Decision-making curriculum. Results of the pre- and post-instruction developmental assessments

About cognitive development

When we employ the term *development*, we are referring to an increase in the *complexity* and *integration* of thought[1]. This perspective on cognitive development is embedded in a rich research tradition with its origins in the work of Baldwin, Piaget, and Werner[2]. During the last 25 years, it has become clear that developments in the complexity and integration of thought are not confined to childhood and adolescence. They can take place at almost any point in the life span, given an appropriately stimulating intellectual environment. This means that adult learning is much more than the accumulation of facts. It involves changes in the way we think—the same kind of changes that occur in childhood development. Given the complexity of problems faced in today's work environments and rapid changes in the world in which we live, this is good news.

One of the greatest advances in developmental science during the last few years is the development of a valid, reliable, and accurate domain- and content-independent measure of cognitive development[3]. We call this measure the Lectical™ Assessment System (LAS). We describe adult developmental levels and scoring procedures in Appendix B. This system can be employed in any knowledge domain to assess the developmental level of text performances such as interview responses and essays. A content-independent developmental assessment system has numerous implications for curricula and assessments:

1. The complexity and integration of thinking on a variety of subjects can be placed on the same scale, making it possible to compare performance across knowledge domains. This makes it possible to identify and target areas of relative strength and weakness.
2. Developmental progress in multiple knowledge domains can be tracked over time.
3. The developmental level of an individual's functioning over time can be compared to hiring or promotion criteria. For example, we have been working with the IC Standards Committee to align the IC Leadership Standards for Training, Education, and Career Development with complexity levels. These levels can be employed, along with developmentally informed assessments, to help determine how well-prepared a given employee is to face the complexities of a particular leadership position.

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[1] In our academic work, we employ the technical term, *hierarchical complexity*, which refers to the way in which concepts, ideas, or ways of thinking observed at one developmental level provide the basis for new concepts, ideas, or ways of thinking at the subsequent developmental level. For example, it is necessary to understand addition and multiplication as independent ideas—as in 4 + 5 = 9 and 4 x 5 = 20—before it is possible to comprehend compound problems such as (4 + 5) x 3 = 27. Similarly, we find that an understanding of the concept of *honor*—the quality of being honorable or having a good name—requires the comprehension of precursor concepts such as *fair*, *truthful*, and *loyal*. Developmental changes of this kind are referred to as *hierarchical integrations*. For further information about this construct, see:

Dawson, T. L. (in press). *"A good education is..." The development of evaluative thought across the life-span.* Genetic, Social, and General Psychology Monographs.

[2] Baldwin, J. M. (1894). *Mntal development in the child and the race* (Reprinted by Augustus M. Kelly, 1968 ed.). New York: MacMillan.

Gruber, H. E., & Vonèche, J. (1977). *The essential Piaget*. London: Routledge & Kegan Paul.

Werner, H. (1948). *Comparative psychology of mental development*. Chicago: Follett.

[3] Dawson, T. L. (2004a). Assessing intellectual development: Three approaches, one sequence. *Journal of Adult Development, 11*, 71-85.

Dawson, T. L. (2004b, 1/31/03). *The Lectical™ Assessment Manual*. Retrieved January, 2004, from <http://www.lectica.info>.

Dawson, T. L., & Gabrielian, S. (2003). Developing conceptions of authority and contract across the life-span: Two perspectives. *Developmental Review, 23*, 162-218.

Dawson, T. L., Xie, Y., & Wilson, M. (2003). Domain-general and domain-specific developmental assessments: Do they measure the same thing? *Cognitive Development, 18*, 61-78.

4. Scored performances can be employed to trace conceptual development, making it possible to produce comprehensive accounts of the pathways through which learning takes place in a given domain. Such accounts can be paired with expert knowledge of a domain to inform curriculum development, thus improving learning outcomes by allowing teachers to customize curricula to meet the developmental needs of individual learners.
5. Developmentally informed curricula can be appropriately assessed for their developmental impact.

The acquisition of conceptual content, which we call *learning*, is a part of development in the sense that *conceptual elaboration* precedes and supports the kind of increase in complexity and integration that we think of as developmental. An adequate amount of conceptual elaboration is a *necessary but not sufficient* precondition for cognitive development in any knowledge domain. In other words, individuals will not move from one developmental level to another without an adequate amount of conceptual elaboration at their current level, but an adequate amount of conceptual elaboration does not ensure development to the next level. Educational interventions can be focused on conceptual elaboration, complexification/ integration, or both conceptual elaboration and complexification/integration.

Fischer[4] refers to functional and optimal levels of developmental functioning. The functional level is the everyday level at which a person performs without support (guidance, examples, etc.). The optimal level is the level at which a person performs with support. We also think of the optimal level as the highest level at which a person is able to perform in a given subject area.

There is an important relation between cognitive development and real-world behavior. If one is unable to conceptualize or reason through a potential course of action or process, it is highly unlikely that one will be able to implement it. However, motivation, practice, emotional maturity, and a variety of personality characteristics also play a role in determining behavior. The present project focuses on the development of reasoning skills, but this should not be taken as an indication that development of these skills, on its own, will produce better leaders.

In 2004, DTS provided a conducted an analysis of skill development in the decision-making domain. The results of the analysis were used to develop a three level decision making curriculum. In this report, we evaluate the effectiveness of this curriculum by analyzing the learning demonstrated by students enrolled in each of its three levels.

Task definition

- Conduct a cognitive developmental analysis of the complexity levels of 130 problem-solving questionnaires (protocols), 65 completed before respondents attended a decision making course, and 65 completed after they attended the course. Each questionnaire was awarded a single score, based upon the scoring procedures of the Lectical™ Assessment System.
- Provide detailed analyses of gains in a sub-sample of cases selected from each instructional level (T1, T2, and T3)

Quantitative results

Method

The pre- and post assessments employed to evaluate students' decision-making skills consisted of realistic workplace dilemmas. All dilemmas were identically structured, and were followed by a series of standard probes. Students responded to the same dilemmas at the first and second test-times. Student responses were hand-written.

Each dilemma was scored by a master Lectical analyst, using the 5 phase version of the Lectical Assessment System. Table 1 provides information about the scores awarded and their meaning relative to management level definitions.

[4] Fischer & Biddel, 1998.

Table 1: Complexity phases and their relation to expected levels of competence in managers

Complexity phase #	Complexity phase name	Management level
23	Elaborated abstract mappings	L1
24	Highly elaborated abstract mappings	L1
25	Transition out of abstract mappings	L1/L2
26	Transition into abstract systems	L1/L2
27	Unelaborated abstract systems	L2
28	Elaborated abstract systems	L2
29	Highly elaborated abstract systems	L2
30	Transition out of abstract systems	L2/L3
31	Transition into single principles/axioms	L2/L3
32	Unelaborated single principles/axioms	L3
33	Elaborated single principles/axioms	L3
34	Highly elaborated single principles/axioms	L3
35	Transition out of single principles/axioms	off the chart
36	Transition into principled mappings	off the chart

Table 2 shows the results of the Lectical analysis by group. (T3 AM and T3 PM represent two different groups exposed to the same level 3 curriculum.) The pre-instruction ranges are comparable to those reported in the National Leadership Study Results.[5] Interestingly, level 1 managers outperformed level 2 managers on the problem-solving task in that study as well, indicating a troubling trend that should be investigated further. The similarity between complexity phases across the two studies indicates that the written (this study) and interview (Leadership Study) forms of the problem-solving dilemmas function similarly.

Table 2: Pre- and post-instruction minimum, maximum, and median complexity phases

Group	Pre-instruction			Post-instruction		
	minimum	maximum	median	minimum	maximum	median
T1	23	27	25.0	23	29	26.5
T2	24	27	24.0	25	29	26.0
T3 PM	25	30	27.0	26	32	28.5
T3 AM	25	33	27.0	25	36	28.0

Table 3 shows the distribution of complexity phase scores relative to the two test times. Fourteen of the 65 students showed no progress at the time of the post-instruction assessment. One individual advanced four phases, one advanced three phases, 32 advanced two phases, and 17 advanced one phase. It is interesting to contrast this progress with the progress made by students exposed to an earlier critical thinking curriculum.[6] In that case, most students failed to show evidence of advance in either problem-solving skills or reflective judgment. The overall gains were only .2 and .4 of a phase, respectively. Contrast these with the average gains shown in Table 4.

[5] Dawson-Tunik, T. L., & Stein, Z. (2004). *National Leadership Study results*. Hatfield, MA: Developmental Testing Service, LLC.
[6] Dawson-Tunik, T. L., & Stein, Z. (2004). *Critical thinking seminar pre and post assessment results*. Hatfield, MA: Developmental Testing Service, LLC.

Table 3: Pre- and post-instruction complexity phases for entire sample

Pre-instruction LAS	Post-instruction LAS													
	23	24	25	26	27	28	29	30	31	32	33	34	35	36
23	2	1	1											
24			2	6										
25			1	6	3									
26				3	4	8								
27					2	1	11							
28						6	3	1						
29									1		1			
30										1				
31														
32														
33														1

Paired samples t-test for entire sample: mean difference = 1.35, df = 64, $t = 12.24$, $p < .05$

Table 4: Pre- and post-instruction mean complexity phase and mean gain scores by group

Group	Pre-instruction	Post-instruction	Gain
T1	24.75	25.92	1.17
T2	25.00	26.47	1.47
T3 PM	27.00	28.45	1.45
T3 AM	27.28	28.56	1.28

Overall, the results of the quantitative analysis indicate that the decision making curricula are appropriately targeting decision making skills. The growth evidenced in the majority of students is substantial, representing a rate of change that exceeds the average developmental change of 1 phase per year typical for college students. Moreover, as is demonstrated in the next section, students have learned to apply new problem-solving strategies to the solution of realistic workplace dilemmas.

Qualitative analysis

In this section we describe the results of our qualitative analysis of the learning evidenced by students exposed to the decision making curriculum. We sample 4 students from each level of the curriculum, providing renderings of their concept maps and descriptive analyses of their learning. These are shown in Table 5.

In general, among students who evidenced learning, we observed (1) movement from processes that described decision-making processes tied to the specific dilemma, to general processes that could be applied to any workplace dilemma; (2) an increase in the range of stakeholders considered; (3) a greater use of established decision making frameworks; and (4) movement from describing linear processes to describing processes with feedback loops, iterations, or self monitoring processes.