Theories of Intelligence, Learning, and Motivation as a Basis for Praxis

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ABSTRACT

This paper examines how Piaget, Werner, and Gardner differ regarding the roles of cognition, intelligence, and learning in the developmental process. Piaget believes in the predominance of genetic factors. Werner stresses the influence of biological factors, while Gardner proposes that the environment plays a greater influence in how intelligence and learning are acquired.

This paper also surveys research on achievement and learning strategies and their role in student motivation. The development of conceptual understanding is related to prior knowledge, interest, learning goals, and achievement goals.

Introduction

This paper focuses on the developmental theories of Werner, Gardner, and Piaget, all of whom have significantly influenced the field of education through their differing understandings of how students learn from childhood to adulthood.

Most researchers agree that a combination of biology and environment affects personality and intelligence, but they differ in assigning relative importance to these two influences. Although poor nutrition, poor health care, and head injuries have been linked to poor IQ scores, for the most part environmental variables have not been found to account for a substantial portion of observed variations in human intelligence. Therefore, some psychologists believe heredity is the dominant influence on intelligence. They base their views on research that concentrates on variations among people in general cognitive ability or IQ. Others believe that such research overemphasizes the concept of IQ and gives too much credit to genetics (Azar, 1995).

Dr. Thomas Bouchard, a researcher on intelligence from the University Of Minnesota Center for Twins and Adoption Research, claims that "when individuals are under reasonably good circumstances much of the variation in IQ among them is genetic" (quoted in Azar, 1995, p. 27). Most other research has concluded that 40% to 80% of differences in IQ score are due to inheritance. The higher estimate comes from large studies of identical twins who share all the same genes; truly inherited genes should correlate perfectly. Any trait due to environment should have no more than chance correlation (Azar, 1995).

A controversial exposition of the implications of a genetic view of intelligence was developed by Murry and Hernstein (1994). The Bell Curve stated that individuals differ substantially in their cognitive abilities, that these differences are inherited as much as acquired, and that intelligence is distributed in the population along a normal

distribution curve. That much of their analysis was noncontroversial. However, Murry and Hernstein went on to observe that different races perform differently on IQ testing and to conclude that different racial groups have different cognitive abilities. In America, Asians score on average slightly above the norm and Blacks below average. This “impermeable caste system” has been widely debated. Liberals have denounced Murry and Hernstein as racist, while some conservatives have found in their analysis a convenient critique of such social programs as affirmative action.

Over the years there has been no single way of defining and measuring intelligence. As Morgan (1996) has noted, Thurstone was the first theorist to suggest that the human organism is too complex for intellectual activity to be determined only by a single human factor. Thurstone described what he called “primary mental abilities” and introduced intelligence testing to measure intellectual functioning. He developed six different types of test for three age levels, each designed to measure different abilities. Thurstone’s theory suggested that intelligence cannot be determined by measuring a single ability; rather, multiple abilities must be considered. Assessing these abilities—such as verbal ability, deductive reasoning, spatial ability, and perceptual speed—is essential to a unified theory of intelligence, Thurstone believed. The practice of intelligence testing on children today still incorporates Thurstone’s theory of multifactor analyses (Morgan, 1996).

The Stanford Binet IQ test, first published in 1916, provides a single score that reflects general intelligence. The Wechsler Intelligence Scale for Children Revised (WISC-R), another instrument used to test IQ, was designed for children age 6-16 and consists of 12 subtests. Half of the test is verbal and the other half nonverbal. This test is commonly used today to test children for placement in classes for the gifted and talented. The two tests are sometimes used together (Morgan, 1996).

IQ tests continue to be controversial. Estimates of the heritability of intelligence range from 40% to 80%. Some experts claim that children can raise their IQ while others assert that it is stable. Some argue that written IQ tests should be supplemented by personal interviews. Psychometrictrists have argued that IQ testing should be replaced by physical tests to measure reaction speed, glucose production in the brain, the speed of neural transmission, and even the size of the brain (Azar, 1995).

Some psychometrictrists who study how children learn advocate that children's potential be examined by using indicators of intelligence that do not depend on prelearned solutions to problems. For example, the Torrance Test of Creative Thinking is a figural and verbal assessment that evaluates children's responses to open-ended problem-solving situations. That test attempts to measure not only manipulation of familiar concepts but also the ability to deal with unfamiliar concepts (Fraiser, 1989).

According to Fraiser (1989), a continuing outmoded emphasis on IQ testing is based on limited criteria, and minority and poor students do not fare well under such conditions. Therefore, a more complete definition of intelligence would be part of the solution to eliminate barriers. A growing dissatisfaction with traditional intelligence tests has led some information processing theorists to examine other approaches and to create a receptive scientific environment for imaginative and inventive constructs (Sternberg, 1985). As Powell and Gallagher (1993) have noted, one theorist with a more complex understanding of intelligence was Perkins, who argued for three different kinds of intelligence.

1. Neural intelligence refers to the speed and precision of information processing in the neural system.

2. Experiential intelligence is knowledge gained through extended lived experiences, both in academic areas such as physics and nonacademic areas such raising a family.

3. Reflective intelligence means thinking strategies, metacognitive awareness, and managing one's own thought processes.

Neural intelligence is largely given, but experiential and reflective intelligence may be increased with educational interventions. According to this view, teachers can help students improve their intelligence by enlarging on the experimental domain and by helping students learn to be more reflective and to use more of their metacognitive capabilities than they have done previously (Powell & Gallagher, 1993).

Gardner's Theory of Multiple Intelligences

Perhaps the most well-known theorist to propose a theory of "multiple intelligences" is Gardner (1983). While some practitioners still use Thurstone's methods, Gardner's theory offers a different way to assess learners' intellectual functioning. Gardner argued that people have a plurality or set of intelligences or abilities rather than a single intelligence. Gardner's theory proposes seven distinct units of mental functioning, each of which can be observed and measured. As Oliver (1997) notes, different cognitive styles have been observed by other theorists. What makes Gardner's approach different is that each factor of cognition constitutes a separate construct that would qualify as intelligence. One question critics have asked, then, is whether Gardner has actually distinguished multiple intelligences or simply cognitive styles.

Merssick (1976) defined cognitive style as a perceptual preference:

> Each individual has a preferred way of organizing all that he sees and remembers and thinks about. Consistent individual differences in these ways of organizing and processing information and experiences have come to be called cognitive styles. These styles represent consistencies in the manner or form of cognition, as distinct from the content of cognition or the level of skill displayed in the cognitive performance. They are conceptualized as stable attitudes, preferences or habitual strategies determining a person's typical modes of perceiving, remembering, thinking and problem solving. As such, their influences extend to almost all human activities that implicate cognition, including social and interpersonal functioning. (pp. 4-5)

Oliver (1997) has noted that Gardner's multiple intelligence theory can be compared with cognitive style. He states that investigators in intellectually related fields have identified intellectual functioning (cognition) as central to theories of personality. He also notes that the notion of cognitive styles has been central to the conceptualization of personality from a cognitive developmental perspective. In this view, the growth of an individual's personality is viewed as a process that is shaped by the individual's assessment of his or her social context, with application and problem solving at the core (Kelly, 1995).

Gardner defines intelligence as the ability to solve problems or to fashion products that are valued in one or more cultural or community settings. He relates intelligence to societal expectations and values and sees such terms as giftedness, creativity, and genius as labels given to those who exhibit high achievement in areas that the culture values. He does not deny that biological factors have an influence on intelligence but suggests that family and cultural influences play an important role in the development of the child's intellect (Oliver, 1997). As Morgan (1996) notes, multiple intelligence theory suggests that people learn the skills they need to survive and that are valued in their culture. Thus, Gardner links these forms of intelligence not only to societal values but also to the opportunities and resources provided in the culture. He is convinced that how humans manipulate their environment and skillfully adapt to it is a form of intelligence (Morgan, 1996).

Gardner's seven types of intelligence include *spatial/visual*, an important intelligence for artists, sculptors, navigators, and builders. These individuals have the

capacity to perceive the visible world accurately and to perform transformations on their initial perceptions. *Musical* intelligence is the ability to produce and appreciate rhythm, pitch, timbre, and musical expressions. These are singers, composers, and instrumentalists. *Body/kinesthetic* intelligence is demonstrated by athletes, dancers, and surgeons; they have the ability to control their bodily movements and to handle objects skillfully. *Interpersonal* intelligence is responsible for social behaviors. This person is able to discern and respond appropriately to the moods, temperaments, motivations, and desires of other people. Salespersons, counselors, and therapists are people with interpersonal intelligence. *Intrapersonal* intelligence leads to such activities as writing, philosophy, and thoughtfulness. This type of intelligence enables one to discriminate among different kinds of behaviors, acknowledging their strengths and weaknesses. *Linguistic* intelligence is found in poets, novelists, and journalists, who are sensitive to sounds, rhythms, and meanings of words and to different functions of language. *Logical/mathematical* intelligence creates the capacity to discern numerical patterns and to follow long chains of reasoning. These are the scientists and mathematicians (Gardner, 1983).

Oliver (1997) has observed that modern Western cultures focus primarily on only two of Gardner's sets of intelligences—verbal/linguistic and logical/mathematical. The Western cultural perspective could be strengthened, Oliver argues, if it took a broader approach to intelligence and included Gardner's other five intelligences.

According to Gardner, there is no pure form of intelligence; rather, individuals have the ability to express their intelligences in ways that enhance their creative abilities. He states that there is no one right way to use multiple intelligence theory, especially in schools, but he suggests the nurturing approach as a developmental

process. In other words, if a teacher recognizes the uniqueness of the individual child and responds accordingly, the results will be more rewarding. Because people are different, they need education that is responsive to their differences. When an appropriate intellectual profile has been developed for each student, the teacher can then plan the method of teaching. This method should be “intelligence fair” and should be developmentally appropriate for each child’s needs (Oliver, 1997).

Werner’s Theory of Cognition

Gardner’s theory of multiple intelligences has been called a reframing of cognitive style or psychological differentiation theory, a concept first introduced by Werner (1957). According to Morgan (1996), Werner viewed human development as following a biological course from a global state to a state of differentiation, articulation, and hierarchical integration. Human growth, then, is systematic with one stage depending on the developmental level of the other. Werner’s theory (orthegenesis) states that human organisms develop in predetermined stages that are influenced by internal structures more than environmental influences. Werner drew his ideas from the disciplines of anthropology, aesthetics, and embryology to develop a comprehensive theory of developmental psychology (Morgan, 1996).

Werner (1957) believed that the capacity for differentiation and integration is inherited; it is not learned and cannot be taught. He deemphasized experience and learning as parts of the developmental process and saw biology has the primary factor in the psychosocial system (cognitive, perceptual, emotional, and physical). He also believed that perceptual experience is sensory in nature and that perception and certain other aspects of cognition have to be conceived in terms of an interrelationship between sensory inputs and intraorganismic factors.

Piaget's Theory of Cognition

Ideas about cognitive development are relatively new in the United States. Much of what we know originated in the works of Jean Piaget, the Swiss psychologist who in his quest for knowledge about children's development has written many books about the subject (Salkind, 1985).

Piaget described four stages of intellectual development.

1. The sensor motor stage (birth to age 2) is where the child develops from a relatively passive organism that acts without any systematic goal into a thinking being who shows the beginning elements of intelligence.

2. The preoperational stage (age 2 to 7) is where the child develops from a reflective organism to one that intentionally manipulates symbols that represent the real world.

3. The concrete operational stage (age 7 to 12) is where the child's cognitive capabilities are characterized by three attributes: (a) the inability to assume another perspective (egocentrism), (b) the centering on only one dimension of an experience rooted in perceptual information (centration), and (c) the ability to perform an operation requiring reversibility.

4. The formal operational stage (age 12 to 15) is the final stage of intellectual development in Piaget's theory; it is described below. (Piaget 1952)

Formal Operational Thought

Piaget's formal operational stage deals with the intellectual development of children ages 11-15. He believed that cognitive development does not cease after age 15, but any major structural or qualitative changes have already occurred by that point; after age 15 cognitive growths consists mainly of minor additions or modifications (Salkind, 1985, p. 209). During this stage, according to Piaget, the child

deals with problems in all time frames. Children begin to function like scientists and become capable of accepting assumptions without any physical evidence to validate the assumptions. They develop hypotheses, then test and reevaluate them. This stage is the first time systematic scientific thought supercedes other types of thinking. Piaget calls formal operational thinking the systematic analysis, exploration, and solution of problems (Piaget, 1952).

In 1958 Piaget and Inhelder gave adolescents problems in physics, chemistry, and mathematics and provided them with materials to perform experiments to solve problems. They asked subjects to explain orally how they were solving the problems, and these verbal explanations were then analyzed. From these results, Inhelder and Piaget concluded that during the final stage of intellectual development (which begins at age 12 and is consolidated during adolescence), certain universal formal operations are applied across all cognitive domains. Formal operational thought differs from the preceding concrete operational thought in that the adolescent, unlike the preadolescent, can imagine many possibilities and combinations and can either vary them or keep them constant. Adolescents can deal with hypothetical propositions in an abstract way, in contrast to the preadolescent, who deals with objects in a concrete way (Oliver, 1996).

Psychometric Intelligence and Formal Operational Thought

Psychometric intelligence is concerned with the measurement of individual differences, whereas the Piagetian tradition is concerned with the discovery of universal cognitive structures in the development of thought (Keating & Schaefer, 1975; Kuhn, 1976). This distinction raises a question about the relationship between these two traditions and whether a psychometric IQ score is related to a score derived from a Piagetian analysis of logical reasoning (Oliver, 1996).

Kuhn (1976) studied 52 first through third graders, who were in transition to the concrete operation stage and had a mean IQ in the average range. He also studied 56 fifth through seventh graders, who were mostly in transition from the concrete to the formal operational stage and who had average IQs. Kuhn reported a moderately high significant correlation between IQ and performance on concrete operational tasks in the younger group but a no significant correlation between IQ and performance on formal operational tasks in the older group. Chronological age was moderately and significantly correlated with Piagetian score in both the younger and older groups. These results suggest that the transition to formal operational thought may be more sensitive to age developmental processes than to individual differences in intellectual ability.

Keating and Schaefer (1975) compared 50 gifted fifth-grade boys and 50 gifted seventh-grade boys (who fell in the 98-99 percentile on the arithmetic section of the IOWA Tests of Basic Skills) to 50 average fifth-grade boys and 50 average seventh-grade boys (who scored in the 45-55 percentile on the same arithmetic test). The fifth- and seventh-grade gifted groups were significantly higher than the fifth- and seventh-grade average groups on both a psychometric measure of intelligence (the Raven's Standardized Progressive Matrices) and Piagetian formal operational tasks (displacement, balance, and pendulum). These tests were repeated in a sample of bright and average sixth- and eighth-grade girls. Again, those with higher levels of psychometric intelligence were also likely to have achieved higher levels of Piagetian cognitive stage development when age or grade was held relatively constant.

According to Morgan (1996), differences in Kuhn's findings versus Keating and Schaefer may be related to differences in sampling procedures or the Piagetian task used. In any event, results suggest that IQ and Piagetian operational thought

appear to be related at some stage of development. The degree of relationship is significant but only at a moderate level.

Piaget's Contribution

Piaget has made a major historical contribution to our understanding of intellectual development. Today, however, theories of intelligence and cognition have moved away from some of Piaget's claims (Keating, 1990). Although his theories are the most viable organizational framework from which to investigate intellectual development, doubts about the validity of the original formal operation theory have surfaced through testing and retesting his theories. Still, Piaget's idea that knowledge is neither biological nor acquired passively and solely through the environment but rather is constructed through an interaction of the organism and environment is a fundamental insight for the field of education. Research still supports Piaget's claims that adolescents solve problems differently than do younger children. They are more likely to think more abstractly, generate opinions, consider perspectives, anticipate consequences of decisions, and evaluate the credibility of sources (Keating. 1990). According to Oliver (1996), post-Piagetian trends in developmental research should include not only traditional IQ and achievement test scores and measures of creativity but also indices of personality dispositions, values, and cognitive styles.

Conclusion

Piaget's and Werner's theories of cognitive development have biological roots. They both stress the role of genetics or heredity in development. Piaget observed the adaptiveness of biological structures in animals and created a model of the development of a child's mind. Likewise, Werner's principle of orthogenesis has an organic basis and presupposes a genetic structure that controls the timing and

sequence of developmental levels. This debt to biology does not exclude the influence of environmental factors in development. For Piaget and Werner, learning gives rise to many of the specific behaviors that result in different experiences. Practical application of Piaget's work places children in a child-centered curriculum and provides them with many options for exploring the environment (Salkind, 1985).

Gardners's theory of multiple intelligences is the most well-known multifaceted view of intelligence. His seven major dimensions of intelligence (linguistic, musical, logical/mathematical, spatial, body/kinesthetic, social awareness, and self-awareness) provide some basis for differentiating curriculum, although they are not fully incorporated as yet into our educational system (Powell & Gallagher, 1993). Gardner has influenced the teaching styles of many educators. He believes that if a child's' profile of intelligence is understood, and then teachers can tune into that intelligence and help the child. Children should be aware of their intelligences so that they can link their preferred approaches to their strengths as they learn new skills (Gardner, 1983). And finally, intelligence tests are not pure measures of intellectual potential; rather, they are valuable predictors and indicators of academic ability and performance.

Education should focus on a broad exposure to Gardner's (1983) seven intelligences, especially during a child's formative years. Students should be given opportunities to develop their skills. Exposure to different realms of intelligence gives students the opportunity to grow and to set and achieve goals. Intelligence relates to societal expectations and values. Creativity and genius are terms applied to those students who exhibit high achievement in areas of culture and value. Educators should encourage growth and success by acknowledging that students have different

strengths, weaknesses, and interests. Students need to actively participate in their own learning with collaboration and cooperation from both teachers and peers.

Using a mastery orientation model can help teachers achieve the objectives that most teachers would like to accomplish with different topics. A clear plan, an appropriate analysis of the classroom environment, accurate student profiling, and a culturally sensitive curriculum can help achieve learning goals. Also, collaborating and effective team-teaching strategies can assist with this challenging task.

An intelligence-friendly classroom is one where the teaching/learning process is governed by what is known about developing the intellectual potential of human beings. It is friendly to growth patterns of human intellect and friendly to the learner in fostering intelligent behavior for problem solving, decision making, and creative thinking. The intelligence-friendly classroom serves as a caring companion and mindful guide to the intellect of each person in it. It furnishes support that is reliable and time tested and fosters the ongoing development of human intelligence potential.

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