomas Aquinas, Francis Bacon, Descartes, and Kant, just to name a few) have contributed to the development of tools for critical thought. Many scientists (e.g., Newton, Boyle, and Darwin are a few notable examples) have applied the tools of critical thinking to develop new models of our natural world. The methods of critical thought are by no means limited to thinking in science, but have also been applied in virtually all other disciplines. They involve both cognitive and affective components.

##### Wisdom is not a product of schooling but of the life-long attempt to acquire it

Albert Einstein

As with other terms introduced in this document, let us start with a definition. Scriven and Paul suggested the following definition to the National Council for Excellence in Critical Thinking (http://www.criticalthinking.org/aboutCT/define\_critical\_thinking.cfm):

*Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. In its exemplary form, it is based on universal intellectual values that transcend subject matter divisions: clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth, and fairness.*

Note that the beginning of this definition emphasizes that critical thinking must be “actively and skillfully” applied. The essential elements of reasoning that should be employed in all thinking, regardless of discipline, are given in Table 4. Additionally, intellectual standards (e.g., clarity, accuracy, precision, relevance, depth, breadth, logic, significance, and fairness) and traits (e.g., intellectual integrity, intellectual humility, confidence in reason, intellectual perseverance, fairmindedness, intellectual courage, intellectual empathy, and intellectual autonomy) should also be applied to thinking to ensure quality (http://www.criticalthinking.org/articles/critical-mind.cfm).

Stated another way, critical thinking is thinking that assesses itself. It examines the elements of thought and is based on intellectual values that transcend the frame of reference of the thinker and the subject matter, purpose, implications, and consequences of the thinking. Scriven and Paul also note that critical thinking has two components: 1) a set of skills to process and generate information, and 2) the habit of using those skills to guide behavior. In other words, its not sufficient to have the skills for critical thinking, you also need to employ them. In another document from the National Council for Excellence in Critical Thinking, Paul and Elder (2004) argue that there are two essential dimensions of thinking that students need to master: 1) be able to identify the “parts” of their thinking, and 2) be able to assess their use of those parts in thinking. Paul and Elder (2004) suggest the following elements of critical thinking:

* All reasoning has a purpose
* All reasoning is an attempt to figure something out, to settle some question, to solve some problem
* All reasoning is based on assumptions
* All reasoning is done from some point of view
* All reasoning is based on data, information, and evidence
* All reasoning is expressed through, and shaped by, concepts and ideas
* All reasoning contains inferences by which we draw conclusions and give meaning
* All reasoning leads somewhere, has implications and consequences

The elements of one’s reasoning can be assessed using standards such as clarity, precision, accuracy, relevance, depth, breadth, logic, and significance. It is important to regularly monitor your thinking for flawed intellectual standards such as “it must be true because:” “I believe it;” “we believe it;” “I want to believe it;” “I have always believed it;” “it is easier to believe it than to understand it;” “or because it is in my vested interest to believe it” (see http://www.criticalthinking.org/articles/critical-mind.cfm). It should be clear from the above discussion, and the guidelines in Table 4, that questioning is the key to sound reasoning. Questions define the path of our thinking, they determine the evidence that we seek, and they lead us to new levels of understanding. Never stop asking questions!

Different Kinds of Thinking and Learning: the Cognitive Domain

Table 1. Bloom’s levels of thinking, from lowest (1) to highest (6), in the cognitive domain. This taxonomy, recently revised by Anderson et al. (2001), remains essentially unchanged, except that synthesis (creating) is considered the highest level of thinking.

**Level of Thinking**

**Example Question That Targets Understanding**

***1***

***Knowledge***

(facts)

Define the term “mineral”

***2***

***Comprehension***

(understand meanings)

Explain why some crystal faces grow faster than others

***3***

***Application***

(apply to new situations)

For the 1994 flood in Minnesota, calculate the frequency of flooding of this magnitude.

***4***

***Analysis***

(see organization and patterns)

Compare the distribution of earthquakes along mid-ocean ridges with those of subduction zones

***5***

***Synthesis***

(generalize, create new ideas)

Use the sequence of rocks exposed along the Mississippi River to construct a model of the changes in sea level during the early Paleozoic.

***6***

***Evaluation***

(assess value of evidence)

Evaluate the arguments for and against the evidence of fossil life in meteorites from Mars

Table 4. Guidelines for developing elements of reasoning (modified from Paul & Elder, 2004).

|  |  |
| --- | --- |
| Elements of Reasoning | Guidelines |
| *Purpose or Motivation* | Choose significant and realistic purposes; state you purpose clearly; distinguish your purpose from related purposes; periodically check that your purpose is still valid |
| *Question or Problem* | Clearly and precisely state the question; reformulate the question several different ways to clarify its meaning and scope; identify if the question has one right answer, is a matter of opinion, or requires reasoning from more than one point of view |
| *Assumptions* | Clearly identify your assumptions and determine if they are justifiable; consider how the assumptions are shaping your point of view |
| *Point of View* | Clearly identify your point of view; seek other points of view and identify their strengths and weaknesses; seek an open-minded evaluation of all points of view |
| *Data, Information, Evidence* | Restrict your claims to those supported by the data that you have; search for evidence that opposes you position as well as supports it; make sure that all information is clear, accurate, and relevant to the question; make sure that you have gathered sufficient information to address the question at hand |
| *Concepts and Ideas* | Identify key concepts and explain them clearly; consider alternative concepts; make sure you are using concepts with care and precision |
| *Inferences and Conclusions* | Infer only what the evidence implies; check inferences for internal consistency; identify assumption with lead you to your inferences |
| *Implications and Consequences* | Trace the implications and consequences that follow from you reasoning; search for negative as well as positive implications; consider all possible consequences |

**Metacognition: Thinking about One’s Own Thinking and Learning**

Intentional thought about one’s own thinking (metacognition) is generally regarded as an essential component of successful thinkers and learners. Studies show “experts” constantly monitor their understanding and progress during problem solving. Critically, their metacognitive skills allow them to decide when their current level of understanding is not adequate. This type of planning, self-monitoring, self-regulation, and self assessment not only includes general knowledge about cognitive processes and strategies, but also appropriate conditions for use of those strategies, and general self-knowledge. Research suggests that metacognitive skills cannot be taught out of context. In other words, one can’t just take a course on metacognition. You need to learn it and apply it within the context of disciplinary content. As you are learn, you should engage in constant questioning (e.g., What am I trying to accomplish? What is the best strategy for learning? How is my progress? Did I succeed?). This sort of self-monitoring and reflection not only leads to deeper and more effective learning, but also lays the groundwork for being a self-directing learner.

*I went to a bookstore and asked the sales-woman, “Where’s the self-help section?” She said if she told me, it would defeat the purpose*

George Carlin

Table 6. Behavioral dimensions of grades and characteristics of outstanding and average students (modified from Williams, 1993).

|  |  |  |
| --- | --- | --- |
| **Behavioral Dimension** | **“A” or Outstanding Student** | **“C” or Average Student** |
| 1. Attendance (commitment) | Nearly perfect attendance; rare excused absences except for other scheduled conflicts; make prior arrangements for missed content | Sometimes comes to class late; occasional absences from class are rarely excused; frequently puts other priorities ahead of course |
| 2. Preparation | Well-prepared; readings and assignments completed before class with great attention to detail; rarely misses deadlines; retains information from the course and makes connections with past learning | Readings and assignments completed in a timely, but perfunctory manner with little attention to detail or further contemplation; work often appears to be “draft” quality |
| 3. Curiosity | Has a motivating purpose; inquisitive; asks thoughtful questions and is an active participant in classroom discussions; makes the extra effort to learn more and connect with other aspects of education or life | Uninterested in subject material and class; participates in class and projects without enthusiasm; exhibits only modest interest in subject matter |
| 4. Attitude (dedication) | Has a winning attitude and shows responsibility, motivation and determination to succeed; enjoys and values learning; listens to feedback and acts on it | Rarely does more than required; Seldom shows initiative; defensive about feedback and unwilling to accept responsibility; perceive themselves as victims |
| 5. Talent (ability) | Possesses special talents such as exceptional intelligence, unusual creativity, or outstanding commitment that are evident to the instructor | Can have greatly varying natural talent; some students are quite talented, but lack organization or motivation; others are motivated, but lack special aptitude |
| 6. Retention | Learns concepts rather than memorizes details so better able to connect past learning with present material | Tries to memorize facts at the last minute rather than learn concepts; makes few conscious efforts to connect new learning with past knowledge |
| 7. Effort (time commitment) | Reads, studies, and thinks about course subject on a regular basis; begins assignments and projects well before deadlines; often willing to devote extra time and effort when needed; attention to detail; seeks out instructor outside of class | Does not develop a regular system for studying and doing assignments; frequently begins readings and assignments at the last minute; rarely willing to devote time necessary to develop deeper understanding |
| 8. Communication Skills | Speaks confidently and writes well; presentations and documents are well-conceived, well-prepared, and informative | Presentations and written work lack organization and clarity; papers are generally draft quality requiring extensive re-writing to be effective; quality of content limited by poor communication skills |
| 9. Results (performance) | Exams and papers are always of the highest quality (among the highest in a class); contributions in the classroom are significant and insightful; work demonstrates critical thinking | Products are mediocre or inconsistent in quality; writing and speaking indicates only a cursory understanding rather than a mastery of material |

Table 7. Characteristics of successful and struggling students (from Cuesta College, 2003)

|  |  |
| --- | --- |
| ***Successful Students*** | ***Struggling Students*** |
| Accept personal responsibility for creating the outcomes and quality of their lives | See themselves as victims, believing for the most part that what happens to them is beyond their control |
| Discover a motivating purpose, characterized by personally meaningful goals and dreams | Have difficulty choosing a purpose and often experience depression and/or resentment about the meaninglessness of their lives |
| Consistently plan and take effective actions in pursuing their goals and dreams | Seldom identify the specific actions needed to accomplish a task, and when they do, they tend to procrastinate |
| Build mutually supportive relationships that assist them in pursuing their goals and dreams | Are solitary, seldom requesting, even rejecting offers of assistance from legitimate resources |
| Gain heightened self-awareness, developing empowering beliefs, attitudes, and behaviors that will keep them on course | Are slaves of disempowering life scripts that carry them far off course |
| Become life-long learners, finding valuable lessons in nearly every experience they have | Tend to resist learning new ideas and skills, often viewing learning as drudgery rather than mental play |
| Develop emotional maturity, characterized by optimism, happiness, and peace of mind | Live at the mercy of their emotions, having success hijacked by anger, depression, anxiety, and a need for instant gratification |
| Believe in themselves, feeling capable, lovable, and unconditionally worthy as human beings | Doubt their personal value, feeling inadequate to accomplish meaningful tasks and unworthy to be loved by others or themselves |