RUNNING HEADER: What *Should* Be the Content for Student Learning?

What *Should* Be the Content for Student Learning?

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Abstract

Content in education is typically conceived as subject matter, often divided into disciplines such as mathematics, English, history, science, geography, and so forth. Content is often further conceived as being embedded in media such as textbooks, handouts, movies, computers, posters, and bulletin boards that are used in the context of classrooms inside school buildings. I present Steiner's alternative conception of content, namely that of schemata for cognition, intention, and emotion, which stand in contrast to traditional notions of subject matter. I further distinguish *signs* of content from content as objects themselves, as does Peirce. I discuss Maccia's epistemology of educational objectives that includes 9 kinds of knowing: instantial, theoretical, and criterial 'knowing that'; protocolic, adaptive, and creative 'knowing how'; and recognitive, acquaintive, and appreciative 'knowing that one'. Next, through retroductive reasoning, I extend content objectives to include formation of affective (emotional) and conative (intentional) mental structures. Finally, I briefly discuss the theory of Totally Integrated Education (TIE) as a way to characterize the educational aim of guiding students to form strongly connected cognitive, conative, and affective mental structures. Instead of conceiving subject matter as acquiring knowledge within extant disciplines, I argue that educational content should be considered with respect to student mental structures that are expected to result from teaching and learning activities. This stands in in stark contrast to "covering the content" presented in printed textbooks and other media. If we pursue totally integrated education (TIE), *student learning will be grounded*. Grounding of knowing, feeling, and intending is vitally important. Students who are grounded are less easily deceived and misled by others who are ignorant, prejudiced, or who intentionally lie or distort truth.

1. Introduction: What is Content?

The great American philosopher of education, John Dewey, discussed the typical conception of the primary aim of education as:

> … the formation of mind by means of a *subject matter* presented from without (p. 69, italics added) …. In the traditional schemes of education, subject matter means so much material to be studied. Various branches of study represent so many independent branches, each having its principles of arrangement complete within itself. History is one such group of facts; algebra another; geography another; and so on till we have run through the entire curriculum (p. 134)…. [Subject matter] consists of the facts recalled, read, and talked about, and the ideas suggested, in course of development of a situation having a purpose. (1916, p. 180)

Dewey (1916) further lamented that:

> … the bonds which connect the subject matter of school study with the habits and ideals of a social group are disguised and covered up. The ties are so loosened that it often appears as if there were none; as if subject matter existed simply as knowledge on its own independent behoof, and as if study were the mere act of mastering it for its own sake, irrespective of any social values. (p. 181)

Elizabeth Steiner (1988), another great American philosopher of education, logically characterized *content* as one of the components of an education system. From a general systems perspective, she contended that:

> Education is defined as a system consisting of subsystems of teacher (T), student (S), content (C), and context (X)…. Learning is defined as psychical development: formation

> of mental structures. *Content* is defined as structures for psychical development: either cognitive (CG) or conative (CN) or affective (AF). (p. 40, italics added)

Based on George Maccia's (1973; 1987; 1988) conceptions of knowing, Steiner (1988) further described cognitive mental structures as being "schemata for thought which are either quantitative (QN) or qualitative (QL) or performative (PF)" (p. 41). Steiner (1988) further defined conative structures as "schemata for volition", and affective structures as "schemata for feeling" (p. 42).

In discussing Elizabeth Steiner's conception of education and the role of content, I previously wrote:

> *Education cannot occur without content*. The content is what is shared between successive generations. Students must interact with content in order to construct understandings and their personal values and beliefs. Content is not just math, English, or biology. And content is not found in books or computer programs or on the television screen either. Content is the stuff of human thoughts, ideas, aspirations, feelings, and attitudes. What is found in media such as books and TV are *representations of content*. The content may be symbolically coded in language only, or it may be conveyed through drama, for example. (Frick, 1991, p. 15)

Charles Sanders Peirce's (1932) semiotic theory clarified the nature of signs:

> A sign, or *representamen,* is something which stands to somebody for something in some respect or capacity…. every representamen being thus connected with three things, the ground, the object, and the interpretant (2:228)…. The Sign can only represent the Object and tell about it. It cannot furnish acquaintance with or recognition of that Object; *for that*

> *is what is meant in this volume by the Object of a Sign; namely, that with which it presupposes an acquaintance in order to convey some further information concerning it* (2:231, italics added).

Educology builds on these conceptions of education and subject matter. Content is defined in educology as "signs of objects and objects selected for student learning" (Educology, 2018, http://educology.indiana.edu/content.html). Content for learning may be represented with signs only, or it may be the objects themselves with or without mediation by their respective signs. In education, students are expected to form mental structures (i.e., to learn) through interaction with content in a context. What those mental structures *should* be is part of the philosophy of education, i.e. the determination of what is *worthwhile* education.

In order to address this question, the typology of cognitive mental structures is discussed next. This is followed by a parallel characterization of conative and affective mental structures. Building on this foundation, the theory of Totally Integrated Education (TIE) is subsequently introduced. Examples of extant cases are then provided which illustrate implementations of TIE. In conclusion, the major goals of *worthwhile education* are summarized.

2. Typology of Cognitive Structures

George Maccia (1973) developed an epistemology of educational objectives, which he further refined and described in 1987 and 1988 (see Frick, 1997). Central to Maccia's argument is that students should not only come to 'know that' but they should also come to

'know how' and to 'know that one'. Maccia (1987) particularly emphasized the importance of qualitative knowing ('that one'). These types of knowing are briefly described next.

Overview of Types of Knowing

There are three fundamental types of cognition: 1) 'knowing that', 2) 'knowing how', and 3) 'knowing that one' (Brown, 1972; Estep, 2003, 2006; Frick, 1997; Geach, 1964; Maccia, 1973, 1987, 1988; Ryle, 1959; Sheffler, 1965). Clearly, these three classifications of cognition are *not exclusive* in the sense that two or more of them can occur at the same time within an individual. For example, in Fig. 1, the person knows Rover as an instance of the dog classification ('knowing that'), a way to give Rover a bath ('knowing how'), and this particular unique dog, Rover ('knowing that one').

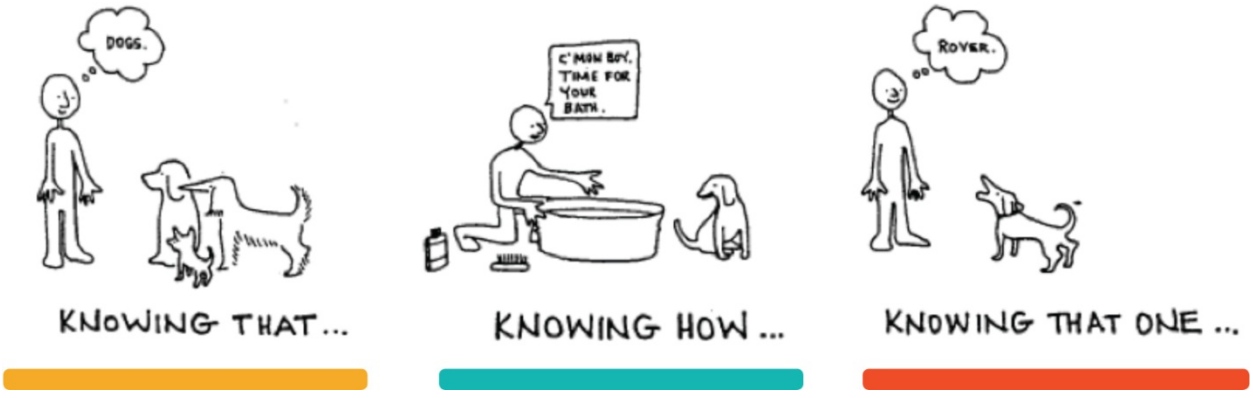

Figure 1. Three basic kinds of knowing (drawings by Elizabeth Boling)

On the physiological level, mental structures are encoded through strengthened neural connections in the nervous system (Kandel, 1989; 2001; Squire & Kandel, 1999). On the basis of a series of empirical studies, Kandel (2001) concluded that "… learning results from changes in the strength of synaptic connections between precisely connected cells

[neurons]" (p. 1032). According to Eagleman (2015), when we are born we each have approximately 100 billion neurons in our nervous system. During the first 2-3 years of life, our body creates trillions of connections among those neurons. As we further grow, develop, and learn, our individual experiences literally prune those connections, so that the remaining connections form a unique mental structure, the unique long-term memories and abilities we each have. Certain connections are strengthened through those experiences throughout our lives, and other connections are weakened.

Moreover, as Eagleman (2015) emphasizes:

> When we look inside the brain, we see neurons, synapses, chemical transmitters, electrical activity. We see billions of active, chattering cells…. To understand human consciousness, we may need to think not in terms of the pieces and parts of the brain, but instead in terms of *how these components interact*. (Locations 2724 – 2730, italics added)

In short, the unique mental structure each of us has at any given point in time allows us to think, to intend, and to feel as we consciously interact with our surroundings. Neuroscientists can observe the patterns of activities of neurons communicating in real time through movies of functional magnetic resonance images (fMRI). Our unique mental structures determine how our individual minds can function from moment to moment.

Since one's knowing consists of cognitive mental structures that are not directly observable by another person, it is necessary to identify observable indicators or signs of such knowing. As educators, we can observe the actions of another person, which indicate what she or he knows, wants, and feels. These may be evident from observing this person carry out some task, from examining a product resulting from this person's activity, and from

examining signs this person uses and creates (icons, indices and symbols) during that activity or in that product. Estep (2006) refers to such indicators as:

> signs of intelligence …. [which] include the broader realm of three-dimensional patterns of sign-making, sign-exhibiting, and sign-disclosure of dynamic intentional doings…. Three-dimensional signs such as signals and cues, include gestures (as with hands), but also full-body doings such as tasks or other performances…. These sign categories ... span all sensorimotor capacities, including visual, auditory, olfactory, gustatory, and somatosensory categories (including touching, moving, and proprioception). (pp. 38-39)

As an example, near the end of physicians' medical education, medical students become interns where they practice medicine with actual patients and their maladies. They are supervised and observed by teacher-physicians who are already licensed for practice, and who provide further coaching and feedback to these student-physicians-to-be. These physician-coaches can infer from observation whether or not their student interns are making proper assessments, diagnoses, and carrying out appropriate treatments. In short, the *test* is a method by which a teacher can unambiguously infer student mental structures from observable indicators of student performance under appropriate conditions. Tests are not restricted to answering questions or solving problems, as typically conceived by educators. Such written or oral exams are just one kind of indicator.

In discussing pedagogical epistemology, Maccia (1973) referred to *tutorial* conditions of knowing:

> ... knowing is viewed in light of tutorial requirements. Only those knowings to which a teacher has access, which a teacher can bring to a learner, and which a learner can communicate in some way to a teacher are taken seriously. (p. 1)

There may be other kinds of student knowing to which teachers have no access when observing and communicating with students. For example, Polyani (2015) refers to "tacit knowing," which essentially means private, personal knowing not sharable with others as intersubjective signs. Similarly, student feelings and intentions may be tacit, unavailable to their teachers.

Without further digression here, if teachers have no way to tell if students have achieved such unobservable kinds of knowing, then these kinds of knowing are excluded from educology. This is why Maccia referred to *tutorial* conditions of knowing in further explicating his pedagogical epistemology (e.g., Maccia, 1987, 1988).

Kinds of knowing are based on Maccia's pedagogical epistemology, Estep's (2003, 2006) evidential arguments about natural intelligence, and Frick's (1997) discussion of issues in artificial intelligence. Nine kinds of knowing are outlined below as goals for worthwhile education—i.e., cognitive structures that students *ought to* develop:

1. **'Knowing that'**: what are indicators of '*belief*'—is it warranted by disciplined inquiry, i.e., is it *true* belief?
    - 1.1. *Instantial*: classification of objects of the same kind.
    - 1.2. *Relational*: rational explanation of relationships between kinds of objects.
    - 1.3. *Criterial*: rational judgment of kinds of objects and their relations according to a norm.

2. **'Knowing how'**: what are indicators of *'performance'*—is it effective and ethical?
    2.1. *Protocolic*: take one path to goal; inflexible, duplicative doing.
    2.2. *Adaptive*: take alternative paths to goal, choosing or combining paths based on specific conditions.
    2.3. *Creative*: innovate or invent a new way to reach an existing or new goal.
3. **'Knowing that one'**: what are indicators of '*opinion*'—is it right?
    3.1. *Recognitive*: select the unique *Q* from not-*Q* and not-*Q* from *Q.*
    3.2. *Acquaintive*: identify relations determinate of the unique *Q.*
    3.3. *Appreciative*: identify relations appropriate of the unique *Q.*

Norms for evaluating these kinds of knowing are indicated by the questions following each of the three major types. In worthwhile education, when students develop mental structures for 'knowing that', their beliefs must be *warranted by disciplined inquiry*. In other words, students should come to hold *true* beliefs. For 'knowing how', student conduct must be both *effective* and *ethical*. For 'knowing that one', *right opinion* is essential. Clearly, some learned beliefs are unwarranted, some actions are unethical, and some opinions are not right.

Unfortunately, students can develop mental structures for false beliefs, bad actions, and wrong opinions. One can, for example, believe that the earth is the center of the universe; however, Galileo and Copernicus long ago provided empirical evidence that this belief is false. It is not supported by facts. One can hold the false belief that plain water freezes at 100 degrees centigrade. Such belief is clearly at odds with empirical evidence. One can learn how to deceive others, by making emotional appeals to their fears and prejudices. Such conduct is unethical.

Note that within each type of knowing, each higher level requires the lower level. Criterial knowing requires relational knowing, and relational knowing requires instantial knowing. Creative 'know how' requires adaptive 'know how' that, in turn, requires protocolic 'know how'. Appreciation requires acquaintance, and acquaintance requires recognition. In other words, within each classification of knowing, the categories are progressively inclusive.

The types of knowing are not mutually exclusive. We can 'know that' with respect to some object, 'know how' and 'know that one'. This is illustrated in Fig. 1, where the dog Rover, is the object of 'knowing that', 'knowing how', and 'knowing that one'. See Frick (1997; 2018) for further examples of these three kinds of knowing.

3. Typologies of Conative and Affective Mental Structures

Maccia's typology for cognitive structures is used here as a starting point for classifying conative and affective structures.

Universals

There are *classifications* of universals. For example, 'justice' is a universal (general). A student can learn to seek justice as a goal. This would be a conative structure. That student could also develop affective mental structures for good feelings about justice, and bad feelings about injustice.

Means to Ends

There are 'means to ends'. For example, the Macintosh operating system is a means to launch apps, print documents, do text messaging, etc. One might want to use the Mac OS,

time and time again. This would be a conative mental structure. One might also have good feelings toward use of the Mac OS. Hence, there may be conative and affective structures for ways of doing.

Uniques

Conative structures can have unique objects, just as cognitive thoughts and means to ends. For example, a person can want a particular thing, such as MacBook computer, or to be friends with a unique person such as Cesur Dagli. Similarly, one can have feelings towards that MacBook or Cesur.

Content as Conative and Affective Structures

In addition to cognitive mental structures, content in education should include goals for students to develop conative and affective structures. Students should learn more than just 'knowing that', 'knowing how', and 'knowing that one'. They should also form moral intentions and good feelings about those respective objects of cognition.

4. Putting It All Together: TIE Theory

The theory of Totally Integrated Education (TIE) is built on well-defined terminology from educology (Frick, 2018). Central to TIE theory is the premise that, to the extent that student mental structures are formed which integrate cognition, intention, and emotion, then student learning will be stronger and more holistic. In TIE theory, *integrated* mental structures are predicted to be less vulnerable to forgetting (Fig. 2, 3, 4, and 5).

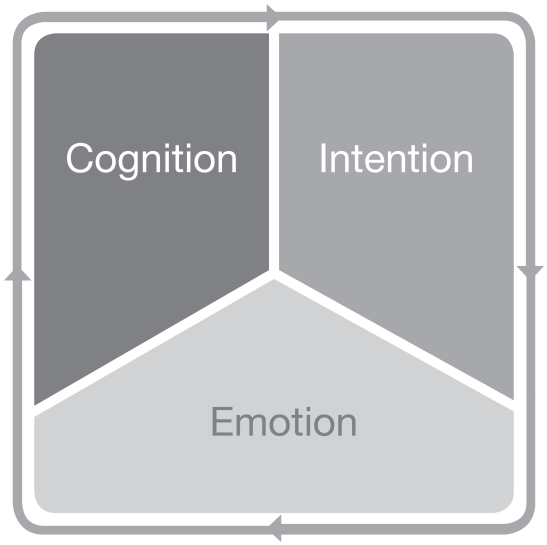

Figure 2. Schema for desired connections among a student's cognition (thinking), intention (willing), and emotion (feeling) during a learning activity (graphic by Colin Gray). Reprinted with permission from Frick, 2018.

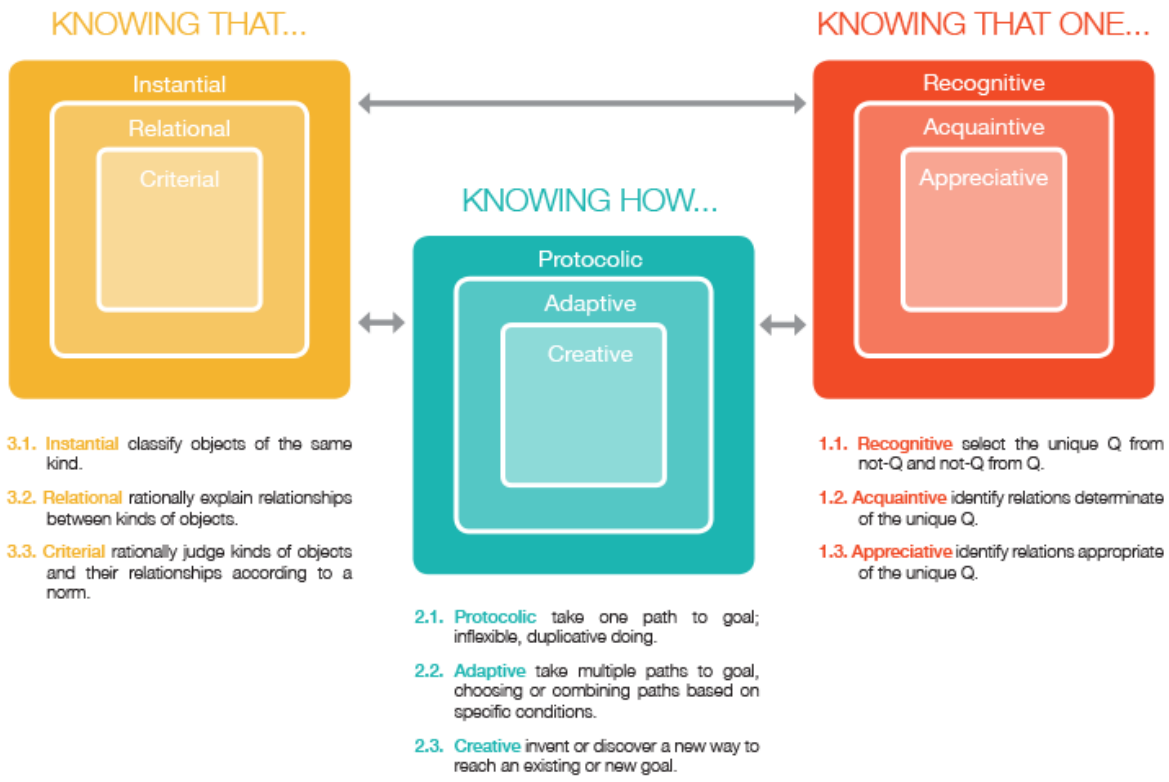

Figure 3. Illustration of integration of 9 kinds of cognition. Graphic by Colin Gray and Theodore Frick. Reprinted with permission from Frick, 2018.

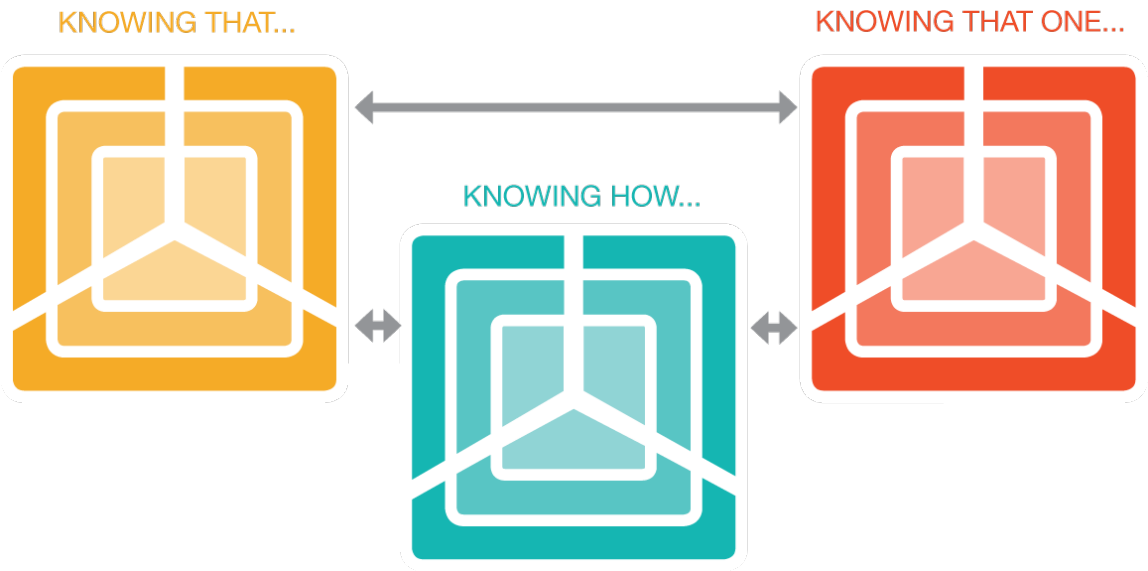

Figure 4. Illustration of totally integrated education, where cognition, intentions and emotions are completely connected. Figures 1-3 are combined visually. Graphic by Colin Gray and Theodore Frick. Reprinted with permission from Frick, 2018.

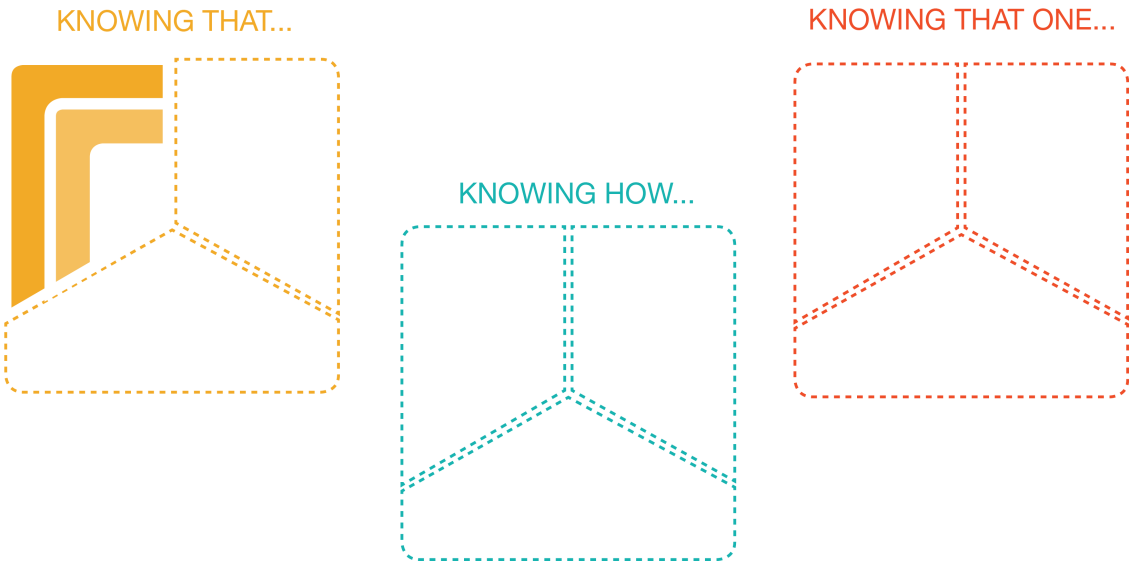

Figure 5. Disconnected mental structures (graphic by Colin Gray). 'Knowing how' and 'knowing that one' are disconnected from 'knowing that'. Student intention and emotion are disconnected from 'knowing that'. This ungrounded and dissociated learning can occur when signs used in communication are used in isolation from their corresponding real-world objects and purposeful activity. The resulting mental structures are weakly connected, lacking wholeness and integration. Reprinted with permission from Frick, 2018.

5. Examples

Frick (2018) described two extant cases which illustrate TIE. Three more cases are described here, the: Unionville Elementary School EARTH curriculum; State University of New York (SUNY) Cobleskill Fisheries, Wildlife and Environmental Sciences program; SUNY Cobleskill Biotechnology program.

5.1 Unionville Elementary School Curriculum

The Unionville Elementary School in Bloomington, Indiana, USA, has developed a unique curriculum they identify by the acronym EARTH: Environment, Art, Resources, Technology and Health. Howell (2018) notes:

> You can see it when you stop by the school: Trays full of seedlings sprouting on classroom windowsills. Potatoes growing roots in cups of water. Large shelves bearing gardening tools and seed packets near the back door. Teachers and students holding class outside, on the hill, by the garden boxes, under the sheltered "learning lab" on the playground and in the miniature amphitheater with wooden benches by the pond. Students planting flowers and vegetables, or watching and sketching the trees, writing their observations in science notebooks. (paragraph 2)

Howell further writes:

> In many ways, the curriculum harnesses things Unionville has been doing for years. They compost and recycle in the school cafeteria, use the outdoor spaces often and go for hikes on Unionville's 18 acres. The fishing club catches fish in the school's pond from a little dock built for class purposes. They use different kinds of art, including quilting, to visually

represent what they're learning. The school teaches digital citizenship and coding, as well as healthy living and good lifestyle choices.

EARTH puts a renewed focus on those elements, increases the number of science experiences and puts an outdoor, environmental twist on it all. (paragraphs 7-8)

Howell quotes the Unionville principal, Lily Albright, who said, "It's about appreciating and understanding what's going on right here in our own backyard, and applying that as we think about the world and our place in the world" (Howell, 2018, paragraph 9).

The EARTH curriculum clearly leads Unionville elementary students to connect 'knowing that', 'knowing how', and 'knowing that one' (see Fig. 1, 2, 3 and 4). It illustrates a practical implementation of TIE theory in this particular context.

5.2 SUNY Cobleskill Fisheries, Wildlife and Environmental Sciences Program

Hands-on learning is central for students in the Fisheries, Wildlife and Environmental Sciences program at the State University of New York, in Cobleskill, NY, USA. The program utilizes its own cold-water fish hatchery tanks (Fig. 6). One classroom includes aquariums with live fish as well as some taxidermized species on the walls (Fig. 7). Advanced undergraduate students spend time in the outdoors doing scientific research, and subsequently present their findings at professional conferences (Fig. 8).

Feldman (2018) quotes department chair, Mark Cornwell, who says:

As students progress in the program, moving up level to level, the mix of their activities changes… For example, those at the beginning of their study are taught in four-hour blocks of time. The first hour is classroom instruction covering theory and practice; the

remaining three hours are spent in the water, where students are suddenly surrounded by what they were just taught about in class. It's a terrific way to teach and learn." (p. 7)

Figure 6. Department chair, Mark Cornwell, explains that large fish tanks on campus are used for breeding purposes. Students learn how such hatcheries are managed, engage in raising fish, and then release them into the wild in upstate New York. Photo by T. Frick.

Figure 7. A classroom at SUNY Cobleskill includes both live and mounted species of fish. Photo by T. Frick.

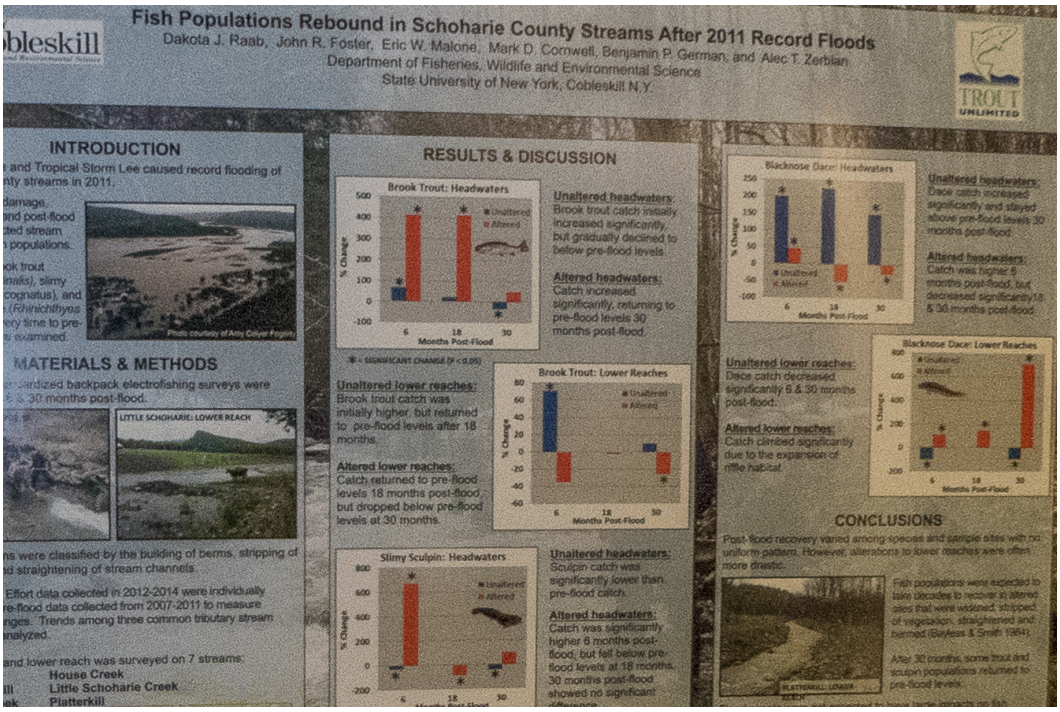

Figure 8. Posters such as this one are presented by undergraduate students at professional research conferences. Photo by T. Frick.

Feldman (2018) further describes this unique program:

> As they continue in the program, students collect and interpret data, delve deeply into the biology of the species with which they work, even become conversant about the laws and regulations that affect the present and future of specific habitats and of the environment in general. (p. 7)

Cornwell is further quoted: "Ultimately, our goal is to produce graduates who are both extremely knowledgeable about the real-world species and systems they study and the relevant public policy issues that arise in our field" (Feldman, 2018, p. 7).

It is clear that students in this undergraduate degree program at SUNY Cobleskill are able to connect 'knowing that', 'knowing how', and 'knowing that one'. Parts of the real world are brought to the campus learning environment, and students also go out into the real world as they continue learning. This is an excellent example of totally integrated education (TIE), as illustrated in Fig. 4. Contrast these SUNY learning environments with typical barren classrooms where students read textbooks, perhaps watch some videos, sit at desks discussing ideas during class, and subsequently take paper-and-pencil tests on what they have learned (schematized in Fig. 5).

5.3 SUNY Cobleskill Biotechnology Program

Undergraduate students from the SUNY Biotechnology program are actively recruited by graduate schools and corporations. Feldman (2018) describes the intensive, hands-on program, where juniors and seniors "do valuable leading-edge research in such areas as developing disease and drought-resistant crops for agricultural enhancement" (p. 8).

Student research involves genetics, and some of them are invited to present at professional conferences. Students not only must understand genetic theory ('knowing that'), but engage in creative 'knowing-how' (Fig. 4) as they develop new strains of plants. Student learning is purposeful (conative) and satisfying (affective). Feldman quotes biotechnology professor, Peiyu Zeng:

> Our program definitely makes its mark among other researchers working in our field… For instance, SUNY Cobleskill is one of only a handful of academic institutions that have been able to create a strain of soybeans capable of withstanding highly adverse growing conditions. It is wonderful for students to know that the work they do here will have a real impact—and real visibility—in the world outside our labs. (p. 8)

The SUNY biotechnology program is a further example of totally integrated education in higher education. TIE is not just a theory; it can be actualized in practice. As defined in educology, *content* is conceived as "objects and signs of objects selected for student learning" (Educology, 2018, http://educology.indiana.edu/content.html). As C. S. Peirce (1932) noted:

> The Sign can only represent the Object and tell about it. It cannot furnish acquaintance with or recognition of that Object; for that is what is meant … namely, *that with which it presupposes an acquaintance in order to convey some further information concerning it* (2:231, italics added).

Context is defined in educology as "the system environment for teaching and learning that includes content" (http://educology.indiana.edu/context.html). Clearly, teachers at Unionville Elementary School and at SUNY Cobleskill utilize content and contexts beyond the

confines of classroom walls and signs (words and pictures) contained in books and other media. These students become acquainted with particular, unique objects in their immediate learning environments with which respective signs are directly associated ('knowing that one'). These students are able to connect cognition with emotion and intention (Fig. 2, 3, and 4). Through hands-on learning activities, they are able to form holistic, integrated mental structures.

6. Summary and Conclusion

Content as typically conceived is the subject matter of education, often contained in textbooks, movies, posters, and more recently within software apps run by computers, tablets, and smartphones. This chapter has, hopefully, dispelled this limited conception of content. My arguments for a much broader conception of content are largely based on those made by Dewey, Steiner, and Maccia (see the Educology Website: http://educology.indiana.edu/). I have further alluded to *conative* and *affective* schemata for student learning as Steiner (1988) described. Conative and affective mental structures are also important parts of content for student learning. TIE theory (Totally Integrated Education) predicts that learning will be enhanced when cognitive, conative, and affective structures are connected via student learning activities which holistically integrate these structures (Fig. 2, 3, 4, and 5). The Unionville Elementary School was used as an exemplary case, as well as two undergraduate programs in the sciences at SUNY Cobleskill.

Worthwhile content in education is what students *ought* to learn. With respect to types of knowing, teachers should select the best of culture and lead students to:

- 'Knowing that': mental structures for beliefs that are warranted by disciplined inquiry (i.e., rigorous research);
- 'Knowing how': mental structures for effective performances which are ethical; and
- 'Knowing that one': mental structures for right opinions, where students learn to appreciate unique elements of their culture and surroundings. (Educology, 2018, http://educology.indiana.edu/worthwhileContent.html)

In other words, students should learn to "distinguish opinion from truth," "tell right from wrong" and act ethically, and "to appreciate beauty" (Frick, 1991, p. 32).

If we pursue totally integrated education (TIE), *student learning will be grounded*. Grounding of knowing, feeling, and intending is vitally important. Students who are grounded are less easily deceived and misled by others who are ignorant, prejudiced, or who intentionally lie or distort truth. Students who can think critically become responsible participants in a democratic society. Critical thinkers will not allow deceitful leaders, tyrants, shysters, or slick politicians to control us and tell us what to believe, feel, or to do.

In conclusion, everyone has a right to a *worthwhile education* that will:

- enhance the quality of life,
- reduce inequality,
- minimize suffering, and
- maximize overall good.

(Educology, 2018, http://educology.indiana.edu/we2.html)

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