A Neuroscience Basis for Reorganizing Middle Grades Education

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Scientific findings now available strongly urge a searching reappraisal of the traditional approaches to cognitive learning in the middle school years.

The optimism that many hold for the middle school does not rest on the result of its efforts to develop curricular experiences that are responsive to needs that learners manifest during the middle school years. To realize success, the middle school cannot ignore the holistic needs of these youngsters that transcend programs with overbalanced cognitive predominance. Cognitive growth during emerging adolescence must be viewed as a separate part of longitudinal development rather than as taking place in an undifferentiated continuum of school experiences. The middle school needs to organize a learning environment that takes into account (and may even have to provide for) social and emotional self-clarification and growth as a basis for working to maximize cognitive learning during these years.

While puberty is inevitable, there is a great variance in the time at which individuals experience this phase. School programs have not traditionally been responsive to the needs of individuals during their emerging adolescence period. The prime facets of this growth are physical and social, but the impact upon the individual during this time is an emotional one. Youngsters begin to develop new and different roles with agemates of the same and opposite sex, and to cope with the realities of their new physical, social, emotional, and intellectual capabilities and expectations. However, the focus of the school upon cognition during this period has resulted in far less growth than we would hope even in the area of cognitive growth.

William Purkey[1] has provided supporting data which identify that during the middle school years, the addition of educational experiences leading to affective growth results in cognitive growth as well. Poor self-concept correlates with lack of cognitive achievement, and practice has demonstrated that experiences that reverse poor self-concept and improve this perception bring about a parallel improvement in cognitive achievement.

Brain growth periodization during emerging

[1] William W. Purkey. *Self Concept and School Achievement.* Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1970.

adolescence is an aspect of development not yet tapped by educators to help organize middle grades programs that will facilitate improved cognitive and affective growth with emotional self-clarification. This periodization was initially reported to the middle grades educational community by Epstein[2] and sets forth that, in perhaps 85 percent of all youngsters between ages 12 and 14, the brain virtually ceases to grow. This slow brain growth period parallels the transescent's pubertal metamorphosis in a large number of individual circumstances.

The human brain increases in weight from 350 grams at birth to about 1,400 grams at brain maturity at about age 17. This increase has been found to consist of two components. The first component is one that is proportional to the increase in body size. The second component appears in a set of five discrete periods of extra growth, approximately in the age intervals of 3 to 10 months; 2 to 4 years; 6 to 8 years; 10 to 12 years; and 14 to 16 years. These brain growth spurts appear in normal children from quite a number of countries.

The significance of the spurts is likely to reside in some of the special functions of the brain because it would otherwise make no sense to have such a set of spurts. This conjecture turns out to be correct because, if we look at the development of mind (as distinguished from brain), correlated spurts can be found in mental age and a number of intelligence-associated tests such as tests of memory, vocabulary, or language utilization.

There is also evidence that these brain growth spurts correlate in age with learning capacity. Data have established a peak around age 11 and a very low (near zero) value for "gf" (the fluid intelligence factor) around age 13 to 13.5 years. In addition, as can be seen from examining the ages of the growth spurts, the spurts appear at the turning points of the classical main stages of Piaget's set of intelligence development periods. These brain growth periods may turn out to be the biological basis of the Piaget stages.

How can we use this knowledge of the existence of correlated spurts in brain and mental functioning? Naturally, any such use is on the level of working hypothesis, for inferences are not of the nature of mathematical inevitabilities. The periods of very slow growth lying between the spurts were studied because it seemed plausible that such periods might represent periods during which it would be hard for the individuals to develop the new thinking competencies required for new cognitive development.[2, 3]

The first such period studied lies between about ages four and six years. This is approximately the period of standard Head Start programs. If there is a direct connection between spurts and the capacity to develop intellectually, we are led to the hypothesis that these standard Head Start programs should be much less successful than similar programs situated during the age two- to four-years spurt period or during the age six- to eight-years period. Hunt[4] has recently summarized the first decade of experience with early childhood intervention programs. He presents support for this prediction in that six programs that cover the age two- to four-years period all seem to be much more successful than the standard program.

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This kind of correct prediction encourages examination of the other slow brain growth periods. The more striking one is the age 12- to 14-year period, corresponding roughly with grades seven and eight. The prediction here would be that it is relatively more difficult to initiate novel intellectual processes in the middle grades years than in periods both preceding and following this period. Another aspect of this prediction is that it

[2] Herman T. Epstein. "A Neuroscience Framework for Restructuring Middle School Curricula." *Transescence: The Journal of Emerging Adolescent Education* 5: 6-11; 1977.

[3] Herman T. Epstein. "A Biologically-Based Framework for Intervention Projects." *Mental Retardation* 15: 26-27; 1976.

[4] J. McVicker Hunt. "Reflections on a Decade of Early Education." *Journal of Abnormal Psychology* 3: 275-336; 1975.

should be characterized far more by maturation in already initiated and learned cognitive skills than in the acquisition of new skills. Thus, achievement levels could well outstrip the other aspects of school performance during these years. Emphasis on affective and psychomotor aspects of learning might well receive increased attention and opportunity during this slow brain growth period.

Based upon such hypothesis-formulation, the first thing to do is to examine the performance of middle grades learners to see if it is, in any sense, correct to characterize these youngsters as being relatively refractory to the acquisition of novel intellectual skills. If so, a recommendation would be to alter curricula for the middle grades to avoid such introduction of new cognitive skills and to include a much larger component of experience and practice of skills already acquired in the cognitive area. This component could be interfaced with experiences related to the affective growth in activities stressing the development of social and emotional skills related to identity stabilization and self-concept clarification.

This period of slow brain growth between 12 and 14 is followed, between ages 14 and 16, by the last period of great brain growth that the human will experience. This latter period coincides with the early years of senior high school for most youngsters. It is important to note that this final brain growth period is not presently accompanied by dramatic cognitive growth by the large number of youngsters who, between the ages of 14 and 16, set the stage for subsequent dropping out of school. This reflects their low cognitive skill advancement during these years. In light of this disparity, let us consider the following.

With virtually no increase of brain size and mass in the large majority of 12- to 14-year-olds, there is no growth in the capacity of the brain to handle more complex thinking processes usually introduced in grades seven and eight. This continued demand for the youngster's brain to handle increasingly complex input, which he or she cannot comprehend during this period, may result in rejection of these inputs and the possible development of negative neural networks to dissipate the energy of the inputs. Thus, it is possible that even when the subsequent growth of the brain between ages 14 and 16 could support the development of more complex cognitive skills, the untold numbers of individuals who have developed such negative networks have been so "turned off" that they literally can no longer develop novel cognitive skills.

Testing this supposition is a critical challenge to the middle grades. It is important, therefore, that middle schools identify the cognitive skill level of individual learners during this period and the onset of the stage in which individuals cannot develop new cognitive skills in the 12 to 14 age period. Upon this identification, it will be necessary to teach new cognitive information at that student's existing skill level rather than to try forcing him or her to acquire new skills that his or her hiatus in brain growth will not support. The implication for testing to identify these individual learner plateaus is crucial and will necessitate a personalized approach to instruction that develops small groups of learners within common plateau perimeters.

It also will be necessary for schools to develop instructional materials that depart from most commercially published programs that invariably introduce new cognitive information through advancing levels of cognitive skills. If this supposition is validated through testing, education in the middle grades must develop a readiness in most students for later development of new cognitive skills during the brain growth period between ages 14 and 16. Thus, middle grades programs must: (a) discontinue the mass introduction of novel cognitive skills to middle grades students who do not have such readiness; (b) present new cognitive information at the existing skill level of students; and, (c) work to mature existing cognitive skills of middle grades learners.

The holistic education of the emerging adolescent will also require a greater emphasis upon learning experiences based as closely as possible upon youngsters' interest centers during this plateau period. The development of positive self-concept during this period will require the definition and exploration of student interests through valuing experiences if the learner is to know who he or she really is as well as whom he or she would like to become. To accomplish this, the middle grades program must be restructured to

include a large component of experience and practice of skills within opportunities for interaction with nature, society, and people. This will require transposing a substantial portion of the middle school educational experience outside the walls of the school. The basis of such efforts can be the development of units of work through community service projects in which students learn through working with the elderly in nursing homes, with children in day care centers, and in community and natural resources reclamation projects. Cognitive information can be taught in relation to these activities and supplement the youngster's total growth in ethical responsibility to society and individuals. Contemporary society continually reveals the need for youngsters to develop these citizenship capabilities and an empathy for the needs for human dignity in our society.

The teaching of cognitive information should emphasize skills already learned in terms of the following: Mathematics would stress application to human problems and daily needs for mathematical skills. History would provide the facts needed for creative human existence and solving of societal problems. Other cognitive areas would provide a background of functional information and experience. This would serve as the base upon which the next intelligence stage could be developed in the period of brain growth between ages 14 and 16.

The development of such programs in the middle school is totally consistent with the present objectives of the middle school and the researched educational needs of emerging adolescents. These biological data provide a validated neuroscience framework in which educators can have confidence. The challenge we face now is finding the courage to examine local programs in light of these data. This can help educators identify means by which we can judiciously move away from the traditional approaches to cognitive learning during the middle grades that do little other than to frustrate cognitive and total growth of learners both in their middle school and ensuing high school experiences. EL

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