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ABSTRACT

For centuries, there has been a raging debate over the origin of knowledge and the nature of learning. This paper describes the essence of that debate as it relates to understanding the current disjunction between natural learning and academic learning. Natural learning represents the wealth of learning that occurs outside of school, especially during the years before formal instruction begins. Academic learning is representative of a very different learning process which takes place within the formal learning environment of today's schools. In an effort to clarify the nature of the disparity between learning in these two contexts, this paper examines information processing and biofunctional educational theories. The main argument is that the prevailing assumptions about the origin of knowledge and the way it is learned are responsible for the existing gap between academic learning and natural learning. (Contains 1 figure and 36 references.) (Author)

NATURAL AND ACADEMIC LEARNING

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Summary

For centuries, there has been a raging debate over the origin of knowledge and the nature of learning. This paper describes the essence of that debate as it relates to understanding the current disjunction in education between natural learning and academic learning. Natural learning represents the wealth of learning that occurs outside of school, especially during the years before formal instruction begins. Academic learning is representative of a very different learning process which takes place within the formal learning environment of today's schools. In an effort to clarify the nature of the disparity between learning in these two contexts, this paper examines information processing and biofunctional educational theories. The main argument is that the prevailing assumptions about the origin of knowledge and the way it is learned are responsible for the existing gap between academic learning and natural learning.

Historical Overview

When ancient Greeks first began their philosophical inquiry, discussion revolved around the nature and origin of knowledge. In the writings of Plato (427-347 B.C.) and Aristotle (384-322 B.C.), two distinct traditions emerged which have defined this debate throughout history. Plato stressed the power of reason over the role of perception. He placed the origin of knowledge within the individual and claimed that the human intellect can go beyond the world of physical appearances to gain rational access to the underlying structure of metaphysical truth. In contrast, Aristotle argued that knowledge originates in sensory experiences of the external physical world. He maintained that ideas or forms exist in the physical world waiting to be internalized by the individual through the senses. These epistemological issues have remained the focal point of philosophical debates for nearly two thousand years and in many ways, the tension between viewpoints has yet to be resolved.

During the seventeenth century, the rationalist flag was carried by philosopher Rene Descartes (1596-1650) who argued, like Plato, that the mind was the innate source of knowledge. Descartes' nativist perspective was challenged by empiricist philosophers like John Locke (1632-1704) and David Hume (1711-1776). Like Aristotle, the empiricists argued against innate knowledge, proposing instead, that knowledge had its genesis in observation, experience, and experiment (Copleston, 1985).

Classical theories of the origin of knowledge have profoundly influenced modern conceptions of knowledge and approaches to learning, but contemporary issues in learning can most commonly be traced through the discipline of psychology. During the early days of psychology, there seemed to be a preoccupation with the scientific study of basic elements of sensation and ideation (Gardner, 1985). In 1879, Wilhelm Wundt proposed a psychology of conscious experience based on the scientific principle of systematic observation, whereby the method of internal observation or introspection was employed to discover the structural organization of mental content (Anderson, 1990).

At the dawn of the twentieth century, functional theorists rose in rebellion to Wundt's structuralist program. William James stood at the vanguard of this new movement. Functional theorists, including Dewey (1896), Angell (1907), and Bartlett (1932), were motivated not by a desire to seek the origin of knowledge in the mind or in the world but by the urge to understand how people function in natural, real-world contexts and how the human nervous system makes cognition possible. Shortly after the arrival of functionalism, a contemporary of Dewey's, J. B. Watson, shook the foundations of cognitive psychology by establishing the behaviorist school of thought. Behaviorism became a common alternative to cognitive functionalism. As behaviorism rapidly gained momentum and support, cognitive functionalism was swept aside.

The focus in behaviorism was on the external stimulus. The goal now was to identify general laws of learning that would enable us to manipulate observable external conditions to predict and control the behavior of organisms. External stimulus became the source of learning and the regulator of the behavior that led to learning. Under the influence of Thorndike, Skinner, and others, this perspective continued to dominate American educational and psychological practice for nearly forty years. During these years it was generally accepted that (a) the sole origin of learning as well as (b) its sole regulator was the external stimulus.

It was not until late 1960, after Sputnik, that the pendulum in education moved in the other direction. The cognitive psychology of information processing (IP) began to revive interest in knowledge, memory, and the active role of the learner. Unlike behaviorism, the IP model places the learner in control of the learning processes. However, like behaviorism, the IP theory continues to assume that the external stimulus, now called the input, is the sole origin of learning. The cognitive machinery is viewed as a mechanical, computer-like, symbol-processing system under the mindful control of the individual learner. In other words, emphasis remains on external information as the only source of knowledge even though the learner now plays an active role in the learning process.

Thus, during the first half of the twentieth-century, research on learning flourished within the behavioral tradition. With the advent of the IP theory, interest shifted exclusively from learning to memory for external input, and from observable behavior to internal strategies for storing, retrieving, and utilizing external knowledge. Then, beginning in the late 1970's, cognitive theories of knowledge which had enjoyed exclusive attention for close to two decades, were challenged by many who realized that the traditionally held assumptions about the computer as the metaphor (Neisser, 1976, 1978) as well as the resulting focus on memory (Brainerd & Reyna, 1992) may not be appropriate. As a result, there was a sudden decline in interest in cognitive theories of knowledge and a corresponding increase in interest in the role of the brain as a biological learning system.

Perhaps the most definitive blow in the face of cognitive theories of knowledge came from the realization that knowledge structures, far from being permanent representations of external objects, could be viewed as transient and continuously-changing structures created in real time by the ongoing functioning of the brain, a view already implicit in the work of Bartlett (1932; Iran-Nejad, 1980) and other cognitive functionalists (Iran-Nejad, Hidi, Wittrock, 1992). The transient knowledge hypothesis became the central idea behind biofunctional cognition and a source of renewed interest in the early twentieth century functionalism (Iran-Nejad & Marsh, 1993). In the biofunctional approach, the brain is not analogous to the computer, it is not a machine for processing external input, and it does not permit the storage of preprocessed knowledge structures. Rather, it is an organic system that has evolved to naturally embrace authentic, real-life, and social aspects of learning under the simultaneous influence of multiple independent sources that contribute to learning, thinking, and problem solving.

Types of Learners

The behaviorist, IP, and biofunctional theories each hold dramatically different views of learners. In behaviorism, learners are born passive reactors to external stimulation and they remain the same as they grow. In IP theory, they are born active learners with no how-to-learn strategies and they can learn to become expert strategists as they grow. In biofunctional theory, they are born natural learners and they can become better or worse learners as they become more strategic (Iran-Nejad, 1990). The issue may be illustrated by what Gardner (1991) calls natural and scholastic learners. According to Gardner, natural learning represents the child's intuitive, spontaneous, and comprehensive capacity for learning. Scholastic or academic learners are those who seek and master the rules, concepts, and strategies necessary for learning in school (Gardner, 1991). For instance, the spontaneous learning that results in mastering speech systems is completely different from the compulsory learning of reading, writing, and mathematics in schools. Inherent in this statement is the idea that new students bring to school with them a rich foundation of intuitive and authentic knowledge. However, once in school, learning takes on a new form, and the natural learner is converted into an academic learner (Iran-Nejad, 1990).

The disharmony that embodies this change in learners compels us to review and examine educational learning theories that engender different ways of academic learning. Through the description of current information processing approaches, we will see what might be responsible for the gap between academic and natural learning as well as some of the ways researchers have attempted to eliminate this gap. We will examine four different instructional models. Each model has in some way been influenced by the IP model which assumes that (a) the sole origin of learning is external and (b) that the only internal source of control or self-regulation is the conscious control system.

Instructional Models for Academic Learning

Cognitive instruction, as influenced by the IP model, is concerned with learning as an active, perhaps constructive, and goal-oriented process dependent on the learner's various strategies including mnemonic and metacognitive ones (Shuell, 1986). Learning begins with conscious storage and retrieval of information and with practice what is initially conscious becomes automatic. The ACT (Adaptive Control of Thought) model (Anderson, 1990) illustrates the rehearsal and repetition aspect of skill learning (or automatization) in the IP tradition. The good-strategy-user model (Pressley, 1986) illustrates the focus on mnemonic strategies. The model of reciprocal teaching (Palincsar & Brown, 1984) and the cognitive self-instruction model (Manning, 1991) are eclectic approaches emphasizing metacognitive, social, and self-regulation aspects of learning. The latter models take major steps toward overcoming some of the problems facing traditional IP theory.

A Model of Skill Learning

J.R. Anderson's ACT model which is acknowledged as a general model of the "architecture of cognition" (Gardner, 1985), posits a specific learning mechanism for problem solving called knowledge compilation. This feature regulates the flow of information through the cognitive system, converting factual information (declarative knowledge) into use-oriented procedural knowledge (Glaser, 1990).

In this approach (see Anderson, 1990), the learner rehearses facts in order to perform a skill. For example, when someone is learning to drive a standard transmission car, s/he may practice shifting from park to reverse. As rehearsal continues (e.g., practicing releasing the clutch while applying the gas, so the car does not stall), facts are arranged in sequence, errors are removed, and correct procedures are strengthened. With repeated, conscious rehearsal, the movements involved in changing gears become automatic, meaning that the procedure has been learned and no longer requires conscious attention. The components of the procedure become so tightly interconnected that they run automatically and simultaneously. As illustrated, learning is conscious, strategic, and confined in scope, where the learner is responsible for acquiring specific problem-solving strategies within a structured learning environment. Thus, according to the

ACT model, skill learning is the establishment of particular automatic memory structures.

Strategies for Memorizing Input

Active learning strategies within academic learning have received much attention in part because of Pressley's (1986) good-strategy-user model. According to Pressley, competent learning is a function of knowing effective strategies for memorizing input (Pressley, 1986). Pressley proposes a variety of memory strategies including, summarization, imagery, question-generation and question-answering, mnemonics, and rehearsal (Pressley, Johnson, Symons, McGoldrick, & Kurita, 1989). For example, when music students are learning the names of the notes on the treble clef staff (E,G,B,D,F) the information is encoded by memorizing a mnemonic sentence or word, Every Good Boy Deserves Fudge. The same procedure applies to learning the notes on the bass clef staff. The mnemonic for the line notes (G,D,A,E,B,F) is Go Down And Eat Baked Fish. Likewise, notes in the spaces (A,C,E,G), can be learned by memorizing the sentence, All Cows Eat Grass.

The IP framework guides both Anderson' and Pressley's procedural perspectives with regard to two assumptions about knowledge. First, knowledge exists apart from the nervous system, and, therefore, to learn is to internalize and store it in the form of input for later retrieval and use. Using the computer analogy, Pressley, Johnson, Symons, McGodrick, and Kurita (1989) Anderson (1990), and Neisser (1967), compare the hardware and the software of the computer to the human brain and mind respectively. Just as computer programs exist separately from the computer itself, knowledge structures exist apart from the brain. Secondly, learning is an entirely conscious, intentional, and strategic process. The learner can specify the elements of the input piece by piece, arrange them in a correct sequence, debug the arrangement, and store the product for future use. Effective learning, therefore, is making use of good strategies to accomplish this. These two assumptions justify the traditional practice of presenting a body of externally available knowledge to students and teaching them how-to-learn strategies for internalizing it. One difficulty with the kind of learning that occurs under these assumptions is that it seldom generalizes to situations outside the school, thereby contributing to the gap between academic learning and the real world of practice.

Reciprocal Teaching (RT): An Eclectic Model

Another instructional model focusing on active learning is the reciprocal teaching (RT) model. The RT model (Palincsar & Brown, 1984) augments automatization and strategy training processes with explicit knowledge of when and where how-to-learn strategies should be used. This type of knowledge, known as metacognitive knowledge, is an attempt to narrow the gap between what is learned in schools and how what is learned is applied to other contexts, including those outside the school. The notion of metacognition is a natural extension of the IP theory as an intentional learning framework. Loosely defined, metacognition is the conscious awareness and regulation of one's own thought processes (Flavell (1987). One third grader called it "spying on your own thinking" (Manning, 1991).

The RT model takes another important step in reducing the gap between academic learning and natural learning. One vital aspect of natural learning is that much of it occurs in a social context. Reciprocal teaching may be viewed as an academic simulation of this aspect of the real world in which much of what is learned is first experienced in a social context. The Vygotskian, sociocultural influence is considered a key component of the model (Glaser, 1990). The instructional procedure involves each student taking turns guiding a group of peers through questioning, summarizing, clarifying, and predicting strategies (metacognitive strategies) for reading comprehension. Thus, the learner's role takes on a more natural and more mature dimension in that RT enables learners to facilitate their own learning as well as that of others (Manning, 1990).

The RT approach maintains the major assumptions of the IP theory. First, the focus remains directly on intentional learning. The learner is explicitly instructed in ways of developing effective conscious control strategies and skills useful in reading comprehension. Secondly, learning is still viewed as internalization of external knowledge. Interestingly, both the IP theory and Vygotsky's sociohistorical theory concur on the assumption that the learner internalizes external input during learning.

Cognitive Self-Instruction (CSI)

We have chosen to discuss this example of the IP theory last because of its richness as an example of the active learning tradition. The CSI model shares many assumptions with the other IP variations, primarily because of its focus on active, academic learning. Most like the RT model, CSI almost exclusively emphasizes metacognitive strategies and is firmly grounded in Vygotsky's sociohistorical theory. Unlike the models discussed so far, CSI is interested in transforming the academic learner into an expert learner. Manning's aim for CSI is to create independent learners whose behavior and knowledge are not limited to the original learning milieu. For example, Manning (1991) suggests that initial metacognitive strategies should be connected with a content area, like reading for instance, but transferring strategies to different disciplines and various new situations is the key to facilitating expert learning.

CSI advocates teaching self-regulated learning strategies through metacognitive processes in areas like memory, comprehension, problem solving, and self-control. When doing independent seatwork, for example, self-instruction (Michenbaum, 1977) includes problem definition, focusing attention, guiding, coping, and reinforcing skills. Students are taught how to <u>ask</u> themselves questions, <u>tell</u> themselves to focus attention, <u>try</u> to do the best work possible, <u>check</u> their work, and <u>cheer</u> for themselves when their activity is successfully completed. In this way, they are taught to become self-reliant learners.

Manning (1991) suggests that teachers must deliberately model metacognitive strategies so the students can master the metacognitive processes that are essential to learning for transfer. However, it is Vygotsky's theory of verbal self-regulation which provides the context through which we can more completely understand the CSI model. Delineated within Vygotsky's sociolinguistic approach to cognitive development, are two concepts that are helpful in determining the relationship between knowledge and learning within CSI: the zone of proximal development and the concept of verbal mediation.

From Vygotsky's perspective, children's conscious control over the learning situation can be extended when aided by an adult-regulated scaffolding context. This scaffolding context permits the child to absorb external knowledge that lies within the child's appropriate zone of development and to convert it into a cognitive tool for the learner's future self-regulation (Bruner, 1985). This image conveys two notions we have asserted as typical in the world of the academic learner: executive or intentional self-regulation and the assumption that knowledge exists outside ready-made to be internalized by the intentional learner. Thus, Vygotsky's theory provides the psychological basis for an emphasis on the academic learner versus the natural learner.

When looking into the concept of verbal mediation, it is clear that Manning assigns the executive system or active internal self-regulation, an exclusive, all-important role throughout the learning process. Figure 1 illustrates the behavior of an individual who relies solely on active self-regulation. It shows that the active internal source of control focuses the learner's attention on what to say or do in response to a particular stimulus. Private speech provides the learner with more time to respond, and a better probability of making a reflective response instead of a reactive one. According to Vygotsky, the meaning of the words we use are like "psychological tools" (Davydov & Radzikhovskii, 1985). They provide what is needed to fill the gap in the stimulus-response chain of behaviorism.

Insert Figure 1 about Here

According to CSI we are capable of guiding our thoughts or behavior through three distinct stages of verbal self-regulation. In the first stage, children are directed from outside by the speech of others. In the second stage, external directives become internal directives as children learn to transfer external speech into a tool for internal self-regulation. Finally, in the third stage, children can regulate their behavior through their own private speech (Manning, 1991). The progression moves from outside to inside, and by the third stage, self-regulation is thought to have become autonomous, independent from external influence but still actively controlled. The learner has received explicit strategic instruction, has mastered the self-regulation skills, and is now eligible to be called an independent expert learner. Continual emphasis is placed on automaticity, active executive control, and internalization of knowledge.

The CSI model attempts to achieve a unified theory of expert learning by integrating the key aspects of the aforementioned theories: use of skills and strategies, automatization, metacognition, self-regulation, social context, and verbal mediation. Because this model is unique in its coordination of traditional academic components it provides a rich context for comparison with the biofunctional perspective on learning as a natural process.

Teaching for Natural Learning

In contrast to what we have been discussing, the wholetheme approach of the biofunctional model (Iran-Nejad, 1994) offers a different orientation to viewing the learner and the process of learning. The principle feature of the wholetheme approach is that it captures a comprehensive picture of cognition as it relates to brain functioning through the biofunctional theory and its examination of the functional nature of the nervous system itself. Understanding that the mind unites with the brain as a biofunctional system, biofunctional cognition capitalizes on the nature of learning within a unified system, and brings it to the instructional spotlight within the framework of the wholetheme approach.

Like early cognitive functionalists, the wholetheme approach emphasizes the importance of focusing on how humans learn in natural, real-world contexts (Iran-Nejad, 1990). Thinking about learning through the wholetheme approach is based on an in-depth exploration of how the nervous system might function (Iran-Nejad, Marsh, & Clements, 1991). Moreover, the way the nervous system naturally regulates the functioning of the physical body is used as an analogy to the way the nervous system regulates learning. In other words, just as we must first understand the workings of the nervous system to understand how the physical body functions, we must explore how the nervous system contributes to our natural, holistic predisposition to learning.

Unlike CSI and other instructional theories that focus on active learning, the wholetheme approach assumes that (a) instead of external input, there are many sources that naturally combine and contribute to learning, and (b) multisource learning necessitates NOT just one source of internal self-regulation but two: active self-regulation is bound inherently to the sequential aspect of learning and dynamic self-regulation which integrates simultaneously the many sources that contribute to learning.

Learning is multisource in nature, much in the same way that the physical life-supporting functions of the body work together at the same time, under holistic coordination of the nervous system, to use and integrate multiple sources that prolong living (e.g., air, food, temperature). This means that learning is not exclusive of innate intelligence nor of environmental experience; but within each of these broad areas, there are diverse sources that must operate simultaneously for learning to occur. In other words, learning is a combination of diverse internal and external sources; it can occur in the total absence of external input as in reflective thinking or imagination; and it can occur in the total absence of external input as well as in the total absence of active control as in sleep. However, learning cannot occur without dynamic self-regulation (Iran-Nejad, 1990). Dynamic self-regulation is the only inevitable regulator of learning and, unfortunately, the only source of self-regulation that tends to be absent in current academic learning situations, prohibited by the exclusive focus on the external input and active self-regulation strategies.

For example, when we are confronted with a problem in the real world, all the sources that factor into that problem go to work cooperatively and simultaneously until we arrive at a reasonable solution. Problem solving continues even when we divert our conscious attention to other issues and even perhaps during sleep until we see the whole picture and the solution. Like natural problem solving as just described, learning, comprehension, and thinking processes in general are multisource and dynamically regulated in nature (Iran-Nejad, McKeachie & Berliner, 1990).

Focus on dynamic self-regulation as the primary regulator of learning, sets the wholetheme approach apart from all previously discussed cognitive theories. Dynamic self-regulation is the non-executive component of the system and the regulator of interest, curiosity, hope, and enthusiasm for learning. This primary component is the source of creative energy which simultaneously integrates many internal and external sources of information into a coherent, thematic, whole-level understanding. It is this type of internal self-regulation that the multisource nature of learning requires (Iran-Nejad, 1990).

Active self-regulation, on the other hand, refers to the conscious supervisor. It coordinates the executive aspects of the system that require and regulate effort, like attention-paying, self-questioning, and, sequential functioning (Iran-Nejad, 1989). Active internal regulation is responsible for creating categories of information which are supported by the ongoing, thematic whole.

To draw attention away from the external input as the exclusive source of learning, the wholetheme approach redefines learning as the creative reorganization of internal knowledge as opposed to internalization of external knowledge (Iran-Nejad, 1990). In this sense, learning is an ever-evolving creative and re-creative process. As Piaget said in reference to the psychogenesis of thought and science, (Piaget & Garcia, 1989), each theory, or idea, in surpassing another, totally and unrecognizably absorbs, or reintegrates, the theory that is surpassed. This evolutionary perspective reinforces the concept that learning is the reorganization and enrichment of existing knowledge into an understanding which absorbs unrecognizably previous conceptions. It is NOT merely internalizing (elaboratively or constructively) and storing external information.

Filling the Gap between Academic and Natural Learning

The wholetheme approach assumes that "before they come to school, children pass a crucial test suggesting that they are spontaneously proficient learners: they master . . . their mother tongue . . . and become quite proficient in the knowledge of the world around them" (Iran-Nejad, 1990, p. 589). Time and time again, Gardner (1991) mentions, that the learning that occurs before school in a spontaneous yet comprehensive fashion is the result of natural, authentic learning experiences. Children bring a rich intuitive knowledge base with them when they begin formal instruction. They have gained considerable understanding of the world around them and are capable of expressing themselves through words, drawings, gestures, music, play, and other symbolic systems. In fact, there is general consensus (see Iran-Nejad, 1990) that preschool children are naturally proficient learners and that once in school they "fail to develop more than a tiny part of the tremendous capacity for learning, understanding, and creating with which they were born and of which they made full use during the first two or three years of their lives" (Holt, 1964, p. xiii). However, this vital realization has been suffocated by the fruitless nature-nurture debate every time it makes a new appearance. The wholetheme approach offers a new understanding and suggests that education must be redesigned to cultivate children's natural capacity for learning.

> How can we explain, then, the fact that children are so effective in learning in the few early years of their lives (when they are relatively less able in so many ways otherwise) and so ineffective in learning later on (when they are more able in so many ways otherwise)? . . . The core of the answer lies . . . in th. inherent relationship between the multisource nature of learning and the context in which learning occurs. One would expect learning to be effective in authentic real-world contexts of early childhood, where the various sources that must contribute to learning are most likely to be operating simultaneously, and to be less effective in less-than-authentic school contexts of later years. (Iran-Nejad, 1990, p. 590)

By ignoring the natural capacities of the learner to integrate simultaneous influences of multiple sources that contribute to learning, traditional approaches to schooling widen the gap between academic and real-world learning. Instead, the tendency is to introduce new ideas in isolation from those belonging intuitively to the learner (Gursky, 1991). As a result, students may become experts in regurgitating and reproducing information, but are unable to think autonomously when the content is presented in a manner slightly different from the original learning situation.

Primary emphasis has been placed on memory, mastery, and the assumption that knowledge is attainable only through an outside-in process. As a result, students may be able to produce work that appears to reflect understanding, but when required to apply in new settings what they have mastered, they often abandon formal reasoning and revert to their initial, more basic ways of knowing (Gardner, 1991).

As Gardner (1991) suggests, the aim of creating that quality understanding that is characteristic of authentic learning has not been a high priority in most schools. Certainly the success of our schools, and the possibility that students be allowed to learn in a manner that is complimentary to their natural learning dispositions depends on an educational orientation that leads most directly to the right kind of learning. By focusing on the multisource nature of learning, the wholetheme approach has the potential to bridge the gap between natural and academic learning.

If there is to be a unified approach it must (a) appreciate how humans function holistically as a result of a finely tuned biological system (Iran-Nejad, Marsh & Clements, 1991), (b) identify the internal sources that contribute to and regulate learning, (c) acknowledge the nature of learning as a constant creative reorganization of existing knowledge, and (d) use these components as a means for life-long learning and quality understanding.

An Analogy

Just as the mind is inherently grounded in and, in turn, influences the way the nervous system functions, so music is inherently grounded in a highly flexible communication system that is made simple through the very sources that make it so intricate. The following musical analogy conveys the process of learning with an eloquence that is otherwise difficult to convey.

Music in itself is a complex system capable of integrating multiple internal and external sources. Its rhythm, melody, form, tone color, and creative expression are the components of its universal language. Since these internal sources function dynamically in the sense specified in biofunctional cognition (Iran-Nejad, 1990), an infinite number of melodies, styles, and forms can be naturally generated. As contributing sources are reorganized and recreated internally, each experience creates a new song that carries the holistic signature of the complex system. This is why cultures throughout the world are able to produce their own unique musical genre reflective of a total cultural experience. In any song, form, or genre, the properties of music become resources for endless discovery and creativity. Music is so pliant it can be constantly redefined by the changing relationships among the vital sources therein. The whole musical experience is qualitatively different from the collective set of multiple sources that contribute to its creation. The sources of the experience never change, but the relationships among them are ever-changing.

One way to think of musical production is to envision a conductor and an orchestra. However, as important as the conductor might be in provoking particular musical nuances, what directly and inevitably creates music is the orchestra. The conductor plays a secondary, and not always necessary role. When an orchestra performs a symphony without the aid of a designated conductor, the orchestra as a system is still functional. An orchestra, however, cannot exist without the individual musicians working in tandem.

According to the biofunctional model, the nervous system works like an orchestra, although there is no physical internal representation in the nervous system analogous to the conductor. The function of active self-regulation emerges as an outgrowth of the multiplicity of sources that converge and contribute simultaneously to the system as a whole (Iran-Nejad, 1994). Comprehension, learning, and thinking processes in general are dynamically regulated in nature in the same manner that a song occurs through the dynamic regulation of simultaneously collaborating musical sources. As music is to song, so the mind is to the learning that occurs therein. Cognitive development that maximizes individual knowledge is indebted to how our natural system functions to adapt in all real-life settings, utilizing the multisource nature of learning, and reorganizing the intuitive knowledge that children cultivate in conjunction with their authentic, real-life experiences.

Summary and Conclusions

Clearly, there is considerable evidence that learning occurs readily in authentic, real-world contexts (Brandt, 1993; Newmann & Wehlage, 1993), and that the spontaneous learning approaches that children intuitively use prior to school should be reflected in the academic setting. Evidence also suggests, however, that natural learning dispositions may pull in a direction quite distinct from those that usually characterize educational forces (Gardner, 1991a). A disjunction exists between early forms of learning and understanding and the forms of learning and understanding that schools typically attempt to promote (Gardner, 1991b).

In an effort to clarify the disparity, we have examined how various assumptions about the origin of knowledge and the nature of learning affect how learning is conceptualized in the classroom. In the information processing view, the individual is an active learner, focusing exclusively on internalization of external knowledge -- academic learning. Through the wholetheme approach, the student is an intuitive learner, dynamically regulating many simultaneously influential sources to reorganize understanding -- natural learning.

As we become increasingly cognizant of how the nervous system naturally functions and how knowledge is organically and meaningfully created and reorganized, we begin to see the learner through new lenses. Educational orientations must subsequently reflect this understanding. The classroom must be arranged in such a way that the same dynamic approaches that help children before school continue to help them while in school. Actively resourceful learners must be able to take advantage of their dynamic resources to maximize the many sources that contribute to learning (Iran Nejad, 1990).

At last, within the notion of multisourceness, the principles of the nature of human development and learning can mesh with the goals of the educational system (Gardner, 1991a; Iran Nejad & Marsh, 1993; Kohlberg & Mayer, 1972). The gap between natural and academic learning may begin to close and the age-old tension between nativist and empiricist positions can be loosened. As Iran-Nejad states (1990), knowledge of the world can neither exist in the child, nor in the world; it must be learned through a process of internal construction that simultaneously brings external and internal sources together. The wholetheme approach to learning not only encourages a new understanding of the learner, but also challenges educators to find new ways to nourish the natural human capacity for learning through authentic school environments.

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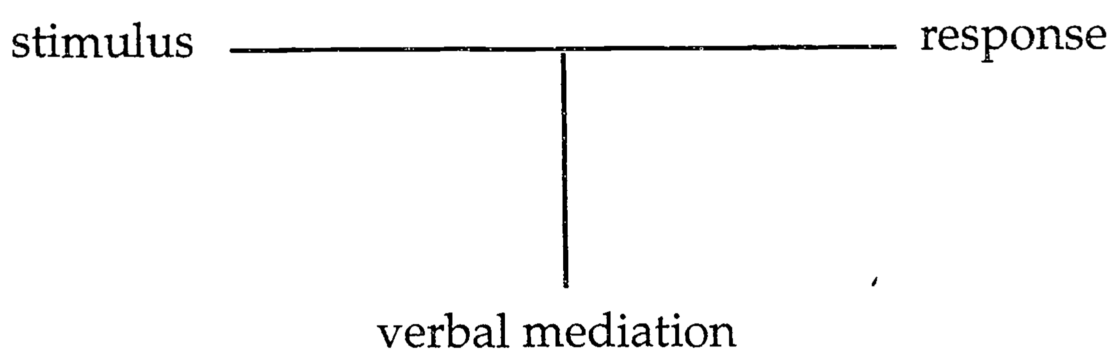
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