Cognitive Styles and Distance Education

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Abstract

Distance education is a new and vital force in higher education. The design and application of distance learning is of central concern to many educators. Research has been conducted from a variety of perspectives in this area. However, there is not much research about how to adapt the design of distance education to students' cognitive styles. This review is designed to address this issue. This article involves four sections: (a) an overview of the construct of cognitive styles, (b) major dimensions of cognitive styles, (c) major characteristics of distance education, and (d) applications of cognitive styles to the design of distance education.

Introduction

A comprehensive review of research in cognitive psychology has indicated that people exhibit significant individual differences in the cognitive processing styles that they adopt in problem solving and other similar decision-making activities (Robertson, 1985). As for individual differences, different researchers have different definitions and conduct research from different perspectives accordingly. However, findings from both qualitative and quantitative research have indicated several consistent major dimensions of individual differences (Dunn, DeBello, Brennan, Krimsky, & Murrain, 1981; Riding & Cheema, 1991). Of these dimensions, cognitive style is a major one. The construct of cognitive styles was originally proposed by Allport (1937), referring to an individual's habitual or typical way of perceiving, remembering, thinking, and problem solving. Since then, especially in the last few decades, there has been additional considerable research in this area. Cognitive style has been broadly investigated by psychologists. Messick (1976) identified as many as 19 cognitive styles. Smith (1984) also tabulated at least 17 learning style inventories.

There are many different definitions of cognitive style. Tennant (1988) defined cognitive styles as "an individual's characteristic and consistent approach to organizing and processing information" (p. 89). Riding, Glass, and Douglas (1993) termed cognitive styles as "a fairly fixed characteristic of an individual" (p. 268) and "are static and are relatively in-built features of the individual" (p. 268). Based on the above definitions, in the authors' points of view, cognitive/learning styles refer to the individual's consistent and characteristic predispositions of perceiving, remembering, organizing, processing, thinking, and problem solving.

Different researchers emphasize different aspects of cognitive styles. Therefore, there are various terms encountered in the literature related to this area. These terms include: breadth of categorizing (Kogan & Wallach, 1964), cognitive complexity vs. cognitive simplicity (Kelly,

1955), deep-elaborative vs. shallow-reiterative (Schmeck, 1983), divergent vs. convergent (Hudson, 1966), field dependence vs. field independence (Witkin, 1962), global vs. analytical (Kirby, 1988), impulsive vs. reflectivity (Kagan, 1965), leveller vs. sharpener (Holzman & Klein, 1954), need for cognition (Tanaka, Panter, and Winborne, 1986-87), objective vs. nonobjective (Leithwood & Montgomery, 1982), organizer vs. nonorganizer (Atman, 1988), right- vs. left-brained (Torrance & Rockenstein, 1988), risk-taking vs. cautiousness (Kogan & Wallach, 1964; Kogan, 1971), scanning vs. focusing (Gardner, 1961), sensitizers vs. repressors (Bergouist, Lloyd, & Johansson, 1973), sensory modality preferences (Bartlett, 1932; Galton, 1883), simultaneous vs. successive (Das, 1988), verbalizer vs. imager (Riding & Taylor, 1976), verbalizer vs. visualizer (Richardson, 1977), visual vs. haptic perceptual type (Lewenfeld, 1945); holist vs. analytic (Peters, 1977), holist-analytic vs. verbal-imagery (Riding & Cheema, 1991), holist vs. serialist (Pask, 1972), Kolb's learning style model (Kolb, 1984), as well as the MBTI learning style model (Lawrence, 1984).

In most situations, cognitive styles and learning styles are used interchangeably, as well as in this article. Generally, cognitive styles are more related to theoretical or academic research, while learning styles are more related to practical applications. A major difference between these two terms is the number of style elements involved. Specifically, cognitive styles are more related to a bipolar dimension while learning styles are not necessarily either/or extremes. Cognitive/learning styles measures conventionally lie somewhere between aptitude measures and personality measures. In addition, cognitive/learning styles in the literature have been viewed in three major respects–structure, process, or both structure and process (Riding & Cheema, 1991; Squires, 1981; Tennant, 1988; Wilson, 1981).

According to Schmeck (1988), there are two basic types of learning styles. One is global-holist/field dependent/right brained, the other is focused-detailed/field independent/left brained. Schmeck asserted that, although both styles are equally good for problem solving, each style is likely to be associated with greater efficiency in specific tasks. The most effective problem solvers should exercise strategies connected with both aforementioned styles.

In addition, Ausburn and Ausburn (1978) argued that cognitive styles were characterized by three important properties. The first important property is the generality and stability across tasks and over time. Therefore, they are resistant to training and change. The second important property is the relative independence of cognitive styles from traditional measures of general ability. The third important property is cognitive styles' relationships with some specific abilities, characteristics, and learning tasks. Cognitive styles have either positive or negative relationships with motivation and academic achievement depending on the nature of the learning task.

The remainder of this paper involves three sections: (a) a review of major dimensions of cognitive styles, (b) major characteristics of distance education, and (c) adaptations of design and delivery of distance education to students' cognitive styles.

A Review of Cognitive Styles

This section reviews the characteristics of five major dimensions of cognitive styles that are either long-standing and/or well supported in the literature. These major dimensions include field independence-dependence, holist-analytic, sensory preferences, hemispheric preferences, and Kolb's learning style model.

Field independence vs. Field Dependence

There has been a growing body of research in the past decades since the field dependence-independence dimension was first proposed by Witkin (1962; 1979). According to Witkin, field dependence-independence is value-neutral and is characterized as the ability to distinguish key elements from a distracting or confusing background. Field dependence-independence has important implications for an individual's cognitive behavior and for his/her interpersonal behavior. Specifically, field independent people tend to be more autonomous in relation to the development of cognitive restructuring skills and less autonomous in relation to the development of interpersonal skills. Conversely, field dependent people tend to be more autonomous in relation to the development of high interpersonal skills and less autonomous in relation to the development of cognitive restructuring skills. In addition, according to Witkin, Moore, Goodenough, and Cox (1977), field independent persons tend to be intrinsically motivated and enjoy individualized learning, while field dependent ones tend to be extrinsically motivated and enjoy cooperative learning.

The field independence dimension is also related to some other individual characteristics, such as solving analogical problems. According to Antonietti and Gioletta (1995), cognitive styles, rather than general abilities, are related to analogical problem solving. Antonietti and Gioletta found that field independent participants were more likely to be analogical solvers than field dependent ones. Males tended to use analogical solutions more frequently than females. In addition, according to Braune and Wickens (1986), there are three important dimensions of individual differences in time-sharing–serial processing, parallel processing, and the internal model. Field independent persons perform better in the parallel processing conditions, while field dependent ones perform better in the serial processing conditions.

The field independence dimension is also related to some task characteristics. According to Bennink (1982), high and low field articulation (FA) students show differences in the following two major respects under cognitively demanding conditions: (a) integrating a set of semantically related sentences to answer inference questions and (b) remembering the actual propositions themselves.

Holist-Analytic

According to Riding and Cheema (1991), learning styles have two basic types of independent dimensions. One is the holist-analytic dimension. The holists tend to view a situation as a whole, while the analytics tend to view a situation as a collection of parts and often stress only one or two aspects at a time. Intermediates will have the advantage of both styles. The other is the verbal-imagery dimension, which has two basic effects: (a) how information is represented, such as verbally, imagery, or both, as well as (b) internal/external focus of attention. Generally, the imagers tend to be internal and passive, while the verbalizers tend to be external and stimulating. The latter type is related to sensory preference described later in this section. The above findings were also supported by Sadler-Smith (1997).

The holist-analytical style develops even in young children. Peters (1977) conducted a study about first language learning among very young children. According to him, children employed two basically different strategies to learn their first language. One is the analytic style, which proceeds from the parts to the whole. The other is the Gestalt style, which proceeds from the whole to the parts. In addition, Peters speculated that these two different language learning strategies may have neurological bases.

Holist-analytical styles have relationships to the type of instructional material and learning performance. According to Riding and Sadler-Smith (1992), among secondary schools or college students, types of instructional material treatment, such as abstract or pictorial presentation and cognitive styles, have very important influences on learning performance. Specifically, students on the analytic-imager dimension improve most in learning due to the inclusion of more pictorial presentations about certain types of contents. In addition, the findings in the above study were also reported in other studies (e. g., Holliday, 1976; Winn, 1982).

Sensory Preference

There is a large body of research about sensory modality preference. According to Bissell, White, and Zivin (1971), a sensory modality is a system that interacts with the environment through one of the basic senses. The most important sensory modalities are visual, auditory, and kinesthetic. According to Dunn and Dunn (1979), about 20% to 30% of American students are auditory; about 40% are visual; the remaining 30% to 40% are either tactual/kinesthetic, visual/tactual, or some combinations of the above major senses.

The concept of sensory preference can be traced back to Galton (1883). According to his research, visual imagery is infrequent among scientists and seems to be incompatible with scientists' abstract thinking. Later, Bartlett (1932) found similar results. In order to provide relatively comprehensive information about the distinguishing features of verbal and visual thinkers, Smith (1964) published his *Spatial Ability*. One of Smith's major findings is that verbal thinking is overemphasized in research and intelligence testing after neglect of spatial or visual thinking. Another major finding is gender differences. Specifically, masculinity is related to visual thinking while femininity is related to verbal thinking. However, gender distinction is not supported by Antonietti and Gioletta (1996).

Many studies have indicated that a visual style is beneficial for some tasks. According to Vicente, Hayes, and Williges (1987), psychometric tests of vocabulary and spatial visualization are the predictors of task performance. Of these two, spatial visualization is the most influential. This was supported by Sein and Bostrom (1989), as well as Schofield and Kirby (1994).

Another term similar to verbalizer vs. visualizer is verbalizer vs. imager cognitive style, which was proposed by Riding and Buckle (1990). This dimension was supported by Riding and Cheema (1991), as well as Riding and Douglas (1993). According to these researchers, the imagers are better in performance than the verbalizers in the text-plus-picture condition, while the verbalizers are better than the imagers in the text-plus-text conditions. In addition, the imagers more often use diagrams to illustrate their answers than the verbalizers.

Hemispheric Preferences

There is a large body of research about hemispheric preferences. Researchers have conducted relevant studies from different perspectives, such as psychological, physiological, and neurological. According to Sonnier (1991), hemispheric preferences might be a major contributing factor to individual differences. That is, left-hemispheric students are strong in analytical thought processing, while right-hemispheric students are visual processors. In addition, O'Boyle (1986) proposed that the difference in cognitive processing between the two hemispheric asymmetries was more quantitative than qualitative in nature. In other words, it is primarily a matter of degree rather than absolute ability.

Many studies have shown that hemispheric preferences play a very important role in cognition

and achievement. According to O'Boyle and Hellige (1989), hemispheric asymmetry, such as degree of dominance, direction of dominance, characteristic arousal level, and complementarity of functioning, play an important role in individual differences in cognition. According to Gadzella and Kneipp (1990), right-hemispheric students process information nonlinearly and holistically, but left-hemispheric students process information logically and sequentially. In addition, according to Gadzella (1995), left-hemispheric students achieve higher grades than right-hemispheric ones, especially when the grades are primarily based on the objective test.

However, some researchers point out that the concept of cerebral preference has some limited practical and theoretical implications (O'Boyle, 1986; Zalewski, Sink, & Yachimowicz, 1992). They warn that teaching models should not be solely based on the students' cerebral preferences. Teachers should use multiple methods of teaching to improve students' learning instead of using a single one.

Kolb's Learning Style Model

Kolb's Learning Style Inventory is one of the dominant approaches to categorizing cognitive styles (Tennant, 1988). Kolb's model has been found to be effective in some language teaching activities (Kolb, 1984). According to Kolb, the four basic learning modes are defined as active experimentation (AE), reflective observation (RO), concrete experience (CE), and abstract conceptualization (AC). In addition, the learning process is not only active and passive, but also concrete and abstract. This model can also be considered as a four-stage model: (a) concrete experience, (b) observation and reflection, (c) the formation of abstract concepts and generalizations, and (d) hypothesis tested by active experimentation leading to new concrete experience.

Based on the four basic learning modes, according to Kolb (1984), there are four basic learning styles: converger, diverger, assimilator, and accommodator. Their characteristics are described below respectively: (1) Converger. The convergent learning style depends mainly on the dominant learning capacities of active experimentation and abstract conceptualization. This style has great advantages in decision making, problem solving, traditional intelligent tests, and practical applications of theories. Knowledge is organized in a way of hypothetical-deductive reasoning. Therefore, persons with this style are superior in technical tasks and problems and inferior in social and interpersonal matters. They tend to choose to specialize in physical sciences. (2) Diverger. The divergent learning style has the opposite learning advantages over converger. This style depends mainly on concrete experience and reflective observation; it has great advantages in imaginative abilities and awareness of meaning and values. Therefore, persons with this style tend to organize concrete situations from different perspectives and to structure their relationships into a meaningful whole; they focus on adaptation by observation instead of by action; they are superior in generating alternative hypothesis and ideas, and tend to be imaginative, people- or feeling-oriented; they tend to choose to specialize in liberal arts and humanities. (3) Assimilator. The assimilative learning style depends mainly on abstract conceptualization and reflective observation. This style has great advantages in inductive reasoning, creating theoretical models, and assimilating different observations into an integrative entity. Similar to converger, persons with this style tend to be more concerned about abstract concepts and ideas, and less concerned about people. However, persons with this style tend to focus more on the logical soundness and preciseness of the ideas, rather than their practical values; they tend to choose to work in research and planning units. (4) Accommodator. The accommodative learning style has the opposite learning advantages over assimilation. This style depends mainly on active experimentation and concrete experience; it has great advantages in doing things, implementing plans, and engaging in new tasks. Therefore, persons with this style

focus on risk taking, opportunity seeking, and action; they tend to be superior in adapting themselves to changing immediate situations in which the plan or theory does not fit the facts; they also tend to intuitively solve problems in a trial-and-error manner, depending mainly on other people for information rather than on their own thinking. Therefore, persons with this style tend to deal with people easily; they tend to specialize in action-oriented jobs, such as marketing and sales.

According to Kolb (1984), the above patterns connected with these four basic learning styles are exhibited consistently at various levels of behavior, from personality type to some specific task-oriented skills and performance, such as professional career and current job role. Kolb's model was also empirically supported by other studies. According to Trevino, Lengel, Bodensteiner, Gerloff, and Muir (1990), Kolb's above CE and AC are similar to the perceptive vs. judging dimension measured by Myers Briggs Type Indicator (MBTI). The perceptive persons are expected to prefer rich media, such as the integrative use of pictures, tables, and diagrams, while the judging persons are expected to prefer lean media, such as without the integrative use of pictures, tables, and diagrams. This may have wide implications in distance education.

In addition, this model has proved to be of practical use. Just as Tennant (1988) remarked, "As a rule of thumb the model provides an excellent framework for planning teaching and learning activities and it can be usefully employed as a guide for understanding learning difficulties, vocational counseling, academic advising and so on" (p. 105). Although Newstead's (1992) study indicated that the reliability of Kolb's Learning Styles Inventory was low and the underlying factor structure was not in agreement with what was predicted, a correlation was found between scores on the active/passive (AE-RO) dimension and the students' academic performance. Therefore, it can be inferred that Kolb's model may be of some diagnostic use in higher education. Furthermore, according to McCarthy (1980), the Kolb model, as well as the model of brain hemispheric dominance, is a very important foundation of the 4MAT curriculum design system applicable for syllabus development in some institutions.

This section reviewed five major dimensions of cognitive styles: field independence-dependence, holist-analytic, sensory preferences, hemispheric preferences, and Kolb's learning style model. These major dimensions have been shown that they have important influences on an individual's psychological factors and performance. In the next section, the major characteristics of distance education will be briefly described.

Major Characteristics of Distance Education

Distance education is a relatively new technology. Its major goal is to provide education to many kinds of populations, especially to some geographically distributed groups. This section deals with three major issues related to the characteristics of distance education: (a) definition, (b) learners characteristics, and (c) technology characteristics.

Definition

Distance education is emerging as a viable and vital force in educational delivery system in recent years, especially in higher education. Much of the growth comes from a rapidly growing demand for educational opportunities directed toward and designed for some specific target groups (Garrison, 1986; 1987; Gaspar & Thompson, 1995). Just as Amundsen and Bernard

(1989) pointed out, "…the definitive characteristic of distance education is the separation between 'teacher' and learner and among learners. As a result, interpersonal communication is not a natural characteristic of distance education" (p. 7). According to Gaspar and Thompson (1995), distance education integrates correspondence, instruction, use of periodicals and teaching aids, mass media, audiovisual lessons, social interactions, computer-assisted instruction, and various technologically-advanced formats. In the perspective of Keegan (1986), distance education has six major features: (a) the separation of teacher and learner, (b) the role of the educational organization, (c) the place of the technological medium, (d) two-way communication, (e) the separation of learner and the learning group, and (f) industrialization. In sum, distance education establishes a system that provides learning opportunities to various groups of learners who have no access to the traditional, higher education institutions.

In addition, according to Bates (1986), there are two basically different approaches of distance education. One is based on structured, pre-programmed learning materials and the other is based on the computers' communications functions. These two approaches have completely distinct philosophies of education. The former is called the black box approach. This approach views the computer as a black box to substitute for the traditional face-to-face (FtF) teacher. Therefore, it is the computer or black box that teaches the students. The frequent example is computer-assisted learning (CAL) software. The latter view is called networks approach. This approach views the computer as a channel of communication between learners and teachers. The frequent example is computer-mediated communication (CMC) systems. Therefore, it is the teacher who teaches the students, only with the computer as a channel of facilitating the two-way communication between teachers and students, online but at a distance and asynchronously. These two approaches are not mutually exclusive. They can be combined to become a powerful medium for distance education. Lauzon and Moore (1989) called the integration of these two approaches the fourth generation distance system that has no barriers of time and place.

Learners' Characteristics

Most of the distance education students in higher education are adult learners. According to Harper and Kember (1986), approaches to the study of the characteristics of the distance education students are basically similar to those of students studying in FtF environments. These students tend to be more intrinsically motivated than their younger counterparts. This result is similar to the findings obtained by Watkins and Hattie (1981) and by Watkins (1983). Generally, mature students tend to be more intrinsic and rely more on a deep-level approach in learning than school-leavers, who mainly depend on rote learning. In addition, according to the survey conducted by Smith (1988) about Open University students, 71% of the students have positively approached the CMC aspects of the distance courses. In addition, 57% of the students have felt that they could participate more equally in CMC than in FtF communication.

However, there are different reasons why some of the distance learners cannot achieve what is expected. According to Coggins (1988), preferred learning style is influential on students' completion of the external degree programs in distance education. Other reasons may include (1) some distance learners do not have effective learning strategies (e. g., Ackerman & Woltz, 1994) and (2) some cited that either the telecourse orientation and testing schedules were not convenient, or the pace of the telecourse was not appropriate, such as too fast, too slow, too hard, or too easy (e. g., Minich,1998).

Technology Characteristics

Educational technology is developing rapidly and is exhibiting many new characteristics. Riding

and Rayner (1995) pointed out six characteristics of the superhighway and personal computers that are helpful to understand distance learning: (1) control of the mode of delivery and the presentation rate; (2) control of the order of presentation, pace of instruction, and selection of learning activities; (3) monitoring of learning performance, storing responses, and conducting assessments; (4) provision of simulations which supply learning experiences in a variety of low-cost and risk-free topics; (5) formation of a collaborative learning group by linking the learner to the instructor and to other students for support; and (6) access to learning resources and assessment materials.

In addition, technology has extensive functions in distance education. McCreary and Duren (1987) identified ten educational functions of computer conferencing. These functions are listed below in order from least to most difficult to implement: (1) the notice board, (2) the public tutorial, (3) the individual project, (4) free flow discussion, (5) the structured seminar, (6) peer counseling, (7) collective database, (8) group products, (9) community decision-making, and (10) inter-community network.

In all, the definitive characteristic is the separation between the learner and the teacher. In addition, distance learners and educational technology have exhibited quite different characteristics from traditional face-to-face instruction. In the next section, suggestions for the adaptation of design and delivery of distance education to students' cognitive styles will be proposed.

Adaptations of the Design of Distance Education

Learner/teaching styles are one of the several important factors to be considered by the designers and teachers of the distance education classes (Kieran-Greenbush, 1993). However, not much research has been done regarding the adaptation of distance education to students' learning styles. Suggestions for the adaptation of the design and delivery of distance education will be proposed below in terms of four major instructional stages: (a) instructional planning, (b) learning environment construction, (c) teaching method selection, and (d) evaluation administration.

Instructional Planning

In this stage, the teacher should fully consider the cognitive style characteristics of all students. Specifically, three major aspects will be discussed below:

1. Audience analysis

The teacher should use appropriate cognitive style instruments to measure and identify the student's cognitive styles either before the start of the first class or in the first class. The teacher should be sure to know the students' preferred cognitive styles. These styles include field independence vs. field dependence, holist vs. analytical, sensory preference, hemispheric preference, and/or Kolb's learning styles. All these will become the basis for the teacher to prepare for the distance education classes.

2. Terminal objectives

Terminal objectives should be comprehensive to meet the cognitive style characteristics of all students. In order to maximize the students' potential performance, the terminal objectives

should focus on the students' preferred cognitive styles described above, as well as the nonpreferred cognitive styles.

3. Instructional preparation

After identifying students' cognitive styles, the teacher should make a full preparation for the match between cognitive styles and instructional contents, methods, and styles. These include: (a) what kind of instructional materials to teach, (b) what kind of learning environments to provide, (c) what kind of teaching methods and styles to use, such as the appropriate use of tapes, diagrams, etc., (d) what kind of formal instruction and informal activities to plan, and (e) what kind of evaluation techniques to use.

Learning Environment Construction

Appropriate construction of supportive environments, either physical or psychological, can facilitate individual's innovative achievement (McClusky, 1976; Mumford & Gustafson, 1988). Supportive learning environments in distance education include two important aspects: online contact and diversified learning styles.

1. Online contact

Since students can't talk to the teacher or other students face-to-face, the teacher should attempt to construct a supportive environment and provide timely online contact and assistance to all the students (Ehrman, 1990). In most situations, the teacher should provide a listserver mailing list or a chat room for all students in a specific class to talk about the course matters and ask or answer questions in order to reduce learning anxiety and maximize learning performance.

Online contact and assistance includes two major types. One is the online peer contact between students and students. According to Amundsen and Bernard's (1989), peer contact could significantly discriminate between final academic standing and course completion. The other is the online contact between the teacher and students. This can be achieved by talking either through the listserver mailing list to all students or through the teacher's individual e-mail account to the individual student. In addition, the teacher should use various media as needed, including face-to-face, telephone, e-mail, letter, note, memo, and the like.

2. Diversified learning styles

The adaptation of the design of distance education to students' cognitive styles should allow diversified learning styles to meet all students' characteristics. Specifically, the teacher should selectively provide theory-based learning to the assimilators and application-based learning to the accommodators; provide individualized learning to field independent students and cooperative learning to field dependent ones.

Teaching Method Selection

A new approach called "supplantation" was proposed by Ausburn and Ausburn (1978) to refer to teachers' adapting instructions to the various cognitive styles of the students. According to Ausburn and Ausburn, this process involves two types of supplantation design: conciliatory supplantation design and compensatory supplantation design. Conciliatory supplantation design means changing the manner of presentation of materials in order to link learner and learning materials without difficulty. This process is based on the use of the instructional modes that the learner prefers. Compensatory supplantation design means supplying some specific processes the

learner cannot supply to compensate for task-related deficiencies. The effect of compensatory supplantation design is expected to be effective for students (e. g., Krumboltz, Kinnier, Rude, Scherba, & Hamel, 1986). In addition, Ausburn and Ausburn proposed three steps in instructional design: (a) to analyze the learning task to find the basic stimulus-transformation requirements, (b) to find out for whom it needs to be supplanted, and (c) to find out how to supply the supplantation.

In order to effectively match the teaching styles with the students' cognitive styles, the teacher should take the following considerations. This part involves two major aspects. One is to match instructional materials with cognitive styles. The other is to match teaching styles with cognitive styles.

1. Matching the instructional materials with cognitive styles

It is very important to provide high quality instructional materials to match the students' cognitive styles and to fully communicate the richness and complexity of the subject matter (Jegede, Taylor, & Okebukola, 1991). According to Dick and Carey (1996), high quality instructional materials have ten characteristics, of which many are related to the issue of matching the students' cognitive styles with appropriate and complete content. Specifically, this type of matching includes the following:

> (1) Matching the type of content with verbal-visual style. In terms of content, the teacher should provide verbal versions of pictorial and diagrammatic material to the verbalizers and provide verbal material to convert to pictorial form and supplied with concrete analogies of abstract ideas to the visualizers (Riding & Rayner, 1995).
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> (2) Matching the type of content with Kolb's abstract-concrete style. In terms of content, the teacher should provide abstract information to the convergers and provide concrete information to the divergers in the instructional process.
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> (3) Matching the type of content with Kolb's career preferences. In terms of content, the teacher should provide different examples to different students to their different career preferences. Specifically, the teacher should provide examples in liberal arts and humanities to the divergers; provide examples in physical sciences to the convergers; provide examples in research and planning work to the assimilators; provide examples in marketing and sales work to the accommodators.

2. Matching the teaching styles with cognitive styles

Teaching styles refer to the implementation of the match between cognitive styles and the instructional materials described above. Specifically, this type of matching includes the following aspects:

> (1) Matching the instructional strategy with field dependence-independence style. In terms of instructional strategy, cooperative learning is an important learning strategy that can overcome the problems of distance education and improve students' deep processing skills (Savard, Mitchell, Abrami, & Corso, 1995). In addition, the teacher should allow both cooperative learning and individualized learning in the whole class.
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> (2) Matching the layout of materials with holist-analytic style. In terms of layout of learning materials, the teacher should not only provide the holist view of materials,

but also provide diagrammatic materials such as tables and tree diagrams.

(3) Matching the conceptual structure with holist-analytic style. In terms of the presentation of the conceptual structures of the material, the teacher should provide instructions for stressing both the whole and the parts. Specifically, holists need an organizer to identify the parts and structure of the material and analytics need an overview to provide a picture of the whole (Riding & Rayner, 1995).

(4) Matching the choice of presentation mode with sensory preference. In terms of the choice of presentation mode, the teacher should provide the written material to the verbalizers and provide pictorial presentation to the visualizers, such as pictures, diagrams, charts, and graphs (Riding & Rayner, 1995). In addition, the teacher should use multiple modes of presentation, such as visual, verbal, and auditory imagery. Crosby (1994) also proposed twelve suggestions for effective electronic presentation, including choosing appropriate software, font size, color, images, sound, order of presentation, and light.

(5) Matching social preferences with verbal-imagery style. In terms of social preferences, the teacher should provide lively, outgoing, and stimulating presentations to the verbalizers and provide less bothered tasks about a dynamic presentation to the imagers (Riding & Rayner, 1995).

(6) Matching the teaching aids with hemispheric preference. In terms of teaching aids, the teacher should implement holistic education in schools (e. g., Sonnier,1991). Specially, in explaining a specific content, visual aids are used for every step in instruction. Meantime, the content should be thoroughly and linear-logically explained. In addition, the teacher should use a combination of various instructional design, teaching techniques, and modes of presentation, such as computer based multimedia presentation, drawings, transparencies, video tapes, lectures, and discussions.

Evaluation Administration

The administration of evaluation in distance education includes two major aspects. One is assessment, the other is feedback about assessment.

1. Assessment

Assessment is used to measure what and how the students have learned in the distance education classes. For most distance education classes, students' grading should be based upon such tools as regular assignments, individual or group projects, online or in-class quizzes, and take-home exams. According to Jegede, Taylor, and Okebukola (1991), these types of tests should have maximum validity, feasibility, and objectivity in order to meet the characteristics of all the students.

(1) Contents of the Assessment. The content of the assessment tool should cover the entire course. According to Bloom, Englehart, Furst, Hill, and Krathwohl (1956), the comprehensive content of the assessment should include the following six aspects: (a) knowledge, (b) comprehension, (c) application, (d) analysis, (e) synthesis, and (f) evaluation. This type of assessment will be especially helpful to the holists, convergers, and assimilators.

(b) Formats of the assessment. The assessment tool can take many forms, including regular assignments, individual or group projects, online or in-class quizzes, and take-home exams. The formats of the tools should be appropriate and include: filling in the blanks, multiple choice questions, identification of terms, a variety of short and essay questions for the students to select, and writing papers. In addition, the teacher should provide appropriate hints, such as diagrams, tables, and verbal description, for different assessment instruments.

2. Feedback

The teacher should provide appropriate timely feedback regarding the results of the above assessment outcomes, such as exams, assignments, projects, and papers. In addition, the feedback should be primarily positive and encouraging.

Conclusion

Five major dimensions of cognitive styles are reviewed in this study. These are field independence vs. field dependence, holist vs. analytic, sensory preferences, hemispheric preferences, and Kolb's learning style model. It can be inferred that cognitive style is an important factor in individual differences. Therefore, the instructional adaptation and design of distance education to the students' cognitive styles appear more important than traditional classroom education. Many suggestions for the instructional adaptation and design of distance education to the characteristics of the students' cognitive styles result from this study. These suggestions involve four major stages of distance education: instructional planning, learning environment construction, teaching method selection, and evaluation administration.

References

Ackerman, P. L., & Woltz, D. J. (1994). Determinants of learning and performance in an associative memory/substitution task: Task constraints, individual differences, volition, and motivation. Journal of Educational Psychology, 86 (4), 487-515.

Allport, G. W. (1937). Personality: A psychological interpretation. New York: Holt & Co.

Amundsen, C. L., & Bernard, R. M. (1989). Institutional support for peer contact in distance education: An empirical investigation. Distance Education, 10 (1), 7-27.

Antonietti, A., & Gioletta, M. A. (1995). Individual differences in analogical problem solving. Personality and Individual Differences, 18 (5), 611-619.

Antonietti, A., & Gioletta, M. (1996). A study of some psychometric properties of the verbalizer-visualizer questionnaire. Journal of Mental Imagery, 20 (3-4), 59-68.

Atman, K. S. (1988). Psychological type elements and goal accomplishment style: Implications for distance education. The American Journal of Distance Education, 2 (3), 36-44.

Ausburn, L. J., & Ausburn, F. B. (1978). Cognitive styles: Some information and implications for instructional design. Educational Communication and Technology, 26 (4), 337-354.

Bartlett, F. C. (1932). Remembering. Cambridge, Mass.: Harvard University Press.

Bates, T. (1986). Computer assisted learning or communications: Which way for information technology in distance education? Journal of Distance Education, 1 (1), 41-57.

Bennink, C. D. (1982), Individual differences in cognitive style, working memory, and semantic integration. Journal of Research in Personality, 16 (3), 267-280.

Bergouist, W. H., Lloyd, J. T., & Johansson, S. L. (1973). Individual differences among repressors and sensitizers in conceptual skills. Social Behavior and Personality, 1 (2), 144-152.

Bissell, J., White, S., & Zivin, G. (1971). Sensory modalities in children's learning. In G. S. Lesser (Ed.), Psychology and educational practice (pp. 130-155). Glenview, IL: Scott, Foresman, & Company.

Bloom, B. S., Englehart, M. B., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (Eds.) (1956). Taxonomy of educational objectives. The classification of educational goals. Handbook I: Cognitive domain. New York: McKay.

Braune, R., & Wickens, C. D. (1986). Time-sharing revisited: Test of a componential model for the assessment of individual differences. Ergonomics, 29 (11), 1399-1414.

Coggins, C. C. (1988). Preferred learning styles and their impact on completion of external degree programs. The American Journal of Distance Education, 2 (1), 25-37.

Crosby, J. (1994). Twelve tips for effective electronic presentation. Medical Teacher, 16 (1), 3-8.

Das, J. P. (1988). Simultaneous-successive processing and planning: Implications for school learning. In R. Schmeck (Ed.), Learning strategies and learning styles (pp. 101-130). New York: Plenum Press.

Dick, W., & Carey, L. (1996). The systematic design of instruction (4^{th} ed.). New York: HarperCollins Publishers.

Dunn, R., DeBello, T., Brennan, P., Krimsky, J., & Murrain, P. (1981). Learning style researchers define differences differently. Educational Leadership, 38, 327-374.

Dunn, R. S., & Dunn, K. J. (1979). Learning styles/teaching styles: Should they … Can they …Be matched? Educational Leadership, 36, 238-244.

Ehrman, M. (1990). Psychological factors and distance education. The American Journal of Distance Education, 4 (1), 10-24.

Gadzella, B. M. (1995). Differences in academic achievement as a function of scores on hemisphericity. Perceptual and Motor Skills, 81, 153-154.

Gadzella, B. M., & Kneipp, L. B. (1990). Differences in comprehension processes as a functional hemisphericity. Perceptual and Motor Skills, 70, 783-786.

Galton, F. (1883). Human faculty and development. London: Macmillan.

Gardner, R. W. (1961). Cognitive controls of attention deployment as determinants of visual illusions. Journal of Abnormal and Social Psychology, 62, 120-129.

Garrison, D. R. (1986). The role of technology. In R. G. Brockett (Ed.), Continuing education in the year 2000 (pp.41-54). San Francisco: Jossey Bass.

Garrison, D. R. (1987). The role of technology in continuing education. New Directions for Continuing Education, 36, 41-53.

Gaspar, R. F., & Thompson, T. D. (1995). Current trends in distance education. Journal of Interactive Instruction Development, 8 (2), 21-27.

Harper, G., & Kember, D. (1986). Approaches to study of distance education students. British Journal of Educational Technology, 17 (3), 212-222.

Holliday, W. G. (1976). Teaching verbal chains using flow diagrams and text. AV Communication Review, 24 (1), 63-78.

Holzman, P. S., & Klein, G. S. (1954). Cognitive system-principles of leveling and sharpening: Individual differences in visual time-error assimilation effects. Journal of Psychology, 37, 105-122.

Hudson, L. (1966). Contrary Imaginations. Harmondsworth: Penguin.

Jegede, O. J., Taylor, J. C., & Okebukola, P. A. (1991). Knowledge engineering: An alternative approach to curriculum design for science education at a distance. Research in Higher Education, 21, 198-207.

Kagan, J. (1965). Impulsive and reflective children: Significance of conceptual tempo, in J. D. Krumboltz (Ed.), Learning and the educational process (pp. 133-161). Chicago: Rand McNally.

Keegan, D. (1986). The foundations of distance education. Dover, New Hampshire: Croom Helm.

Kelly, G. A. (1955). The psychology of personal constructs (Vol. I). New York: Norton.

Kieran-Greenbush, S. (1993). Learning to use the internet: Issues for instructional designers and teachers. In D. Foster, & D. V. Jolly, (Eds.), Proceedings of TEL - ED '93. Austin, TX: Southwest Educational Development Laboratory.

Kirby, J. R. (1988). Style, strategy, and skills in reading. In R. R. Schmeck (Ed.), Learning strategies and learning styles (pp. 229-274). New York: Plenum Press.

Kogan, N., & Wallach, M. A. (1964). Risk-taking: A study in cognition and personality. New York: Holt, Rinehart, & Winston.

Kogan, N. (1971). Educational implications of cognitive styles. In G. S. Lesser (Ed.), Psychology and educational practice (pp. 242-292). Glenview, IL: Scott, Foresman, & Company.

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Englewood Cliffs, NJ: Prentice Hall.

Krumboltz, J. D., Kinnier, R. T., Rude, S. S., Scherba, D. S., & Hamel, D. A. (1986). Teaching a rational approach to career decision making: Who benefits most? Journal of Vocational Behavior, 29, 1-6.

Lauzon, A. C., & Moore, G. A. B. (1989). A fourth generation distance education system: Integrating computer-assisted learning and computer conferencing. The American Journal of Distance Education, 3 (1), 38-49.

Lawrence, G. (1984). A synthesis of learning style research involving MBTI. Journal of Psychological Type, 8, 2-15.

Leithwood, K. A., & Montgomery, D. J. (1982). The role of the elementary school principal in program improvement. Review of Educational Research, 52, 309-339.

Lewenfeld, V. (1945). Tests for visual and haptical aptitudes. American Journal of Psychology, 58, 100-112.

McCarthy, B. (1980). The 4MAT System. Oakbrook, IL: Excel Inc.

McClusky, H. (1976). What research says about adult learning potential and about teaching older adults? In R. M. Smith (Ed.), Adult learning: Issues and innovations (pp. 112-122). Illinois: Northern Illinois University Information Series (No. 8).

McCreary, E. K., & Duren, J. V. (1987). Educational applications of computer conferencing. Canadian Journal of Educational Communication, 16 (2), 107-115.

Messick, S. (Ed.) (1976). Individuality in learning. San Francisco: Jossey-Bass.

Minich, E. (1998, spring/summer). Why do students withdraw from telecourses? Agenda, 16.

Mumford, M. D., & Gustafson, S. B. (1988). Creativity syndrome: Integration, application, and innovation. Psychological Bulletin, 103 (1), 27-43.

Newstead, S. E. (1992). A study of two "quick-and-easy" methods of assessing individual differences in student learning. British Journal of Educational Psychology, 62 (3), 299-312.

O'Boyle, M. W. (1986). Hemispheric laterality as a basis for learning: What we know and don't know. In G. D. Phye & T. Andre (Eds.), Cognitive classroom learning: Understanding, thinking, and problem solving (pp.21-48). New York: Academic Press.

O'Boyle, M. W., & Hellige, J. B. (1989). Cerebral hemisphere asymmetry and individual differences in cognition. Learning and Individual Differences, 1 (1), 7-35.

Pask, G. (1972). A fresh look at cognition and the individual. International Journal of Man-Machine Studies, 4, 211-216.

Peters A. M. (1977). Languages learning strategies: Does the whole equal the sum of the parts? Language, 53, 560-573.

Richardson, A. (1977). Verbalizer-visualizer: A cognitive style dimension. Journal of Mental Imagery, 1 (1), 109-126.

Riding, R. J., & Buckle, C. F. (1990). Learning styles and training performance. Sheffield: Training Agency.

Riding, R., & Cheema, I. (1991). Cognitive styles -- an overview and integration. Educational Psychology, 11 (3-4), 193-215.

Riding, R., & Douglas, G. (1993). The effect of cognitive style and mode of presentation on learning performance. British Journal of Educational Psychology, 63, 297-307.

Riding, R. J., Glass, A., & Douglas, G. (1993). Individual differences in thinking: Cognitive and neurophysiological perspectives. Special issues: Thinking. Educational Psychology, 13 (3 & 4), 267-279.

Riding, R. J., & Rayner, S. (1995). The information superhighway and individualized learning. Educational Psychology, 15 (4), 365-378.

Riding, R., & Sadler-Smith, E. (1992). Types of instructional material, cognitive style and learning performance. Educational Studies (England), 18 (3), 323-340.

Riding, R. J., & Taylor, E. M. (1976). Imagery performance and prose comprehension in 7-year-old children. Educational Studies (England), 2, 21-27.

Robertson, I. T. (1985). Human information-processing strategies and style. Behavior and Information Technology, 4 (1), 19-29.

Sadler-Smith, E. (1997). "Learning style": Frameworks and instruments. Educational Psychology, 17 (1-2), 51-63.

Savard, M., Mitchell, S. N., Abrami, P., & Corso, M. (1995). Learning together at a distance. Canadian Journal of Educational Communication, 24 (2), 117-131.

Schmeck, R. R. (1983). Learning styles of college students. In R. F. Dillon & R. R. Schmeck (Eds.), Individual differences in cognition (pp. 233-280). New York: Academic Press.

Schmeck, R. R. (Ed.) (1988). Learning strategies and learning styles. New York: Plenum Press.

Schofield, N. J., & Kirby, J. R. (1994). Position location on topographical maps: Effects of task factors, training, and strategies. Cognition and Instruction, 12 (1), 35-60.

Sein, M. K., & Bostrom, R. P. (1989). Individual differences and conceptual models in training novice users. Human-Computer Interaction, 4, 197-229.

Smith, C. D. (1988). The educational value of computer-mediated communications. Media in Education and Development, 21 (4), 169-171.

Smith, I. M. (1964). Spatial ability. San Diego, CA: Knapp.

Smith, R. M. (1984). Learning how to learn. Milton Keynes: Open University.

Sonnier, I. L. (1991). Hemisphericity: A key to understanding individual differences among teachers and learners. Journal of Instructional Psychology, 18 (1), 17-22.

Squires, G. (1981). Cognitive styles and adult learning. Nottingham: University of Nottingham.

Tanaka, J. S., Panter, A. T., & Winborne, W. C. (1986-87). Associations between daydreaming style and information processing predispositions. Imagination, Cognition, and Personality, 6 (2), 159-166.

Tennant, M. (1988). Psychology and adult learning. London: Routledge.

Torrance, E. P., & Rockenstein, Z. L. (1988). Styles of thinking and creativity. In R. R. Schmeck (Ed.), Learning strategies and learning styles (pp. 275-290). New York: Plenum Press.

Trevino, L. K., Lengel, R. H., Bodensteiner, W., Gerloff, E. A., & Muir, N. K. (1990). The richness imperative and cognitive style: The role of individual differences in media choice behavior. Management Communication Quarterly, 4 (2), 176-197.

Vicente, K. J., Hayes, B. C. & Williges, R. C. (1987). Assaying and isolating individual differences in searching a hierarchical file system. Human Factors, 29 (3), 349-359.

Watkins, D. (1983). Only rote learning needed at ANU. ANU Reporter, 14 (16), 3.

Watkins, D., & Hattie, J. (1981). The learning processes of Australian university students: Investigations of contextual and personological factors. British Journal of Educational Psychology, 51, 384-393.

Wilson, J. D. (1981). Student learning in higher education. London: Croom Helm.

Winn, W. D. (1982). The role of diagrammatic representation in learning sequence, identification, and classification as a function of verbal and spatial ability. Journal of Research in Science Teaching, 19 (1), 79-89.

Witkin, H. A. (1962). Psychological differentiation: Studies of development. New York: Wiley.

Witkin, H. A. (1979). Socialization, culture and ecology in the development of group and sex differences in cognitive style. Human Development, 22 (5), 358-372.

Witkin, H. A., Moore, C. A., Goodenough, D. R., & Cox, P. W. (1977). Field dependent and field independent cognitive styles and their educational implications. Review of Educational Research, 47, 1-64.

Zalewski, L. J., Sink, C. A., & Yachimowicz, D. J. (1992). Using cerebral dominance for educational programs. The Journal of General Psychology, 119 (1), 45-57.

Online Journal of Distance Learning Administration, Volume II, Number III, Fall1999
State University of West Georgia, Distance Education

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