DOCUMENT RESUME

ED 235 185 TM 830 554

AUTHOR Curry, Lynn
TITLE An Organization of Learning Styles Theory and Constructs.
PUB DATE Apr 83
NOTE 28p.; Paper presented at the Annual Meeting of the American Educational Research Association (67th, Montreal, Quebec, April 11-15, 1983).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Cognitive Style; Definitions; Individual Differences; *Learning Theories; *Models; Psychometrics; *Research Needs; Standards

ABSTRACT

In the past 3 years there has been a resurgence of interest in learning styles as applied to education generally and to professions education in particular. For all this activity there are difficulties preventing significant progress. Chief among these is the bewildering confusion of definitions surrounding learning style conceptualization, and the concomitant wide variation in the scale of behavior claimed to be predicted by learning style conceptualizations. This presentation outlines a technical reorganization of learning style constructs and proposes an empirically testable structure encompassing style concepts that have established psychometric standards. (Author)

An Organization of Learning Styles Theory and Constructs

Lynn Curry, Ph.D.
Division of Continuing Medical Education
Dalhousie University
Halifax, NS
B3H 4H7

prepared for presentation at
American Educational Research Association
Annual Meeting, April 1983
Montreal, Canada

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In the past three years there has been a resurgence of interest in learning styles as applied to education generally and to professions education in particular. For all this activity there are difficulties preventing significant progress. Chief among these is the bewildering confusion of definitions surrounding learning style conceptualization, and the concommitant wide variation in the scale of behaviour claimed to be predicted by learning style conceptualizations. This presentation outlines a technical reorganization of learning style constructs and proposes an empirically testable structure encompassing style concepts that have established psychometric standards.

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Lynn Curry, Ph.D.
Division of CME
Dalhousie University
Halifax, NS

Introduction

In the past three years there has been a resurgence of interest in learning styles as applied to education generally and health professions education in particular. This interest stems from those with research interests in learning style(1,2), those charged with the responsibility for curriculum determination(3,4), and from those with political responsibility to insure the quality of initial training and continuing education(5).

For all this activity there are difficulties presently preventing significant progress in application of learning styles to professional training and continuing education. Chief among these difficulties is the bewildering confusion of definitions surrounding learning style conceptualizations, and the concommitant wide variation in scale or scope of behaviour claimed to be predicted by learning style models. Some learning style conceptualization, for example, claim to predict only an individual's choice between a lecture style course versus a small group style course; others attempt to predict habitual procedure for all learning acts in which an individual might engage. Needless to say the evidence gathered to support various conceptualizations varies radically in terms of psychometric standards. The organization described here attempts to bring some order to this chaos by proposing an empirically testable structure encompassing learning style concepts that have established psychometric standards.

Background

Studies in learning styles initially developed as a result of interest in individual differences. These issues were very much in vogue within investigatory psychology during the 1960's, enjoyed a continuing popularity during the early 1970's but have unfortunately past from vogue since then due to our society's changed focus or an evolution of professional interest. Society and the profession of psychology has become more interested in between-group differences such as racial differences, sexual differences, and social class differences. This diminuation of research in learning styles was unfortunately premature, and left the whole field of investigation fragmented and incomplete. Further, the field was left without clear utility or established connection with any of the central concerns of education.

The fragmentation of the learning styles field has resulted in a vast confusion of terminology. To proposed and discuss an organization across the learning styles field we will use the following terms in the manner stated here:

1. Learning: The term will refer to intended learning in contrast to unintended learning. Intended learning is both a process and a product. The process is adaptive, future focused, and holistic, affecting an individual's cognitive, affective, social, and moral volitional skills. The product is observable as a relatively permanent change in behaviour, or potential behaviour. The process is observable in the improved ability of the individual to adapt to environmental stimuli.

2. Learning Style: This term is at present overused and will be avoided in any discussion of organization other than to refer to the general area of interest concerning individual differences in cognitive approach and process of learning.

3. Instructional preference: This is the individual's choice of environment in which to learn. We would expect this choice to be modulated by all person-environment interactions. Examples would be a preference for attending lectures versus small group learning situations.

4. Information Processing Style: This is the individual's intellectual approach to assimilating information following the classic information processing model (orienting, sensory loading, short-term memory, enhanced associations, coding system, long-term storage). An example would be whether better retention occured in an individual given one or other approach to hierarchies among concepts (ie. processing generalizations followed by details, or detailed examples followed by generalized principle.)

5. Cognitive Personality Style: This is defined as the individual's approach to adapting and assimilating information, but this adaptation does not interact directly with the environment, rather this is an underlying and relatively permanent personality level dimension that becomes manifest only indirectly and by looking for universals within an individual's behaviour across many learning instances. Habitual time to closure (reflectivity-impulsivity) in the data gathering phase of problem solving is an example of this type of style.

6. Self concept about learning: This self concept is the individual's conscious perception about the way he or she best learns. This affects the choice an individual makes among learning alternatives.

7. Learning strategy: This is a translation-like mechanism by which the individual copes with the particular learning environment. An individual uses a learning strategy whether or not a particular learning environment matches his or her learning style to "translate" information from the form supplied into a form meaningful to the individual.

8. Learning ability: This is the individual's potential performance given a defined setting and a defined task demand.

Literature Review: Is There Evidence that Learning Styles Can be Used to Improve Learning Outcomes?

The bulk of the literature concerning learning styles is focused on improving the immediate and long term results of teaching-learning episodes. Our review to date has located 47 pertinent citations utilizing various concepts of learning styles in general education. There are 16 additional citations with a specific focus on professions education. The majority have a reasonable research base and come to positive conclusions about the relationship between learning style and improved educational (teaching and learning) outcomes. A reasonable review of these results can be found in Kirby's 1979 monograph([6]).

When positive results are found they generally indicate that student learning can be improved by tailoring instructional modality as much as possible to each student's preference or style(7). Further, there is a suggestion that even when the groups must be offered a standard experience, patterns of modal preference or style characteristic of the groups should be taken into consideration in planning that standard experience(8). Here, there is an issue concerning a systematic mis-match of teacher or environment style to that of the student. On the one hand some theorists [ie. (9,10,11)] believe that this would be a "stretching" or "strategy building" experience for the mis-matched student; another group of theorists [ie. (12,13,14)] feel that learning is difficult enough in itself and should be structured to match the learner's style as closely as possible.

When negative results are found they are reported to indicate that learning style does not add significantly to predictions of student outcomes based on more usual variables such as IQ(1) . Usually these studies are designed and conducted in a rigid yet too simple manner that assumes learning style is stable over time unmaskable, unambiguous attribute like eye color(16). It is not surprising that there is no evidence of learning style in a restricted sample of overly-ambitious, very clever multi-learning strategied medical students!

Literature Review: Are There Other Important Outcomes Achievable Using Learning Styles?

Learning styles have been observed to be related in various ways to many different areas of the professional career, everything from admissions to study,

scholarly achievement, willingness to practice in small communities, choice of specialty and general competence.

We discovered 24 citations about professional career choice that in some way involved learning styles. In most cases the research design is to discover the most common style in various comparison groups. Some of the difference between the groups is then attributed to the modal style differences. Thus there was some significant differences between the learning styles of those applicants successfully placed in medical schools and the unsuccessful applicants, as well as a differentiation between those that did and did not apply to medical school from the general college population(17). Researchers in this area feel that issues of recruitment to understaffed professional specialties or geographic areas could be manipulated by recruiting a certain "style" of undergraduate student. This line of research has been extensive in terms of populations studied and has reasonable reliability and concurrent validity. But since the samples are so large these indications are hard to evaluate. Predictive validity has not been attempted.

Our conclusions from reviewing research that utilized learning style measurements for education or manpower purposes:

1. Learning style researchers have not yet unequivocably established the reality or utility of this concept. Learning styles indeed may not exist other than as an insubstantial artifact of the person-environment interaction. Alternatively it may be real, stable and potent enough to be very useful to educational planners, particularly those concerned with truly individualized educational programming.

2. There is enough suggestive and substantive work utilizing learning style concepts, enough of it with a clear professions focus to warrant an organized program of investigation.

Proposal For New Learning Styles Organization

Description

The 21 models of learning style listed in Appendix 1 were reviewed for psychometric acceptability. Of these the ten marked with asterisks demonstrated sufficient reliability and validity to be considered seriously. The criteria for acceptability were minimal. There had to be some meaningful data collected, reported and described concerning validity and reliability of the measure proposed. Many models made, or at least reported, no attempt at either. Still there was a great deal of overlap and confusion in the terminology, conceptual levels, and behavioural foci. We endeavoured to create some order by proposing an organization among the surviving models that could be empirically tested.

Based on the psychometric evidence presented later in this paper, reviews of the written documentation about the instruments and extensive discussion with instrument developers, it appeared reasonable to organize nine of these models of learning styles into strata resembling layers of an onion. (see Figure 1) By this organization learning behaviour is fundamentally controlled by the central personality dimensions, translated through middle strata information processing dimensions and given a final twist by interaction with environmental factors encountered in the outer strata. This three step connection between the personality strata and observed behaviour is analogous to the trait-state concepts in personality theory.

The outermost layer, and the most observable, will be titled Instructional Preference. Three of the learning style research groups, regardless of the name they use to refer to their concept, concern themselves with instructional preference. They are: 1)Friedman and Stritter, 2)Rezler, 3)Grasha and Reichmann. Instructional preference refers to the individuals' choice of environment in which to learn. As this is the layer that interacts most directly with learning environments, learner expectations, teacher expectations and other external features, we would expect instructional preference to be the least stable, the most easily influenced level of measurement in the learning styles arena.

The second level of the learning style onion will be called Information Processing Style. This is conceived of as the individual's intellectual approach to assimilating information following the information processing model. Because this processing does not directly involve the environment we would expect that measures of this Information Processing Style would be a good deal more stable than Instructional Preference, and yet still be modifiable by learning strategies. Researchers 1)Kolb, 2)Tamir, Elstein and Molidor, and 3)Schmeck and Ribich are all dealing with information processing style concepts applicable at the intersection between fundamental personality level individual differences and environmentally offered learning format choices.

The third and innermost layer of the hypothetical learning style onion is Cognitive Personality Style. This is defined as the individual's approach to adapting and assimilating information; but this adaptation does not interact directly with the environment, rather this is an underlying and relatively

permanent personality dimension. These constructs form part of the construct description of personality. Representative researchers in this area are 1)Witkin, 2)Myers-Briggs, and 3)Kagan.

Present Evidence Supporting Reconceptualizaton

The first line of argument is based on a content analysis of the instruments surviving the psychometric screening. This analysis revealed parallels in of focus and likely sub-scale content groupings across instruments. Thus, the concept of students' preference for working at a pace and on material chosen by themselves as opposed to the teacher or a peer group appears in all three scales grouped under "Models of Instructional Preference Theories". Similarly these three measures have an interest in how participative a student prefers to be during learning, and how much structuring a student prefers to do for him/herself.

The three measures grouped under the title "Models of Information Processing Style" share a concern with the propensity of a student to stick with concrete experience, facts and simple recall as opposed to an orientation towards synthesis and analysis of data, and derivation of principles, concepts or relations among the observable facts. All these measures contain a scale involving reflection, elaborate restating, reorganization or critical questioning of information. All of these concerns affect aspects of information processing.

The "Models of Cognitive Personality" share a concern with the deep structure of personality. These measures all purport to have wide applicability

in predicting behaviour, but they all specifically include learning behaviour within their range. As such there are aspects of each measure that are reflected in the others. For example, Witkin's concern with field dependence-independence likely bears some relationship to Kagan's dimensions of impulsivity-reflectivity which in a clinical setting is referred to as "time to closure" (the data gathering phase in problem solving). This issue of time or amount of detail checking is again reflected in the MacCaully work with the Myers-Briggs Type Instrument through all four bi-polar scales, particularly the thinking-feeling scale.

The second line of argument is based on an examination of the test-retest reliability results for these various measures. This type of reliability can be interpreted as an indication of the stability of the construct being measured. The reorganization offered here hypothesizes, following trait-state theory, that the constructs at inner layers will be more stable than those at outer layers. Thus measures of Instructional Preference should be less stable than measures of Information Processing which in turn would be less stable than the Cognitive Personality measures.

Collected in Table 1 are the available test-retest correlations indicating stability of the various measures over time within a person. Internal consistency results are also supplied in Table 2 as a test must be internally stable before it is likely to be stable over time.

Our contention that measures of the cognitive personality level of learning style should be more stable than other levels is supported by examination of the internal consistencies (Table 2). The average internal consistency for the

cognitive personality level is .86. For the Information Processing level it is .68, and for Instructional Preference it is .63.

Drawing a conclusion based on test-retest indications of stability (Table 1) is more difficult due to the unavailability of data on three measures (Stritter-Friedman, Rezler and Tamir). It is certainly true that the time span for temporal stability in the Cognitive Personality level (average stability across three measures = .79) is significantly longer than that measured for any other level. The two available measures of temporal stability in the Information Processing level average .71. There is only one measure available (.80) of the Instructional Preference level.

While this data is not overwhelmingly in support of the prinicples of this proposed organization, it is not discouraging. In addition to further dialogue with the researchers involved to locate or produce the missing data, a direct plan must be developed to test the proposed organization. Some preliminary thoughts towards that end are outlined below.

Empirical Test of Proposed Organization of Learning Style

Research Question

A test of the proposed organization must produce a defensible answer to two questions: 1) Are the three measures in any one layer of this reconceptualization of learning styles measuring the same thing, or some things more closely related than those measured in other layers. 2) Are the three

layers ordered inclusivity? That is, can the hypothesized central layer (Cognitive Personality) be pschometrically proven to be fundamental to all other layers?

This seemingly obvious set of questions have not been answered or, to my knowledge, attempted by learning style theorists for good reason. First, the statistical tests necessary to approach these questions have not been developed and secondly the amount of testing necessary to generate sufficient within-subject information is not trivial. We have developed a detailed statistical model, test procedures and research design to address these problems.

The design will be of the following form: 3:9 X a:b [nine measures of learning style within the three organizational levels of proposed; and a sample size of "a" size; within "b" blocks of extraneous but important interacting variables, for example speciality type([30],[31])]. All participants should complete all nine instruments. The order of instruments should be balanced across a Greco-Latin square to insure that the non-essential order effects are randomly distributed across participant scores.

Analysis

The analysis procedure will examine in each layer the three measures in order to observe whether the second, then third measure contribute any additional information beyond that given by the first measure. In this manner within each layer a subset of important measures will be constructed. Next, the measures will be compared between layers taking the scale of the innermost layer as fundamental.

We expect this research design and analysis to accomplish the following. 1) To prove that the plethora of constructs now available for measurement in learning styles is empirically reduceable to an onion-like layering which would collapse the number of constructs and order them from most fundamental, stable or central to the most peripheral, variable and changeable. 2) To provide a statistical test of the "onion theory" sufficiently signficant to establish construct validity for the proposed organization of learning style levels. 3) to provide a statistical validation of the "onion theory" indicating the most appropriate level of measurement for further experimental work in the area of learning styles in issues of selection, training and manpower planning.

Conclusion

The various conceptualizations of learning style and related concepts appear often enough in our professional literature with enough confusion in design, definition and results to make an organized program of study worthwhile. If learning styles as a concept is an artifact, or a convenient scapegoat for all kinds of unexplained individual variability, then a careful program of research should unequivocally lay the concept to rest. On the other hand, should there be some utility and predictability made possible by use of the various learning style concepts and their measurement, then this power should be made available to those interested in effective and efficient professional education.

Developing learning styles into a useable set of construct has potential for real economic effects by improving selection, training and continuing education of professionals. Professions researchers should be interested in

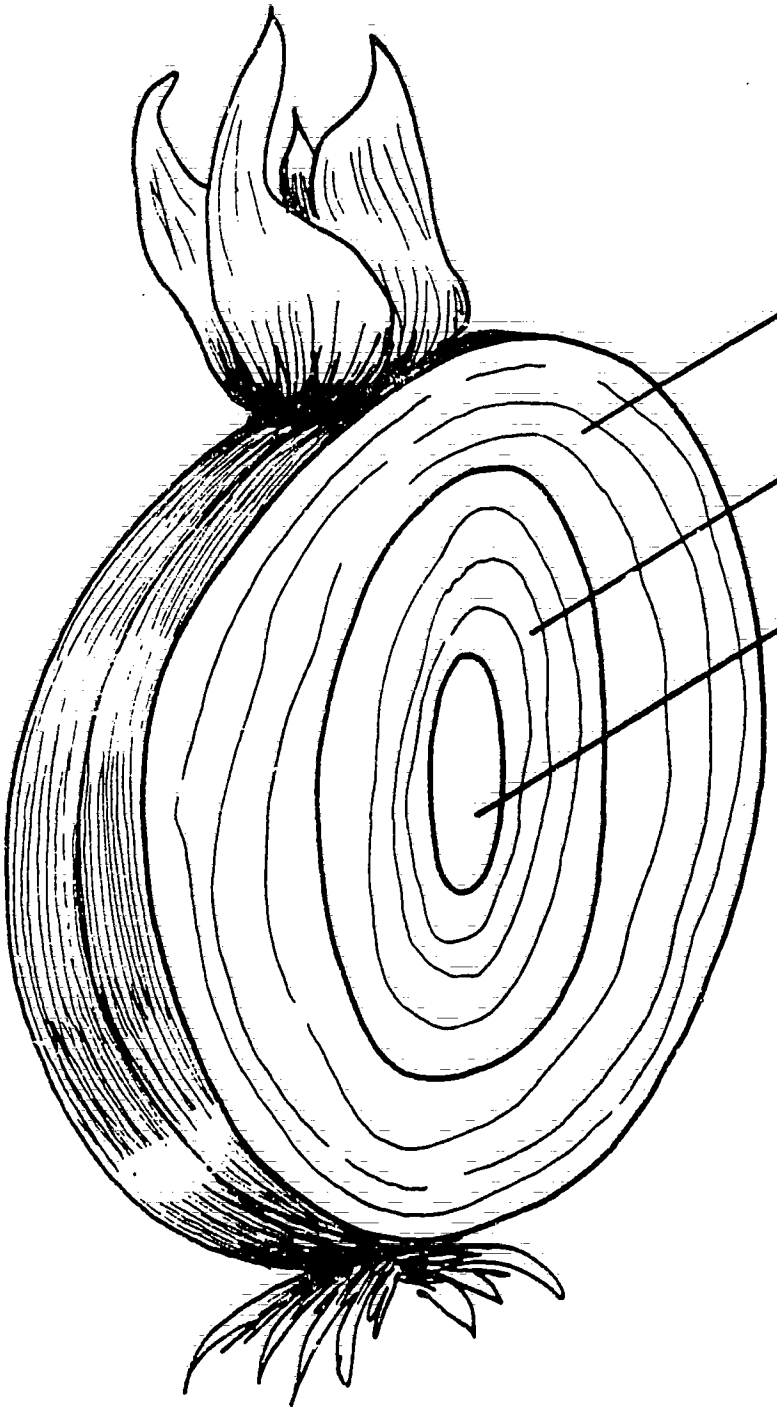
learning styles development by their relevance to manpower recruitment, selection, training, speciality choice, and geographic placement.

Adequate measurements of a clearly conceptualized learning style theory will be important in the development of individualized methods of continuing professional education. The costs of group based education are always increasing, and it is all but impossible to satisfy any one individual's real knowledge deficits and experience organize for a group. Thus the demand for efficient, effective, and accountable ways for individual professionals to organize continuing education for themselves or small practice groups, will continue to grow. This growth should be encouraged by all levels of continuing education providers as it is both fiscally and educationally responsible. Knowledge about learning styles of participants would be of immense benefit to planners of both group and individualized educational experience as there is some fairly good preliminary evidence indicating increased efficiency of learning when educational experiences are organized to match learning style of participants.

The interests that various levels of government have in developing mechanisms to encourage professionals to establish practices of certain types in certain underserviced geographical areas([32]) could be informed by a thorough testing of the claims made for learning style predicting speciality and geographic area choice. It could be that our nation-wide shortage of certain kinds of professionals([33]) willing to serve in remote areas could be ameloriated by seeking and recruiting individuals for training best suited to those occupations and location by their preferred style of processing information.

The present emphasis on cost effectiveness in research and delivery of all professional services will continue for some time in the future. This theoretical reorganization of the concept of learning styles is offered as one empirically testable step toward making learning style measurment available in a valid and reliable form for application in both manpower and educational studies. If, as is claimed by the present literature, learning styles can help us improve efficiency and effectiveness of manpower decision making and training we have the responsibility to develop these measures sufficiently and make them available to decision makers and educational planners.

LEARNING STYLE THEORIES



INSTRUCTIONAL FORMAT PREFERENCE INDICATOR

INFORMATION PROCESSING STYLE

COGNITIVE PERSONALITY STYLE

Measures	Test-Retest Correlations*	Sample
I. Instructional Preference		
1. Stritter, Friedman	not available	
2. Rezler	not available	
3. Grasha, Riechamnn[18]	AV. = .80 range = .76 - .83	sample = undergraduate students span = 7 days N = 269
II. Information Processing		
1. Kolb[19]	AV. = .58 range = .48 - .73	sample = 4th year med. students span = 3 months N = 27
2. Tamir	not available	
3. Schmeck, Ribich[20]	AV. = .83 range = .79 - .88	sample = undergrads. span = 2 weeks N = 95
III. Cognitive Personality		
1. Witkin[21]	.90 - .92 (one scale)	sample = general students span = 7 years N = 27
2. McCaulley[22]	AV. = .78 range = .70 - .83	sample = undergrads. span = 8 months N = 56
3. Kagan[23]	AV. = .69 range = .46-.92	sample = 2nd grade children span = 10 weeks N = 120

Notes:

*Averages and ranges describe test-retest correlations across scales wi the measure.

Table 1: Temporal Stability Indications for Measures Composing the Proposed Organization of Learning Style

Measures	Internal Consistency*	Characteristics
I. Instructional Preference		
1. Stritter, Friedman ([24])	Av. = .66 Range = .52 - .79 (Cronbach)	sample = law, business & med students Σ items = 40 # items/scale = 7-9 # scales = 5
2. Rezler ([9])	Av. = .65 Range = .58 - .73	sample = allied health workers N = 159 # items/scale = 15 # scales = 6 Σ items = 15
3. Grasha, Riechmann	Av. = .60 Range = .39 - .76	sample = undergrads N = 569 Σ items = 90 # items/scale = 15 # scales = 6
II. Information Processing		
1. Kolb([25])	AV. = .69 range = .55 - .82	sample = undergrads, grads, managers N = 687 Σ items = 9 # items/scale = 9 # scales = 4
2. Tamir([26])	Av. = .66	sample = med. school teachers N = 37 Σ items = 18 # items/scale = 18 # scales = 4
3. Schmeck, Ribich([27])	AV. = .70 range = .58 - .82 (KR-20)	sample = undergrads. N = 434 Σ items = 72 # items/scale = 7-23 # scales = 4

III. Cognitive Personality

1. Witkin([28])	.82 (one scale) (split half)	sample = undergrads N = 397 Σ items = 18 # items/scale = 18 # scales = 1 (bipolar)
2. McCaulley([22])	AV. = .86 range = .80 - .88 (split half)	sample = med students N = 91 Σ items = 143 # items/scale = 34-44 # scales = 4 (bipolar)
3. Kagan([29])	.89 (time) (undefined)	sample = undefined N = undefined Σ items = 12 # items/scale = 12 # scales = 1 (bipolar)

*Note: Averages and ranges are across scales

Table 2: Internal Consistency for Measures Involved in the Proposed Organization of Learning Styles

Biggs, J.B. -- Study Process Questionnaire

Canfield, A.A. and Lafferty, J.C. -- Learning Style Inventory

*Dunn, Rita and Dunn, Kenneth -- Learning Style Inventory

Goldberg, Lewis R. -- Oregon Instructional Preference Inventory

*Grasha, A.F. and Reichman, S.W. -- Grasha Reichmann Student Learning Styles Scales

Gregorc, Anthony F., and Ward, Helen B. -- Concept of Duality

Heath, R.W. -- Cognitive Preferences Test

Hill, Joseph E. -- Cognitive Style Interest Inventory (Cognitive Mapping)

Hunt, David E. -- Paragraph Completion Method

*Kagan, Jerome -- Matching Familiar Figures Test

Kempa, R.F. and Dube, G.E. -- Cognitive Preference Test

*Kolb, David -- Learning Style Inventory

*McCaulley, M. -- Myers-Briggs Type Indicator

Papalia, Anthony -- Learning Modalities Inventory

Pask, G. -- Conversation Theory

Reinert, Harry -- Edmonds Learning Style Identification Exercise (ELSIE)

*Rezler, Agnes G. -- Learning Preference Inventory

*Schmeck, R.R. and Ribich, F. -- Inventory of Learning Processes

*Stritter, Frank T., and Friedman, C.P. -- Instructional Preference

*Tamir, P., Schiffman, A., Elstein, A.S., Molidor, J.B., Krupka, J.W. -- Cognitive Preference Inventory

*Witkin, H.A., Moore, C.A., Goodenough, D.R., Cox, P.W. -- Embedded Figures Test

* - those demonstrating sufficient reliability and validity to be considered

Appendix 1: Learning Style Theories Reviewed

Level I Models of Instructional Preference

1. Stritter, F.P. and Friedman, C.P.
   Instructional Preference Questionnaire

2. Rezler, Agnes
   Learning Preference Inventory

3. Riechmann, S.W. and Grasha, A.F.
   Grasha Riechmann Student Learning Style Scales

Level II Models of Information Processing Style

1. Kolb, D.
   Learning Style Inventory

2. Tamir, P. Elstein, A.S., Molidor, J.B.
   Cognitive Preference Inventory

3. Schmeck, R.R. and Ribich, F.
   Inventory of Learning Processes

Level III Models of Cognitive Personality

1. Witkin, H.A.
   Embedded Figures Test

2. McCaulley, M.
   Myers Briggs Type Indicator

3. Kagan, J.
   Matching Familiar Figures Test

Appendix 2: Theories Composing the Reconceptualization of Learning Style

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