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Conceptual Tools for Improving Self-Knowledge: V Diagrams, Concept Maps, and Time Writings

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Abstract

This paper presents three metacognitive tools that enable each of us to monitor and assess our degree of self-knowledge with a given topic. **V** diagrams, concept maps, and time writings are presented as conceptual tools for improving self-knowledge. Self-knowledge comes about from our own individual experiences and the experiences that we glean from others. Each of these conceptual tools reveal language in one of three ways: the **V** shows the structure of knowledge; the concept map is a word diagram showing relationship of ideas; and, the time writing spontaneously elicits the extent, accuracy, and relevance of these ideas.

In many school experiences students find themselves at risk for failure when information is presented in a way that is artificial and not meaningful. Learning experiences are artificial when information that is presented lacks a situational context for students to link new ideas to existing knowledge. In such instances, the school experience emphasizes facts and abstract ideas in a manner that is rarely related to the students' life and community. Students often resort to storing this "artificial" information as compartmentalized units to be later accessed in a specific subject area by way of either question answering or examination. Whitehead (1929) addressed this form of knowledge as being "inert." Inert knowledge is activated when explicitly demanded, but is not spontaneously incorporated into other relevant problem-solving contexts. If information is perceived as being artificial, then no amount of extolling by the teacher will make a student understand its relevance.

Even when complex concepts are related to their background of experience, students experiencing failure lack training in interpreting this new knowledge or fail to activate existing knowledge sources to cope with these facts and ideas. Consequently, these students spend their time being told either by their teacher or by textbooks what they need to know for later retrieval. Being told without a context that encourages student analysis and synthesis of ideas can produce students who are unable to apply information in problem-solving situations.

Bronowski (1965) warns us that "it is not true that science, as a language of thought, is free from ambiguity. It could not be imaginative if it were; it would be closed and dead (p.67)." However, in school environments, experiments are designed to succeed and those that fail are dismissed with the "right" answer given by the teacher to the students to enter into their lab manual despite its incongruence. Expediency takes the

place of thought. The knowledge of the self cannot reach closure simply by having someone tell us what is or should be. Knowledge is continually open to unresolved dilemmas. Finding the paths that students take when resolving issues are important considerations for educators.

How students create their own thinking-learning contexts when confronted with authentic problem-oriented tasks is an important issue influencing instruction and learning. Thinking-learning contexts are those mental models (conceptual frameworks) that students invoke when confronted with problem-oriented tasks that go beyond memorizing and compartmentalizing information (Alvarez, 1993). Gowin's (1981) theory of educating, Ausubel's (1963, 1968) cognitive theory of meaningful reception learning, an emphasis on teachers and students becoming "communities of thinkers" (Alvarez, 1996, 1997), and an action research constructivist epistemology provide the philosophical and theoretical background for this paper.

Gowin's theory of educating focuses on the educative event and its related concept and facts. This theory is helpful in classifying the relevant aspects of the educative event using the four commonplaces of educating: teaching, learning, curriculum, and governance. A fifth component, the societal environment is also part of this evaluation process (Gowin & Alvarez, 2005). In an educative event, teachers and learners share meanings and feelings so as to bring about a change in human experience. This theory stresses the centrality of the learner's experience in educating. In Ausubel's theory, three conditions need to be considered: (1) materials need to be concept rich, with clear relationships; (2) the learner needs to have relevant prior knowledge and experience with the concepts and propositions that are presented in the new materials; and, (3) learners need to have a meaningful learning set – a disposition to link new concepts, propositions, and examples to prior knowledge and experience. The notion presented by this theoretical framework enables both students and practitioners to become better informed and knowledgeable about practices that enhance conceptual learning and meaningful understanding.

A community of thinkers is defined as an active group of students and teachers striving to learn more about a discipline by engaging in the processes of critical and imaginative thinking (Alvarez, 1996, 1997). During this inquiry, the teacher thinks about the facts and concepts that need to be understood by students, the supplementary reading materials and artifacts that need to be provided, ways in which to incorporate other subject disciplines into the inquiry, and selects from an array of teacher-directed/teacher-assisted strategies and meaningful materials that can be used to facilitate student thought. Likewise, the student becomes an active thinker in the learning process by engaging with the lesson by relating prior knowledge and world experience both informal and formal, selecting from an array of student learning strategies that are part of an individual's arsenal, and with the teacher works toward extending meaning and understanding with the subject matter.

Developing a community of thinkers focuses on the kinds of thought processes needed by the teacher and students to achieve learning outcomes. *Thinking of ways to*

achieve learning outcomes are not the same as focusing on ways that learning outcomes can be achieved (Alvarez, 1996). The former is process oriented; the latter product oriented. The process of thinking moves from some initiation to a conclusion or solution. A learning outcome focuses on increasing a skill or perfecting solutions (see Russell, 1956). In an effort to increase learning efficiency, we focus on the processes of thinking, selecting, eliminating, searching, manipulating, and organizing information. Emphasis is placed on thinking as a process involving a sequence of ideas moving from some beginning thought, through a series of a pattern of relationships, to some goal or resolution. Within our community of thinkers, teachers and students ask questions, seek answers, and reflect on their thoughts and feelings as they engage in action research case-based investigations. Within this context of a community of thinkers, hierarchical concept maps, **V** diagrams, and time writings are shown to indicate how these tools influence learning contexts between students and their teachers when learning new information.

This paper focuses on five high school students who participated in the Exploring Minds Project and who did time writings, concept maps, and **V** diagrams in their self-directed research projects. Their concept maps, **V** diagrams, and time writings are discussed to provide insight into how these conceptual tools enable us to improve our self-knowledge when confronted with new information. These students participated in a two month summer program, two of which partnered in one year; the other three, one of whom worked individually, in another year (see Alvarez**,** Burks, Sotoohi, King, Hulan, & Graham, 2000; also, Alvarez, Burks, & Sotoohi, 2004).

Evaluation

These two studies were monitored and evaluated by using Gowin's (1981) and Gowin & Alvarez (2005) four commonplaces of educating: teaching, learning, curriculum, and governance. Gowin's theory of educating is a conceptual approach to problem solving that focuses on teacher/student social interactions and the ways in which students and the teacher negotiate meaning between and among themselves.

Our assessment of these studies indicated that ***teaching*** is achieving shared meaning between the teacher and the student. The students and the astronomer/educator accomplished this condition through shared meanings that resulted from negotiating facts and ideas. The students were at first overwhelmed with the responsibility of forming their own research questions and path of inquiry. This format was different from those they had encountered during their formal schooling. The astronomer/educator educator facilitated and mediated their thoughts and feelings as they strived to take charge of their own learning.

Learning in the traditional sense is under the control of the teacher. In essence, the teacher tells students what they need to know. Our philosophy is consistent. We want learning to be placed in a context under the control of the students. In past studies (e.g., Alvarez, Burks, & Sotoohi, 2002; Alvarez & Rodriguez, 1995; Alvarez, Stockman, Rodriguez, Davidson, & Swartz, 1999; Alvarez, et. al. 2000) we have found that students

take responsibility when confronted with meaningful projects and materials. We wanted to discern if given the opportunity, these students would take charge and be responsible for their own learning during a summer session? This question was answered in the affirmative when we provided a forum by which the students could take an active role in structuring and creating their own meaning. The students learned how to use interactive hierarchical concept maps to organize their thoughts, and wrote formal case reports.

The ***curriculum*** that evolved from these two studies of Planetary Transits and Black Holes was emergent rather than fixed. The basic materials went beyond the traditional use of teacher-centered lectures and hand-out materials devised and published by others. Instead, they were presented with a problem/situation and asked to formulate questions of interest to pursue. They were also presented with an animated CD that described the uses and functions of concept maps, interactive **V** diagrams, and an Action Research Strategy that enabled them to think about their research agenda. The contents of this CD activated students schema with planetary transits and provided them with records of planetary transits and related conceptual categories that served as a venue for students to make new events happen resulting from their own questions. The information provided in the case CD guided the students to other relevant resources and materials in their quest to seek resolutions to their self-directed cases.

The school climate differed in that these students did not have other classes during this summer session; had the advantage of being at the Center of Excellence in Information Systems, Tennessee State University, and consulted with the astronomer/educator as the need arose; and, were able to work together over a sustained period of time during the day unlike a typical classroom time period. Although we do not expect the same kind of learning environment in the summer that occurs in a formal classroom setting during the school, the findings were consistent with our past studies that occurred during the school-year (e.g., Alvarez & Rodriguez, 1995, Alvarez, et al., 1999).

The ***governance*** exercised in this type of study differs from policies and formats that are typical in curriculum guides, teacher's manuals, or module-based lessons. These students expressed their thoughts and feelings freely and made critical decisions. The learning atmosphere was nonthreatening and promoted a social context where ideas were openly shared and discussed. The astronomer/educator guided the students by specifying criteria for executing and completing the case. The students were encouraged to make decisions in governing and conducting their research. This research experience differed from their previous encounters in formal school settings where questions and procedures are predetermined with expected outcomes.

The students exercised their own governance during their research investigations. They would sometimes leave the environment of the Center and go to another location within the building or to the library. This type of governance differed from their regular school experiences where a more structured learning environment is in place. Since they were in charge of their case, they became responsible for analyzing data, making decisions about their worth, using statistical methods, sorting through relevant and

irrelevant data sources, and accessing the Internet and to determine whether or not the information was pertinent and authentic.

Three Conceptual Tools

In both of these studies students used concept maps, **V** diagrams, and time writings to organize and reveal their ideas, plan, carry-out, and finalize their research study, and to spontaneously make known their thoughts and feelings by writing within a specific time interval.

V Diagrams

V diagrams change our thinking by acting as a tool that releases energy (see Gowin & Alvarez, 2005). **V**s provide us with alternative ways of conceptualizing reality. In the cases of these students, the **V** was a tool that "unsettled" their normal procedure for achieving predictable outcomes. The **V** requires conceptual and methodological elements bridged by research questions and the events under study. The researcher needs to write research questions that correspond to the events that are being investigated. It is vital that these two components are unified. These students initially had difficulty with this tool and the epistemic elements that comprise the **V**. This was a telling revelation since the **V** engages mental processes that require formulating, manipulating, revisiting, and decision-making. This finding is consistent with other students who have participated in this project who likewise have difficulty formulating their own research questions and using the elements on the **V** diagram. This is not a surprising revelation since seldom are students permitted to ask their own questions in school settings. However, it does point out the need to spend more time in teaching the **V** diagram to students so that they will be familiar with its components and use in the learning and research process. In so doing, students learn to analyze and understand documents and actively engage in the research process.

As part of the Exploring Minds Network (http://exploringminds.tsuniv.edu) designed at the Center of Excellence in Information Systems, Tennessee State University, these students use the **V** diagram to plan, carry-out, and finalize their research investigations. One of the advantages of this interactive **V** diagram is the ability to share information with others electronically.[1] These exchanges led to a better understanding of the topic being studied and sharpened their ability to initiate and formulate questions of their own choosing for directing their learning. We have designed a version of this **V** diagram that can be installed on personal computers. A limitation is that our version does not operate with Apple computers. The **V** can be shared with others electronically via email attachment and written comments can be exchanged readily.[2]

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[1] See the Gowin & Alvarez paper in this 3rd Annual IERG collection, 2005).
[2] For information of this **V** software program email: exploringminds@coe.tsuniv.edu

Concept Maps

A hierarchical concept map is a visual representation of an individual's thought processes. It is a word diagram that is portrayed visually in a hierarchical fashion and represents concepts and their relationships. Students, teachers, and researchers use concept maps as a way to visually display and share ideas.

The university educator, astronomer educator, and a researcher with the Center of Excellence used a scoring protocol developed by Alvarez (2002) to independently score the concept maps (see Gowin & Alvarez, 2005). The astronomer/educator reviewed the concept maps for accuracy, misconceptions, and/or faulty linkages associated with the target concepts studied by AB "Planet Evolution" and that studied by JQ, "Theories of Migration." CMap, developed at the University of West Florida, was used to construct the concept map. AB's concept map had identical scores for both concept maps. A review of JQ's concept showed a misconception with the target concept she was studying. The misconceived concepts were "How gravity and angular momentum lead to changes in the planet's orbit." This is consistent with what she writes in her spontaneous time writing. The maps enabled the astronomy/educator to see the area of most concern to the student. After completion of the students' timed writings this concern was verified.

BH and AG's concept maps were on the topic "black holes." Each map was reviewed and comments made by the astronomer/educator. Once they were received, the two students revised each map leading to a finalized fourth version.

Time Writing

Time writings (see Alvarez, 1983) were used to assess all five students' knowledge, degree of spontaneous relationships, and understanding of the specific topic of study in the self-directed case on Planetary Transits and Black Holes. These timed writings occurred after the completion of their concept maps.

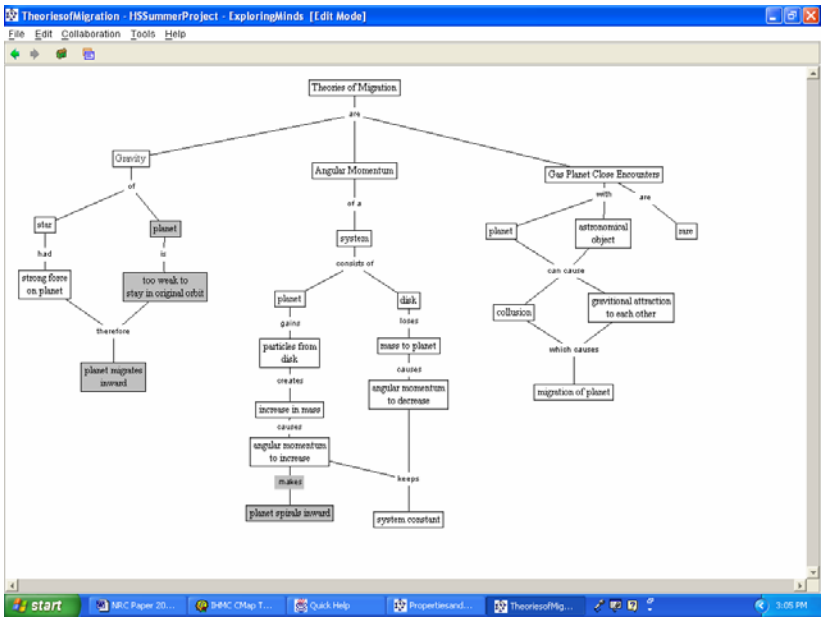
In the case of JQ, TM, and AB, they each wrote for six minutes without stopping their pencil in the process. They were told beforehand that if they couldn't think of anything to write they were to write their first and last name over and over until another thought came to mind. The astronomy/educator reviewed their timed writings and checked for accuracy, misconceptions, or faulty reasoning. The three students were asked to write about the Planetary Transit HD209458b (Alvarez et al., 2004). JQ's time writing was entitled, "Extrasolar Planet HD209458b," AB's title was "Properties and Evolution of the Planet HD209458b," and TM's time writing was entitled "A Study of the Physical Properties of HD209458b."

The astronomer/educator and university/educator each read the timed writings and selected words and word phrases for purposes of coding and comparison. Word and word phrases were selected according to relevant specialized vocabulary associated with the key target concept "Planetary Transit HD209458b" and the concepts stated in their respective self-selected titles. Agreements were decided on the word and word phrases

selected based on the astronomy/educator's expertise with this topic. Analyses of these word and word phrases were conducted. Upon completion of this analysis, the university educator constructed a concept map of each student's time writing and reviewed by the astronomer/educator who examined and compared these concept maps to those that were constructed one-week prior.

General observations comparing the three students' time writings indicated that AB and JQ, while working together, their time writings revealed that they structured their knowledge differently. JQ's writing was along the line of a "stream of consciousness" in that she wrote what she remembered but did not show coherence. She seemed to have a lot of information memorized but the information was not organized or assimilated in her cognitive structure in a short spontaneous setting. For example, she used the term "Angular Momentum" in a way that showed an incomplete understanding of how the term is appropriately applied. Her linkage was incomplete and needed more elaboration. Again her writing and a concept map developed by the university/educator of her writing shows that a logical linkage is missing when she again uses "Angular Momentum" without completely explaining the relationships. However, this revelation is an important factor in that it enables the astronomer/educator to better read and "see" this faulty or missing linkage and helps to inform his teaching practice as a follow-up when meeting with this student. Application of this concept seems to be difficult for high school students since the variables within it --- Angular Momentum equals mass x velocity x radial distance (L=mvr) --- can interact in complicated ways under different circumstances. This misconception also appears on her concept map (see Theories of Migration, figure 1). These two measurements (her concept map and time writing) tends to confirm that she is having difficulty understanding the interrelationship between gravity, angular momentum, and the change in the planet's orbit. This is not surprising since this is a difficult relationship for novices to apply to a planet's movement since it requires advanced math study. JQ appears to be numerically oriented in that she includes them in her writing and they are correctly stated.

Figure 1. JQ's Hierarchical Concept Map



AB's time writing was more of a mini-essay in that her thoughts were more coherent and included a concluding paragraph that summarized her main points. She seemed to have a more unified picture of the interrelationships between the concepts. However, she either has a misconception that planets exist outside our "Universe" or she simply inserted the incorrect word instead "Solar System."

The time writing of TM indicated that he was more data oriented than the other two students. Specifically, he mentioned the mathematical principle (Kepler's Law) to take the data in order to form a conclusion. His ideas are accurate, but not necessarily coherent, his repeated use of his name shows that the linkages are not automatic, but instead uses his repeated name to think about the next link in his chain of reasoning. This is not unusual since this is a difficult concept to apply.

Both AB and JQ's map of their time writing indicated that they were focusing more on theory than TM who appears to be focusing more on observations. A review of a concept map made of his time writing shows that his time writing is based on data and drives his thoughts.

These time writings indicated that these students tended to focus or possibility fixate on the uncertain part of their story rather than the part that could be generally agreed upon. This may be an acknowledgement of discomfort with working on a problem without the right answer. Much of high school education seems to be centered with getting the right answer.

This spontaneous writing provided the astronomer/educator with knowledge to evaluate student progress and conceptual understanding with the target concept. It also

enabled students to better understand their own individual mind set on the kinds of learning required for "school" achievement and that required for personal knowledge and self-development. This is an important distinction since many students have been conditioned to focus on what is to be measured that mostly consists of "right" answers instead of ways to use past records and prior knowledge to make new knowledge.

Spurring the Imagination

To illustrate how these conceptual tools can be used to spur imagination an example of BH and AG's writing combining science and fantasy literature is described. After completing their research project on Black Holes, a fantasy piece was written that incorporated the science affiliated with the topic and an analogy with *Dante's Inferno*. Their paper begins with a quote that leads into their first paragraph that provides the setting for this escape into space.

> "Abandon hope, all ye who enter here." This quote by Dante was referring to the gates of Hell, but it also applies to entering the dark abyss of a black hole. The theory of black holes is one of the most mysterious and intriguing concepts in science. These monstrous anomalies are believed to have many terrifying qualities and are usually identified with science fiction and horror stories. A scientist's definition of a black hole is this: A black hole is a theoretical region of space with gravitational forces so strong that not even light can escape. Resulting from the collapse of a high-mass star, these astounding phenomena are believed to contain infinite mass and zero volume. This paper will explore the clues to a black hole's existence, its reactions with matter, and will end with a hypothetical journey into a black hole. Get ready for the ride of a lifetime! Saddle up; lock and load!

Their paper describes gravitational lensing, X-ray radiation, gravitational redshift, object movements, and contains figures to describe these scientific phenomena. They then close their paper with a story that explains the effects that a black hole would have on matter, such as one of us, an astronaut named Vincent (not very bright) born in the year 2334. They describe his childhood and adolescent misadventures that lead to his continued misfortunes in space and his encounter with a black hole. They invent an interesting term "spaghettification" to describe the effect of the tidal forces that will stretch Vincent into spaghetti. This story exemplifies how science and fantasy literature can be incorporated to portray the "real" with the "imagined."

Discussion

Self-knowledge comes about from our own individual experiences and the experiences that we glean from others. Each of these conceptual tools reveal language in one of three ways: the **V** shows the structure of knowledge; the concept map is a word diagram showing relationship of ideas; and, the time writing spontaneously elicits the extent, accuracy, and relevance of these ideas.

During this process ideas are shared and meaning is negotiated in ways that go beyond simple listings or incoherent thoughts. Instead, ideas are revealed to be critically scrutinized for value and educational significance. The meaning that is transacted in the

literacy process involves the receptive acts of reading and listening and the expressive acts of writing and speaking. Within these processes language is not free of ambiguity. The fact that a language is alive attests that the human mind manipulates and explores the ambiguities that lie in every general idea and in every word thus preventing the closure of ideas and imaginative thinking.

Throughout these action research investigations the students were encouraged to seek answers to their own questions, sort through electronic and print mediums, make judgments, and synthesize facts and ideas as they progressed in their case research. Evidence was provided of the learning and understanding with the topic "Planetary Transits" and "Black Holes" through the visual displays of the concept maps, time writings, and written case reports.

Thinking/learning contexts were better understood as a result of these investigations. Ideas revealed in the timed writings and electronic concept maps together with information gathered from the survey and student case reports better informed us of the conceptual change approach to teaching and learning. Likewise, the process raised the level of consciousness of the student researchers concerning the thought processes and requisite knowledge needed to undertake a complex investigation.

Adolescents deserve the right to have learning environments that provide thinking/learning contexts that challenge their cognitive and affective abilities, interests, and curiosity. As a member of the former Commission on Adolescent Literacy of the International Reading Association we have published a position statement that emphasizes the need for adolescents to receive and "show" what they can do in meaningful learning environments (see Moore, Bean, Birdyshaw, & Rycik, 1999). Some of these principles are evident in these studies: Adolescents deserve access to a wide variety of reading material that they can and want to read; adolescents deserve instruction that builds both the skill and desire to read increasingly complex materials; adolescents deserve assessment that shows them their strengths as well as their needs and that guides their teachers to design instruction that will best help them grow as readers; adolescents deserve expert teachers who model and provide explicit instruction in reading comprehension and study strategies across the curriculum.

Some essentials for adolescent learning are emerging that are compatible with a series of studies that we have conducted (e.g., Alvarez, 1993; Alvarez, Burks, & Sotoohi, 2002; Alvarez & Alvarez, 1999; Alvarez & Rodriguez, 1995; Alvarez, Stockman, Rodriguez, Davidson, & Swartz, 1999; Alvarez, et. al. 2000) and that have been analyzed using the four commonplaces of educating: teaching, learning, curriculum, and governance (see Gowin, 1981; Gowin & Alvarez, 2005).

One essential is that Educating is a process of deliberate intervention in the lives of students in order to *change* the meaning of experience. The change educating makes happen empowers students to become self-educating; they learn to take charge of their own experience. This change of the meaning of experience requires teachers and students achieving shared meaning. The deliberate intervention in the lives of students is

aimed at negotiating meaning between teacher, curriculum, and student to the point of mutual understanding. In this process, the teacher brings something, the curriculum presents something, and the student brings something. All three are involved in contributing something toward the empowerment of students such that they become self-educating.

Another is that just as teachers cause teaching, students cause learning. The student is therefore responsible for learning. Learning is defined as an active, nonarbitrary, voluntary, reorganization by the learner of patterns of meaning. The student learns the new with the power of the old; the new unfamiliar materials must become integrated with the old, familiar ideas and meanings the student already knows. Learning is the way the student grows from the familiar to the unfamiliar such that these two are progressively integrated and differences reconciled. Adolescents find working with authentic data and primary sources couched in meaningful learning contexts stimulates their curiosity and enables them to incorporate a given subject discipline with other related content areas.

Further, these studies, as with our others, the curriculum is emergent rather than fixed. The curriculum is an analyzed record of prior events that we use to make new events happen; the curriculum is related to teaching and to learning, but *not* reduced to either. The curriculum refers to a material thing that exists not the experiences that can be undergone as a consequence of interacting with those materials. The whole of the educative process is not reduced to one part.

Governance is an essential in the school climate. *Governance controls the meaning that controls the effort*. This formula states that governing events control the meaning that controls the effort put into teaching, into curriculum and into learning. Students in this study, as in our others, are encouraged to exercise their own governance by making decisions and choices in their research and case investigations. They impose control over their work and negotiate the paths of inquiry with peers and teachers that will be taken in reaching resolutions.

Finally, adolescents' societal learning environments directly impact their formal school learning. *Educating is a social practice that takes into consideration both formal and out-of-school experiences*. As learners we need to make connections between our societal learning environments and the formal school type environments while simultaneously enabling us to discover learning contexts to deal with problem-oriented tasks. These societal and school factors are complex, interrelated, and interactive entities that influence our education. Being aware of the sociocultural context in which students live helps the teacher to make learning a meaningful connection between the classroom and the students' world environment (Alvarez, 1993; Dewey, 1902; Donham, 1949; Erickson, 1984; Sarason, 1991).

The five students were thoughtful and diligent. They were evaluated using the four commonplaces of educating: teaching, learning, curriculum, and governance. This theory of educating makes sense of educative events. The key event is *a teacher teaching*

meaningful materials to a student who grasps the meaning of the materials under humane conditions of social control. The teacher initiates the event, the materials (curriculum) are guides to the event, the students take part in the event, and the event as a social event has distinctive qualities governing it.

Electronic contexts provided students with ways to monitor and negotiate meaning with each other and their teachers. In this study, the electronic concept maps were tools used by the students to organize and reveal their thought processes with the target concept under study. This required time, effort, and conceptual understanding with complex ideas.

Simplistic solutions to complex problems do little to enhance the learning process of coming to know and understand. If we want to be knowledgeable in dealing with educational problems and situations we need a theory that is designed to guide us in the process of learning and evaluating what is and has occurred. Such a theory of educating espoused in these studies deals with the commonplaces of educating and the ability to become self-empowered. When confronted with novel problems or situations we need to be mindful of the various landscapes that the problem or situation offers us. Our goal is to view its complexities without denying them, and to simplify them so that they can be better known and understood.

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