Building Knowledge by Overcoming the Dualistic Mindset in Education

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Abstract

This article reviews recent research on the process of learning in education. The research findings reveal that students are active learners whereas instruction in schools continues to treat them as passive objects that vary in their capacity to uptake knowledge. In spite of this widely-known insight that learning arises out of action, many educators, particularly in poor developing countries that still rely on old-fashioned school systems adopted from the colonial past, rely on ready-made information following a dualistic view of mind and body. Presented with rules to memorize, students are not encouraged to question or develop their own rules but to accept what adults provide. However, the static dualistic mindset is of little help in a complex and ambiguous world. It stifles real learning and problem solving, and thwarts the adoption of social and political responsibility. Real life understanding should not be discarded as irrelevant but as an essential part of an bottom-up, active learning process guided by knowledgeable mentors.

Introduction

For many centuries it has been assumed that conscious reason is predominant in optimal human functioning. In this view, the body and its passions are to be tamed so that conscious reason can learn and wisely guide life's choices. Education was about providing knowledge and accumulated wisdom to the young mind for absorption out of which good decisions and choices would emerge. Early cognitive science adopted this dualistic perspective, reducing cognition to mental events and brain processes. But this is an outdated view. The last few decades of psychological science have shown that the cognitive unconscious governs most everyday tasks [1] . For example, Libet (1985) showed how the body begins to take an action before the decision is made by the conscious mind [2]. The unconscious mind, based on varying layers of tacit knowledge, makes many decisions without our conscious awareness [3] .

But even more importantly, it is becoming more apparent how understanding is *embodied*. Instead of residing in a mind that can reason and function apart from the body, the "embodiment" view places our understanding in physical experience. For example, Lakoff and Johnson (1999) uncover the myriad body-based metaphors that humans use to express themselves (e.g. for thinking, we say "I *see* what you are saying," "where are you *going* with this idea?" "that idea leaves a *bad taste* in my mouth")[4]. Damasio's (1996; 1999) "somatic marker hypothesis" points to how chemical changes in the body, occurring as signals of past experience, unconsciously guide decision making [5]. Countless studies demonstrate how thinking is aided by physical experience and how our imaginations are bounded by physicality (see Gibbs, 2005, for a review [6]).

Also in contrast to the dualistic view, embodied cognition revises the view of evolution. The human brain "did not evolve merely to register representations of the world" but instead the brain evolved "for adaptive action and behavior;" body structures co-evolved with brain structures so "it is the entire system of muscles, joints, and proprioceptive and kinesthetic functions and appropriate parts of the brain that evolve and function together in a unitary way" [7] (Kelso, 1995, p. 268). Neural events and brain systems are structured by embodied experience [8] .

If conscious reasoning is not dominant and human understanding is largely embodied, there are serious ramifications for the way schooling takes place, the way teachers teach and students learn. These are the topics of this chapter: learning and knowledge development, the embodied nature of knowledge, and the ramifications of these insights for instruction.

1 Conceptions of Human Learning

1.1 Learning as reception

Dualism still pervades human perceptions and practices, including within education. The dualistic view assumes that the mind is separable from the body and can be taught ignoring the body. In this view the mind is most important for guiding behavior whereas the body or passions are the source of distraction and must be controlled. These notions influence how people view learning.

The more prevalent but mistaken notion of learning has been called the “receptive-accrual” view [9] . According to this view, students passively receive knowledge from the teacher. The teacher “pitches” the information to the student and the student “catches” it. Students store the knowledge as presented. If the student does not learn, it is the student’s fault for not “catching” the information. The student fails due to being inattentive or stupid.

The common instructional approach for the receptive-accrual view is one where the teacher presents a “top-down” framework or set of principles developed by adults from their “bottom-up” or organic experience. The adult-learned lessons are presented as material to be memorized by the students. For example, in many U.S. classrooms, teachers present fractions in numbers and formulas on the blackboard and expect the students to complete worksheets on fractions [10] . This kind of education offers inert knowledge to students—information that a student may be able to memorize and regurgitate for a test, but is quickly forgettable. Worst of all, the student is unable to apply such inert knowledge to real life. These teachers fail to realize how children’s experiences can lead to the principles themselves and how principles cannot be truly learned without such experience. Japanese math teachers appear to be aware of this. They typically help students develop knowledge from “bottom-up” experience [11]. For example, fractions are learned first through working with real-life materials before working with the numbers themselves.

The type of mis-education by adults described above frequently occurs in moral education. Some adults believe that presenting a list of virtues is nearly as clear to the students as it is to them. Adults may find a trait list helpful because they have had a lifetime of experience building knowledge about the trait behaviors and use the list as a reminder. When you mention ‘honesty’ to an adult, chances are that he or she recalls many personal experiences of being lied to, of lying, of the consequences of lying, of the degrees of honesty one displays based on the level of intimacy with another, of the differences between honesty and being private or polite, and so on. The label, ‘honesty,’ is convenient for the adult in linking together all these experiences in memory. Adults are not novices when it comes to honesty, whereas most children are. A child has had relatively few experiences with honesty, and fewer yet that are recalled. Further, these experiences may not have been reflected upon, and hence may remain closed to mental scrutiny. Advising a child to “be honest” is talking at students and likely has little effect on their skills (knowledge and application) or character development (except perhaps to think they know what honesty is because they heard about it).

Labeling a complex set of behaviors with a single word (codifying multiple experiences) does not help the novice. For example, if you tell a child to be responsible, it is like telling a person who does not know how to cook to ‘make a white sauce!’ he or she will be at a loss on how to proceed. Likewise, if you tell a child ‘be responsible!’ the child may be at a loss on how to act regardless of how many school assemblies or wall posters espouse its importance. As a result of misunderstanding learning and performance, there can be a big gap between what teachers present and what students learn. In many cases, children never apply the knowledge that teachers want them to learn.

In my research we have tested the assumption that children understand the “magic” and message of a story if you let them experience the story [12]. We told children’s stories to children to see whether they could understand the intended theme [13]. Eight year olds were very poor at understanding the intended themes of stories, selecting correctly about 10% of the time, whereas 11-year-olds were better, understanding the theme about 45% of the time. Scores improve with age until perfect performance in late adolescence. These findings cannot be explained by the receptive-accrual approach but are explained by the next view of learning.

1.2 Learning as transformation

The contrasting view of learning held by those who study human learning and development is the “cognitive-mediational” perspective [14]. According to this view, individuals bring to the learning experience a set of unique conceptual structures or schemas built from previous experience. These structures influence what and how they perceive, what they understand and what they remember. Learning is defined as an *active transformation* of conceptual structures [15] rather than a passive accrual of information. The learner actively manipulates key aspects of the domain, interacting with them, testing the way they work and interact, and gauging how they help meet one’s goals. Knowledge arises out of action. To know an object, one must act on it and transform it through mental and physical operations. Development proceeds by the assimilation of the environment to cognitive structures, and, reciprocally, the accommodation of these structures to the environment. Movement to higher levels of development depends on "reflective abstraction," which means coming to know the properties of one's own actions, or coming to know the ways in which they are coordinated. Cognitive structures naturally change in the course of being used, and both the organism and the environment are involved in this process of change.

Thus we can explain developmental differences in story understanding, like those mentioned above, by emphasizing how children bring their own understanding to the learning situation. Every learner does this. If the learner does not have the appropriate background knowledge for the situation, he will not learn the material in the way intended by the teacher.

The "learning-as-transformation" perspective advocates a different type of instruction. Instead of passing inert knowledge to students through lecture and other top-down methods, students are immersed in bottom-up, active learning. For example, even during cognitive activities such as reading, good learners are active. They actively process the reading material through selective attention. They relate new information to their prior knowledge thereby forming new knowledge. They monitor understanding in order to know when to ask for help or when understanding is complete [16]. These active learning skills can be taught and are necessary for successful learning [17].

1.3 Learning as Embodied Effectivity: The Apprenticeship View

The cognitive-mediational view of transformational learning described above has been augmented by the apprenticeship view [18]. Based on naturalistic learning processes found around the world, apprenticeship learning includes not only immersion in the learning experience but also explicit guidance from a mentor. The mentor guides the learner's attention to key information and its interpretation. The mentor provides "scaffolding," just enough support for the learner to be successful, which is gradually lessened as the learner's skills develop. The learner develops a sense of the affordances (action possibilities) in the domain while at the same time a sense of effectivity (capacity for effective action).

Extensive experience in a domain is required for understanding and knowledge building generally. In older normal children, it is evident that reflective thinking is rooted in "lived emotional experience" [19]. For example, children who have more social experience have developed greater emotional self-awareness and an increased ability to use emotions effectively to think out problems. They demonstrate superior social skills, moral reasoning, and intelligence. Children with extensive free play experience are able to create more ideas and organize those ideas in a broad, analytical context—Greenspan and Shanker's definition of intelligence [20]. Children's play is found to be a powerful educator of both emotions and cognition [21]. Immersion in active learning with material can mimic the free play that is foundational for learning.

Active learning builds the icebergs of tacit knowledge that underlie behavior. Tacit knowledge is formed through the work of at least three types of unconscious processing: basic, unconscious and sophisticated [22]. These represent primitive, default processing systems that remain robust even when explicit systems are damaged, showing low variability among individuals, independence of age and IQ, and a commonality of process across species. The "basic" information processing system includes instinctive behaviors that regulate life (e.g., feeling of hunger precipitated by a drop in blood sugar that results in the conscious desire to seek food). The "primitive" information processing system keeps track of basic information devoid of meaning, such as subsymbolic processing of environmental stimuli, mechanistic registration of the frequencies and covariation of event, inferring implicit rules of systems that are encountered (e.g., grammar). It includes "somatic markers" as memory and warning devices [23]. The "sophisticated unconscious" guides perceptual processing. It attends to meaning and affect, recognizes affordances, and builds embodied structures of knowledge.

These three unconscious systems are the tip of the iceberg in terms of the type of knowledge acquisition or conceptual transformation a person performs without effort. Some tacit knowledge is conceptual but difficult to put into words; other tacit knowledge resides in neuroendocrine and other body systems. But all knowledge is embodied. Usable human knowledge is by and large dependent on this vast network of tacit or implicit knowledge, learned inside and outside of school [24]. Tacit knowledge forms the rich base of practical intelligence within a particular domain which is largely a set of schemas that change with experience [25].

2 How Does Knowledge Develop?

There is a common understanding among cognitive psychologists about how knowledge develops and it generally involves the transformation of schemas or generalized knowledge structures [26]. The traditional view of schemas is explained first and then a more embodied view is addressed.

2.1 Schemas

The notion of schemas is one that has driven research and teaching for several decades. Working from Kant's and Piaget's notions of schemas, classic schema theorists [27] introduced schemas as general knowledge structures residing in long term memory. Schemas (i.e., expectations, hypotheses, concepts), built from brain patterns formed from experience, are shaped as people notice similarities and recurrences in experiences. Schemas are evoked (or "activated") by current stimulus configurations that resemble previous stimuli. A schema consists of a representation of some prior stimulus phenomenon; this organized prior knowledge is used to understand new information (sometimes referred to as "top-down" processing). The functions of schemas are essential to human understanding. Schemas guide attention to new information and provide guidance for obtaining further information, give structure or meaning to experience by logically inter-relating the parts, enable the perceiver to "chunk" an appropriate unit, and to fill in information where information is scarce or ambiguous, provide guidance for evaluating and for problem-solving. In short, schemas facilitate information processing. This is evident across domains, including moral reasoning [28].

A more recent discussion of cognitive schemas distinguishes among the (1) form, (2) creation, (3) types of knowledge represented and the application of schemas [29].

(1) Schemas have a particular form or architecture. They are basic storage devices represented by a tightly organized network structure. The structure is determined by the pattern of interconnections among the element which are connected positively or negatively, strongly or weakly. The degree of connectivity among constituents and sub constituents (+ or -) determines strength and accessibility. Schemas are noted for their flexibility. They can vary in size and be embedded in or overlap with other schemas. No instantiation of a schema is identical to another.

(2) Schemas are not memorized but constructed from experience. A schema will develop in response to repeated opportunities to solve a particular kind of problem. The schema contains abstractions from the commonalities in experience, yet they can be concrete or abstract. Their construction involves attention and selective processing. Although individuals experience life uniquely, the similarity of their experiences brings about the development of similar schemas.

(3) Schemas include both procedural knowledge (rules) and declarative knowledge (concepts and facts). Schemas can be applied subconsciously and automatically or consciously and controlled. Schema application involves analogical reasoning and both linear and parallel processing. Essentially, a schema has been considered a goal-oriented cognitive mechanism.

2.2 Instruction for schema development

How do educators begin to foster in students the vast network of schemas that make up a domain's practical intelligence? According to Marshall (2000), there are several levels of knowledge in a fully-developed conceptual network or schema, from less to more complex: (1) identification knowledge, (2) elaboration knowledge, (3) planning knowledge, and (4) execution knowledge [30]. The least complex type of knowledge is (1) identification knowledge which comes about from many different experiences in the domain. Identification knowledge establishes the boundaries of the domain. The student becomes familiar with the essential nature of domain situations and learns to recognize essential elements in the dynamic context (simultaneous processing of multiple elements in a configuration).

Complexity is added when the teacher begins to draw attention to the details of problems and patterns, fostering (2) elaboration knowledge in the students. Elaboration knowledge is declarative knowledge that enables creation of a situation/mental model. It includes individual experiences and general abstractions, including sensory information. It focuses on the details of the elements in particular situations (verbal and visual). Initially, a student uses a prototypical example with which to make comparisons. Students create a mental model of the specific problem from the specific situation or from a generalized schema.

The next layer of understanding involves solving problems in the domain. This allows the students to build (3) planning knowledge which shows them how to access identification and elaboration knowledge. Planning knowledge refers to the way a schema can be used to make plans, create expectations, and set up goals and subgoals. The schema is updated with each usage. Given more than one situation in a problem the student must acquire knowledge necessary for determining which situation to examine first and how the situations are related to one another. Student learns to formulate a plan of action. Planning knowledge is difficult to acquire, greatly dependent on having the right mental model and being comfortable working with it. Planning knowledge is rarely displayed in overt measurable settings and is often detectable only by inference.

Finally, students begin to integrate their knowledge across contexts and build (4) execution knowledge in the domain. Execution knowledge puts everything together. Planning knowledge is used to determine the steps to take in solving a problem. Execution knowledge allows the student to carry out the plan. It consists of algorithms or techniques to complete each step in a plan. Students learn what knowledge to apply when and why. As each step is completed, the execution knowledge is called on to address subsequent steps. Below and in Table 1, we describe a project that incorporated these steps into a novice-to-expert approach to moral character education.

To this point we have been discussing schemas from an information processing perspective. This is "old cognitive science" [31]. The newer cognitive science pays attention to the body-mind-environment interactions. Ideally, students have multi-sensory experience in a domain so that several routes are established for building and accessing knowledge schemas (i.e., material is presented in *different modes:* visual, auditory, tactile, kinesthetic, olfactory, musical and in ways that foster *different types of thinking*: analytical, practical, creative, predictive, retrospective, motivational). This is best described in terms of "embodied schemas."

2.3 Embodied schemas

We can change slightly the notion of cognitive schemas as facilitators of information processing so it more clearly reflects embodied knowledge. Instead of a disembodied mind that learns and applies knowledge, we know now that body, mind and environment are linked. Proper units of knowledge are primarily *concrete*, embodied, incorporated. Knowledge is about situatedness. The uniqueness of knowledge, its historicity and context, is not a "noise' concealing an abstract configuration in its true essence" (Varela, 1999, p. 7) [32]. Instead, the "noise" is the context-specific knowledge required for successful interaction with that situation. Embodied cognition results from 'mesh,' the particular way that situational affordances, knowledge, and goals combine [33].

Because human behavior is goal-directed, categories of knowledge emerge from goal directed behavior. For example, the infant learns "that a certain category of force dynamics is appropriate for a certain class of tasks" [34]. The organism actively constructs a sensorimotor representation based on environmental features that are directly relevant to the goal-directed action being currently performed.

Thus perception-action-knowledge is contextualized. We are embedded in space and time, which constrains interactions, the "processing' of environmental information. The same space is viewed differently by the same organism depending on the type of task to be performed at the time. The particular goal-directed activity determines which environmental features are relevant to the performance of the activity. Sensorimotor experiences that occur while acting in a particular environmental context specify the type of categories/concepts the organism forms. Our goals and capacities interact with the specific environmental configuration in our learning of "what works" to be effective in that situation. Humans, like all organisms, are continuously self-organizing, self-developing and so we quickly learn these perception-action links. "The system can generate its own change, through its own activity, and within its own continuing dynamics, be it the spring-like attractors of the limbs or the neural dynamics of the brain" [35].

If learners are self-organizing, if knowledge is contextualized, then how does instruction incorporate these factors? Novice-to-expert instruction provides the apprenticeship model that most closely mimics natural, embodied learning, and schema development.

3 Novices and Expertise Development

> *"Billy has an IQ of 121 on a standardized individual intelligence test; Jimmy has an IQ of 94 on the same test. What do each of these scores, and the difference between them, mean? The ... best available answer to this question is quite different from the one that is conventionally offered---that the scores and the difference between them reflect not some largely inborn, relatively fixed ability construct, but rather a construct of developing expertise. I refer to the expertise that all of these assessments measure as developing rather than as developed because expertise is typically not at an end state but is in a process of continual development." [36]*

The abilities that are fostered by schooling are now considered to be a set of capacities that develop continuously from experience [37]. According to this paradigm, individuals build their knowledge over time during the course of immersion in and interaction with the elements of a particular domain. In this view, standardized tests are not measuring innate capacity but how much expertise the respondent has developed in a particular subject area or domain (and how much expertise the respondent has at taking such tests).

So if we see school learning, like all learning, as developing expertise, we need to examine what expertise is (for a review of literatures, see Ericsson, Charness, Feltovich, & Hoffman, 2006 [38]). Expertise is the ability to solve problems effectively within a domain. According to Sternberg (1998), expert skills include the ability to develop sophisticated representations of domain problems based on structural similarities [39]. Experts work forward from given information to implement strategies for finding unknowns in problem solving. They choose a strategy based on elaborate schemas for problem solving and use automated sequences of steps in problem solving. They are highly efficient and effective problem solvers who monitor their success in reaching a solution.

Experts focus on the key patterns and information needed to solve the problem, whereas novices are distracted by superficialities (e.g., Vicente & Wang, 1998 [40]). Experts have large, rich, organized networks of concepts (schemas) containing a great deal of declarative knowledge about the domain, whereas novices have superficial knowledge [41]. Experts have well-organized, higher interconnected units of knowledge in the domain that have developed from extensive experience in the domain [42]).

3.1 Expertise development

Expertise requires extensive study and deliberate practice [43]. Unlike the lay person, experts have the benefit of learning tacit knowledge and explicit knowledge in tandem [44]. They have networks of schemas linking their tacit and explicit knowledge banks. They develop a whole set of skills including reflective, deliberative skills, routines and superior processing capabilities.

As mentioned previously, like many experts, adults generally forget what it is like to be a novice [45]. Whitehead (1929) pointed out that whereas individuals learn from experience and then abstract and codify their experiences, adults focus on the codifications they have made from their experience when they educate the next generation, burdening the children with inert knowledge [46]. Yet society typically understands this to be good education. Knowledge presented in this manner might be memorized but not learned in a way that is useful unless the top-down principles are accompanied by bottom-up experience.

In primary and secondary schooling, there are many subjects to be covered and little time to spend on each one. Nevertheless, teachers can approach the subject matter as a domain of knowledge that novices can, over time, learn to master. Nurturing mastery of a domain is a lifelong endeavor. Teachers have a chance to help students develop the attitudes and motivation to monitor their own progress towards expertise.

3.2 Novice to expert instruction

Real life understanding requires a pedagogy that integrates immersion experiences with mentor-guided interpretation. There are four features of education that are fundamental for developing expertise. First, an environment that rewards appropriate behaviors is critical for learning effective intuitions about the domain. Second, mentors should provide links to theory at the appropriate moments for maximal learning. Third, students require extensive practice. Fourth, students require the mentor to guide learning, coaching the student on what to attend to, what details are important and what skills to apply.

The environment. We have noted what every individual effortlessly does with stimuli through interaction with the environment—finds contingencies and regularities, creates body-mind-context patterns of response, and so on. This is the normal course of learning for the lay person. The environment plays a large role in what is learned. According to Hogarth (2001), the environment provides learning structures (the characteristics of the task in which we learn from experience), which shape the intuitions that drive us [47]. Through direct experience, people learn content, rules, and "cultural capital." People learn by noticing associations or contingencies. Rewards and punishments reinforce memories for some associations over others. Conceptualizations are associated in the mind through spreading activation of schemas.

According to Hogarth (2001), some environments are more favorable in providing quick and accurate feedback. Because we aren't aware of the learning structures in the environments we inhabit, we can learn the wrong lessons and end up with erroneous intuitions [48]. This can happen when a child has parents who are depressed or addicted. The affordances of one environment may not generalize to others or to most environments, leaving an individual with a poor set of responses to generalize. A child that has learned to respond casually to inconsistent and undemanding parenting may not learn skills of listening, following through, or empathy. In contrast, experts have learned their skills in more favorable (well-structured) environments—environments that provide them with accurate feedback on whether they are learning what works. Experts immerse themselves in the appropriate domain environment.

Theory. It is not only the superior, controlled environments that contribute to the development of expertise. Experts-in-training learn theory too. Instructions for expertise involve explanation of key principles in the domain, why certain things are better than others. Along with the implicit learning that comes from immersion in a situation, experts-in-training are given theoretical tools to 'see' the domain [49]. Experts become experts in part because they use/ learn explicit theory developed by previous generations of their profession.

Practice. But there is more to building expertise than a well-structured environment and learning theory. Experts put in a lot of time and focused effort/practice in the domain. Some argue that this is the key to expertise and that it takes about 10,000 hours or 10 years of focused practice [50].

Guidance. In order to build expertise, novices need a "guide on the side," someone who will point the way at critical times in their learning, and someone who will model effective behavior in the domain.

In sum, teaching for expertise differs from the usual approach to instruction in schools. Students are immersed in a well-structured environment. They explicitly learn theory. And they spend a great deal of time on focused, deliberative practice. Through these practices in combination they learn representations, many of them action schemas, cognitive conceptual networks or mental models, along with physiological responses of what works to solve domain problems.

4 An Example

The Minnesota Community Voices and Character Education project (CVCE; Narvaez, Bock & Endicott, 2003; Narvaez, Bock, Endicott & Lies, 2004)[1] [51] adapted the four schema development levels (identification, elaboration, planning, execution) to four levels of novice-to-expert instruction for moral character education in schools. CVCE identified sets of skills that are necessary for taking moral action. These include skills in four components that are necessary for moral behavior [52]. These components are *ethical sensitivity* (e.g., perspective taking, working with diverse individuals and groups, controlling social bias), *ethical judgment* (reasoning about ethical problems, considering consequences, developing resilient thinking), *ethical focus or motivation* (e.g., acting responsibly, showing respect, developing integrity, and *ethical implementation or action* (e.g., resolving conflicts peacefully, persevering, taking leadership). In Table 1 shows the levels of novice-to-expert instruction that could be used for the subskill, Being a Good Steward, from the skill, Acting Responsibly, which falls into Ethical Focus.

5 Policy Implications

In the USA, ideas about learning as knowledge transformation have been kicking around at least since John Dewey (1916). The government, through the National Science Foundation, has been funding research that emphasizes teaching for understanding and knowledge transfer [53]. For example, for forty years Project Zero (http://pzweb.harvard.edu/) has spearheaded projects that aim to help teachers teach for understanding in math, science, arts and across disciplines. The goal is to teach in such a way that students do not only understand domain information but are able to expand upon it, and then apply it in new ways.

Conclusion

Despite advances in our understanding of how people learn, much of education continues to focus on inert knowledge that a child may be able to memorize and regurgitate for a test, but is useless in real life. Real life understanding requires a pedagogy that integrates immersion experiences with mentor-guided interpretation. Instruction that embraces the embodied nature of human understanding ensures that students are holistically engaged in active transformation of the domain. Educators provide theory, extensive practice and guidance that novices need to reach towards expertise in their particular local environment. Novice-to-expert instruction engages both the implicit, intuitive mind as well as the conscious deliberate mind, leading to the most adaptive understanding. In this context, governments in developing countries who are eager to improve the quality of education and ensure its practical relevance for local development may consider a dual-track approach in which schools partner with local entrepreneurs and innovators that could adopt the role of mentors and thus enrich the school-based education and work-based training segments.

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Table 1. Component: Ethical Focus

Skill: Acting Responsibly

Subskill: Being a Good Steward

Level 1: Immersion in Examples and Opportunities

Attend to the big picture, Learn to recognize basic patterns

Examples of stewardship. Present students with examples of people (readings, video) who describe their stewardship and what they think about stewardship. Students notice what motivates stewardship and how different people define it. They can develop a set of defining characteristics of stewardship, as well its variations.

#History of stewardship. How have organizations practiced stewardship or not? Have your students break up into groups and choose and present on a particular group that has shown or not shown stewardship (e.g., the World Wildlife Federation, Exxon Mobil).

*Examine local stewardship. How do local organizations and traditions practice stewardship? Students interview representatives of local groups about their views and practices of stewardship and report on their findings.

+Limits of resources. Discuss the limits of all resources (ecological, social capital, personal energy, time—hours in the day) and how people are always making choices (usually not consciously). Read recent papers or websites on the limitations of resource use (e.g., 350.org). Examine Jared Diamond's thesis in the book, *Collapse*, and how runaway resource use can bring down societies.

LEVEL 2: ATTENTION TO FACTS AND SKILLS

Focus on detail and prototypical examples, Build knowledge

#Create videos demonstrating stewardship. Based on their findings about how organizations are good stewards, students work in groups to create videos demonstrating stewardship.

*Brainstorming exercise on stewardship. After defining what stewardship is, have the students brainstorm about different ways that the classroom and school or they and their families have shown good stewardship. How have people whom they know shown good stewardship? Make sure to look across domains such as economic, ecological, social-relational, civic, intellectual, gifts and talents.

+Assessing resource availability. Find examples of ways that people budget their resource use. Using a broad view of stewardship across domains (e.g., economic, ecological, social-relational, civic, intellectual, gifts and talents), what are some effective ways that the students budget their own resources? Discuss how stewardship might be improved based on examples from others.

LEVEL 3: PRACTICE PROCEDURES

Set goals, Plan steps of problem solving, Practice skills

#Self assessment on resource use. Students keep a record of how much of the following they use in one week: water, heat, electricity, foods, transportation, etc. Students come together and graph their usage of each resource. Students set a goal to improve stewardship and after practicing for a week or more, regraph resource usage.

*Write letters of thanks to those who show good stewardship locally. Have the students write letters to the local groups and clubs that have shown admirable stewardship in their group's activities. Include in the letter the ways in which the groups' stewardship has inspired the class and helped the community.

+Planning stewardship. After investigating their own stewardship and the options for conserving and managing resources, students make a specific plan for improvement in one small area of stewardship. Students make a plan, carry it out and then report on the results.

LEVEL 4: INTEGRATE KNOWLEDGE AND PROCEDURES

Execute plans, Solve problems, Transfer knowledge across situations

#Resource budgeting. Using information from their self assessment on resource usage, have students budget themselves on resources usage in multiple areas or in an area that is more difficult (e.g., energy usage). The class or group can decide together on limits. Assess by having students keep track for a week and report to their group and class.

*Group stewardship practice. Students participate in a local group that practices concrete forms of stewardship (e.g., recycling, roadside clean-up, etc). Reflect and share reports on the experience.

+Local expert guidance in planning. Have the students invite and host a local expert(s) on stewardship in a particular domain, e.g., energy conservation expert, recycling commissioner, etc. Ask the local expert to help the class develop a plan for stewardship (for the class, the school). Plan to involve other classes, teachers, students in the plan. Invite the expert back in several months to hear reports about how the plan implementation has progressed.

#*+ These symbols link activities that can be linked together for a sequence of novice-to-expert instruction.