Learning Styles Again: Where is Empirical Evidence?

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ABSTRACT

Purpose
The purpose of this review was (a) to distinguish what has been empirically proven about learning/cognitive styles from what has popular appeal alone, and (b) to discuss implications for the design of effective and efficient learning experiences for all potential learners.

Lack of Empirical Evidence
No single theory unites the literature on learning styles (BECTA, 2005; Coffield, Mosley, Hall,& Ecclestone, 2004a; McLoughlin, 1999; Stahl, 1999). While it is likely that learners differ in many ways, there is question as to whether these style differences are stable across all situations or whether they vary according to task and environment; and how or if addressing these styles has an impact on learning. The issue of matching a learner to a particular instructional strategy has been fraught with a lack of research demonstrating a relationship between instruction design of learning materials or teaching styles and learning outcomes (BECTA, 2005; Evans & Sadler-Smith, 2006; Hattie, 1999; McLoughlin, 1999; Spoon & Schell, 1998). These issues have further been clouded by commercialization efforts that focus on intuitive appeal of models and instruments over psychometric rigor (Coffield et al., 2004b).

Conclusions
The lack of empirical evidence linking learning/cognitive styles to learning outcomes suggests a rethinking of this topic. The impact of prior knowledge of the learner and nature of the subject matter are stronger partners in the decisions relating to what and how to provide instruction. Opponents and proponents of learning/cognitive styles research have suggested that efforts should focus on examining (a) constructs rather than models and (b) the impact of associated strategies on learning outcomes. Research on prior knowledge, cognitive load, motivation, and metacognition offers promising insights into how to prepare learners to achieve desired learning and performance goals and to become lifelong learners.

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BACKGROUND

The mere mention of the term learning styles causes many in academic communities to cringe; and yet, over and over in the practitioner world we hear that instruction must address individual learning styles. The intuitive appeal of finding a construct to explain individual differences and provide a tailored roadmap for instructional design overshadows the lack of empirical evidence associated with many of the so called learning styles and the tests purported to identify these styles.

Interest in learning styles has gone through various cycles. The search for ways to identify and address individual differences that have an impact on learning has a long history producing inconsistent research results. Early research by Cronbach and Snow (1977) examined the link between learner characteristics and the effectiveness of certain strategies or treatments. Their research into Aptitude Treatment Interaction showed disappointing results, however, and some put the issue to rest. For others, the discovery of ways to identify and address individual differences to improve learning has great appeal and continues to be a research focus. The underlying interest rests in thinking that if we better understand how people learn and the individual differences in the ways people learn, we can design instruction to promote effective and efficient learning. A renewed interest has been generated as instruction has moved from classrooms to independent online environments in which learners must take more responsibility for their own learning.

Efforts to name these differences as learning styles or cognitive styles have resulted in many models and instruments. In their extensive analysis conducted for the Learning and Skills Council and the Department for Education Skills of the United Kingdom, Coffield, Moseley, Hall, and Ecclestone (2004a) identified 71 models, yet concluded that there is no single theory defining what a learning style is and few instruments demonstrate the psychometric properties necessary to meet measurement standards.

The purpose of this review is to shed light on what is known about the individual differences in the ways people learn (referred to as learning styles and cognitive styles) and to identify the implications for the design of effective and efficient learning experiences for all potential learners. This goal includes understanding how individuals learn, process, and recall information. We offer this literature review as a way of (a) sorting out what is proven and distinguishing it from what has popular appeal alone, and (b) discussing the implications from research on this topic in terms of what this means for lifelong learning.

METHODS

This review examined models and the associated instruments purported to asses the characteristics labeled as learning styles and cognitive styles.

Models and associated instruments selected for in-depth review focused on one or more of the following research criteria:

- Findings were published in referred articles or journals
- Models were validated by independent sources (i.e., those other than the author of the model)
- Psychometric properties were reported
- Model was theory-based
- Instrument is used by industry and/or the military

Limitations

The question that continues to surface and perplex researchers is, “Why don’t we know more after so many years of learning styles research?” The answer, at least in part, lies in the fact that learning styles is not a unified field (BECTA, 2005; Coffield et al., 2004a; McLoughlin, 1999; Stahl, 1999). Many terms are used to explain similar concepts. These elegant variations produced multiple models and purported research often examined the impact on small populations for brief periods of time in academic settings. Longitudinal studies are necessary for assessing the impact of styles on learning outcomes. Commercial interests in

instruments derived from some models also tend to promote distinction among models and emphasize surface appeal over psychometric rigor. In this review we distill what is known from various models and their implications based on the Standards for Educational Measurement and Testing (1999) developed jointly by the American Psychological Association (APA) Educational Research Association (AERA), and the National Council on Measurement in Education (NCME).

CLASSIFICATION OF MODELS AND INSTRUMENTS

Terms

The term learning styles has been used as a broad classification within the literature to describe various constructs often with similar properties linking to foundations in psychology, personality, motivation and cognition research. While some question whether this is even a topic that should be researched (Stahl, 1999), much seems to depend on what is being considered a learning style. The most commonly used terms include learning styles, cognitive styles, learning preferences, cognitive preferences and cognitive strategies. Table 1 below provides a concise description of each and illustrates the similarities. These serve as the basis for grouping models in the remainder of this review.

Table 1: Learning Style and Cognitive Style Definitions

Term	Definition
Learning Style	• A tendency to approach cognitive tasks with a preferred strategy or set of strategies, corresponding with a preferred mental set (McLoughlin ,1999)
	• The way a person habitually approaches or responds to a learning task (LSI, 2004)
Learning Preference	• Favoring one method of teaching over another (McLoughlin, 1999)
Learning Strategy	• Adopting a habitual and distinct mode or plan for acquiring knowledge, skills or attitudes (McLoughlin, 1999)
Cognitive Style	• A systematic and habitual mode of organizing and processing information. (McLoughlin, 1999)
	• Cognitive style is cognitive-centered in that it reflects the way an individual person thinks (LSI, 2004, p. 1).
	• Cognitive style refers to an individual's preferred and habitual approach to organizing and representing information (Chen & Macredie, 2004)
Cognitive Strategy	• Adopting an action plan in the process of organizing and processing information. (McLoughlin, 1999)

Conceptualized Relationships Among Constructs

The overlap and interconnectedness of these terms is apparent in the research literature. Several researchers have developed frameworks for explaining the relationships among the models and their constructs. Curry's 'Onion' model (1983) depicts the relationship among learning styles and preferences as layers as illustrated below in Figure 1. The cognitive personality style inner layer is viewed as a stable trait more important to complex learning, while the instructional preferences (represented in the outer layer) is more flexible and less important in learning.

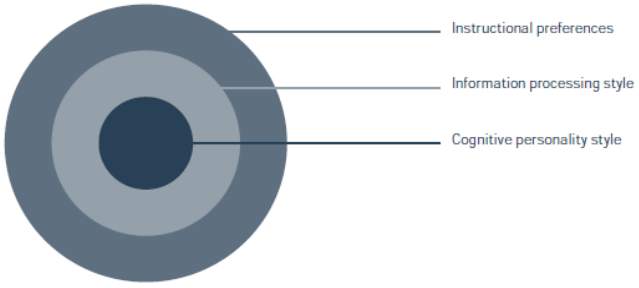
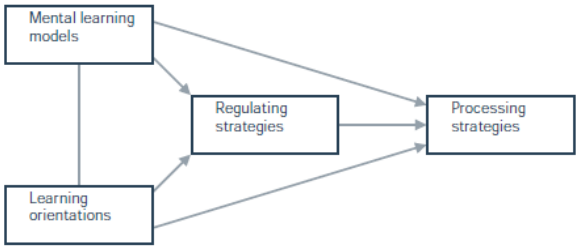


Figure 1: Curry's 'Onion' Model of Learning Styles

Source: Coffield, et al. (2004a)

Sternberg (1997) takes a different view, suggesting that the study of styles can be characterized as those that are (a) cognitive-centered (relating to abilities such as field dependence/independence and reflectivity/impulsivity); (b) personality-centered (relating to factors such as concrete/abstract) and (c) sequential/random ways of processing), and activity-centered (styles that mediate activities of cognition and personality).

Vermunt (1998) provides a different framework (Figure 2 below) to illustrate how an individual's learning style integrates four components of learning. The mental learning models and learning orientations components are considered to be relatively stable; the regulating and processing strategies are considered to be contextually determined. In this interpretation, learning style is viewed as the full range of learning activities that students usually employ, their learning orientation, and their mental model of learning (Pabst, 2006).



Source: Coffield, et al. (2004a)

Figure 2: Vermunt's Model of Learning Styles

Models and Model Families

Fixed or Flexible Elements

While the use of terms may appear to be a choice of personal preference, theoretical distinctions among learning/cognitive models discussed in the sections that follow exist based on the underlying beliefs about the constructs they describe. The importance of understanding whether the model purports to identify (a) a fixed or stable trait—one that can reliably be identified and remains consistent across context, tasks, and time, or (b) a fluid, changeable preference - one that varies depending on context, task and time has important instructional implications.

If one views these traits as constitutionally-based or fixed (e.g., something as permanent as eye color) a diagnostic approach might make sense. The logic would follow that based on the identified learning or cognitive style, (a) specific strategies could be recommended and (b) matching the learning environment to the learner characteristics might be beneficial. This is what the proponents of fixed characteristics have advocated. In contrast, those advocating a more fluid approach, hypothesize that learners would benefit by becoming aware of their preferences and developing a repertoire of learning strategies that could make learning easier for them in varied situations.

After extensive analysis, Coffield, et al. (2004a) developed a classification grouping assigning models to the following based on the extent to which the model depicts the style as a collection of fixed or flexible elements. The classification of family types is described as follows:

- Constitutionally-based learning styles and preferences – Learning styles and preferences are determined biologically and developmentally.
- Cognitive structure – Learning styles are habitual and stable; part of the cognitive system.
- Stable personality type – Learning styles are "one part of the observable expression of a relatively stable personality type."
- Flexibly stable learning preferences – In this family, learning styles are not considered to be fixed, but as preferences that may change given the context. However, there is also the consideration that learning style demonstrates long-term stability at the same time.
- Learning approaches and strategies – This family is defined by fundamental differences in personality and cognitive traits that are reasonably fixed.

Table 2 presents the sixteen models according to this classification framework. These models were selected because (a) their psychometric properties were reported, (b) they were widely used, or (c) they had a theoretical grounding. We have added Witkin's Embedded Figure Test, Midgely's PALS, and Kiersey's, Temperament Sorter to the 13 of the models identified by Coffield, et al. (2004a) as influential.

Table 2: Model/Instrument Descriptions by Family Type

Family	Model/Instrument	Author(s)	Author's Descriptor
Constitutionally-based Learning Styles and Preferences	Gregoric Style Delineator	Gregorc	Learning style
	LSI (Learning Style Indicator)	Dunn & Dunn	Learning style
Cognitive Structure	CSA (Cognitive Styles Analysis)	Riding	Cognitive style
	EFT (Embedded Figures Test)	Witkin	Cognitive style
Stable Personality Type	MBTI (Myers-Briggs Type Indicator)	Briggs & Myers	Personality inventory (preferences)
	KTS – II (Keirsey Temperament Sorter II)	Keirsey	Personality inventory (temperament, character, personality)
	MSP (Motivational Style Profile)	Apter	Indicates metamotivational states
	LSP (Learning Styles Profiler)	Jackson	Learning style
Flexibly Stable Learning Preferences	LSI (Learning Style Inventory)	Kolb	Learning style
	LSQ (Learning Styles Questionnaire)	Honey& Mumford	Learning style
	HBDI (Herrmann Brain Dominance Instrument)	Herrmann	Thinking style
	CSI (Cognitive Style Index)	Allinson & Hayes	Cognitive style
	PALS (Patterns of Adaptive Learning Scales)	Carol Midgley, et al.	Goal orientation
Learning Approaches and Strategies	ASSIST (Approaches to Study Skills Inventory for Students)	Entwistle	Learning style
	ILS (Inventory of Learning Styles)	Vermunt	Learning style
	TSI (Thinking Styles Inventory)	Sternberg	Thinking style

Theoretical and Psychometric Support for Models

Promising Models

Many models purport to identify and measure learners' learning/cognitive style; however, some seem more promising than others. According to Coffield et al. (2004a), the following models demonstrated sufficient psychometric validity and reliability, in the areas of internal consistency, test-retest reliability, construct validity, and predictive validity to be appraised as promising and worthy of continued research.

1. Allinson & Hayes: Cognitive Style Index (CSI)
2. Apter: Motivational Style Profile (MSP)
3. Entwistle: Approaches and Study Skills Inventory for Students (ASSIST)
4. Hermann: Hermann's Brain Dominance Instrument (HBDI)
5. Jackson: Learning Styles Profile (LSP)
6. Vermunt: Inventory of Learning Styles (ILS)

Even among these models research is far from conclusive to date. Findings lack clear direction and perhaps most importantly do not demonstrate an impact on learning outcomes. For example:

Apter's MSP. Test-retest data on adult populations indicate that the instrument's 14 subscales support reversal theory, a theory that examines human behavior and experience as an interplay between motivational states rather than a fixed personality type. While this may provide important clues into changeability of styles over time, as yet, there is no research linking strategies to learning outcomes.

Allinson and Hayes CSI. Offers potential for examining analytical and intuitive orientations; however recommended use for the instrument is in organizational research.

Vermunt's ILS. Reliability estimates and demonstrated validity suggest use of the ILS as a model for linking learning and thinking strategies of university students. Data indicate that the Vermunt's ILS might be most useful as a tool to aid university students in expanding their approaches to learning, and providing a common language for teachers and students to use in communicating about learning. The instrument however is not a strong predictor of learning outcomes (Coffield, et al., 2004a). In addition, analysis of this self-report instrument showed little correspondence between the ILS and student processes as assessed through think aloud protocols. (Veenman, et al., 2003).

Widely Used Instruments

In contrast, some models not only have limited application, as the examples above indicate, they also may lack independent research or psychometric evidence to support their use. Models are widely used for a variety of purposes; however, as a basic measurement course will caution, instruments are only valid if used for their intended purpose. There is no such thing as a valid instrument unless such properties have been demonstrated for a particular use. Yet, some instruments are so popular or because they have been used by others, institutional users may not question the intended purpose or the population on which the psychometric properties were assessed. The three commonly used instruments described below exemplify the impact of intuitive appeal over psychometric rigor.

Dunn and Dunn's LSI. The LSI is a popular learning style model, but has little empirical evidence to support its use. While it does present face validity, it lacks predictive validity. The instrument's intent is to address learner preferences which they suggest may impact adult learners in their motivation (willingness to participate) and in creating an environment that supports or distracts from learning. This model presents the following domains: perceptual, physiological, sociological, emotional, environmental, and psychological.

Myers-Briggs MBTI. The MBTI is one of the most widely used instruments, particularly in the business arena. The impact, however, for educational settings is inconclusive at best, and empirical evidence indicates that matching teaching to style does not positively effect achievement (Coffield, et al. 2004a). Internal consistency and reliability meet psychometric standards; however limited uses of the instrument should be recognized. This instrument may be useful for stimulating discussion in the counseling or employment implications, the use of it to make career decision is not recommended.

Keirsey Temperament Sorter. This instrument is provided as a resource on the US Department of Interior website, attesting to its popularity. It is recommended for use as personal exploration for career counseling. Understanding of personal preferences has not yet been supported empirically (Zachar, 2006).

Promising Construct

Field Dependence/Independence

Both opponents and proponents of learning/cognitive styles research have suggested that future research should focus on the constructs or dimensions included in models. Field Dependence/independence is a construct that many believe has important implications for teaching and learning particularly in distributed learning environments in which students must take more responsibility for their learning (Jonassen & Grabowski, 1993; Kogan, 1971; Riding & Cheema, 1991; Shipman & Shipman, 1985; Witkin, Moore, Goodenough, & Cox, 1977).

Field dependence/independence can be defined as the "degree to which a learner's perception or comprehension of information is affected by the surrounding perceptual or contextual field" (Jonassen & Grabowski, 1993, p. 322). Field dependence is part of the cognitive structure style family of constructs which characterize an individual's preferred and habitual approach to solving problems, thinking, perceiving, and remembering information (Riding & Cheema, 1991). Subtests of the Cognitive Styles Awareness (CSA) test identifying this construct meet psychometric standards; however, the entire instrument is not fully validated or reliable in its entirety (Coffield, 2004; Peterson, Deary, & Austin, 2003).

We provide a discussion of this construct to illustrate several key points.

- Complexity of conducting solid research
- Disagreement about fixed versus flexible foundation for the same construct
- Interrelationship of factors
- Role of learner awareness

Researchers view field dependence/independence differently along the fixed versus flexible continuum. Field dependence/independence and cognitive style in general have been viewed by researchers in three main ways, each with its own implications:

- A fixed factor in the learning environment that can only be accommodated (Witkin, 1971; Riding & Rayner, 1998)
- A process which is amenable to change in the learning environment (Leonard et al., 1999; Murphy & Doucette, 1997; Rush & Moore 1991)
- Both a fixed factor and amenable process that can be modified by environmental factors (Curry, 1983)

Regardless of the lens used to examine the role of field dependence/independence, various authors contend that an awareness of cognitive style is beneficial for enabling learners to undergo reflective learning, recognize and take advantage of learning opportunities, and to deal effectively with learning in challenging situations (BECTA, 2005; Hendry et al., 2005; Jones, 1993; Sadler-Smith, 2004).

Lack of Empirical Evidence Supporting Congruence with Instruction

While efforts have been made to link learner style with teaching style, empirical evidence does not support congruence (More, 1993; Spoon & Schell, 1998). First, as previous discussion of models and instruments shows, empirical support for models and instruments to classify learners are fraught with psychometric and theoretical issues that limit the confidence with which we can distinguish styles among learners. Secondly, studies have typically concluded that of the multitude of factors associated with student performance, most importantly congruence between the identified learning style and teaching style has little impact on outcomes. In a meta-analysis, Hattie (1999) found that factors relating to student feedback, prior knowledge, and instructional quality were found to be more than twice as influential as teacher style.

The nature of the task to be learned plays a key role. Understanding the learning task and determining the best ways to achieve the desired outcomes are among the skills instructional designers and experienced teachers typically consider. The nature of the content and the ways students will use what is learned are important elements affecting design and delivery.

In Sum What Do We Know About Learning Styles?

The research findings in the previous sections can be summarized with the following statements:

- Overall there is a lack of research demonstrating an effect of learning/cognitive styles on learning outcomes.
- Many instruments purporting to identify styles lack the psychometric properties expected for making decisions about learners. Intuitive appeal and face validity of these instruments and models contributed to their popularity.
- No single underlying theory forms the basis for learning style/cognitive research.
- Multiple terms are used to describe learning styles, cognitive styles, and learning preferences. There is overlap among them and inconsistency within them. While some may

question the examination of learning styles at all, this depends on how learning or cognitive style is defined, assessed and the implications to be drawn from the assessment.

- Research on promising constructs within models (i.e., field dependence/independence) highlights both inconsistency within the research community and the potential impact of research on learners.
- Field dependence/independence is the cognitive style dimension which some believe has the most important implications for teaching and learning particularly in distributed environments
- Students may benefit by being aware of the differences in the ways they approach learning and may need to develop a repertoire of approaches to combat any gaps they may have.

Promising Lines of Research and Implications for Learning

Researchers contend that the number of inconsistent and sometimes contradictory findings within the learning/cognitive style literature should shift research from an emphasis on learning/cognitive style models to an emphasis on the attributes or constructs that will aid learners in becoming self-directed (Coffield et al., 2004b; Reynolds, 1997; Sternberg, 2001). While a complete examination of these constructs is beyond the scope of this review, we provide brief discussions of potential areas for further research. Some of the most promising constructs include metacognition, cognitive load, and persistence.

Metacognition

Developing learners' metacognitive knowledge, a general knowledge of cognition and the ability to monitor, control, and regulate cognition may offer a more effective route to developing lifelong learning skills than matching learning styles to specific instructional strategies. Development of each of the three types of metacognitive knowledge described by Pintrich (2002), strategic knowledge (strategies for learning, thinking, and problem solving); conditional knowledge (knowledge about cognitive tasks and which strategies to use for which tasks); and self-knowledge (knowledge of one's strengths and weaknesses) has the potential for facilitating lifelong learning. From a design perspective, knowledge of the learner's metacognitive skills is important for determining the kind of scaffolding to be provided as well as the specificity and frequency of feedback required in the instructional design (Costa, 2001).

Role of Prior Knowledge and Cognitive Load

Learners' greatest individual differences pertain to their prior knowledge and experiences rather than to their different learning styles or abilities (Clark, 1998). Prior knowledge, however, is not just an accumulation of facts; rather learners must be able to access and appropriately apply what they have learned in the past. In fact, experts differ from novices not so much in the amount that they know, but in the way that knowledge is organized (Bransford, Brown, & Cocking, 1999; Chase & Simon, 1973). What adds to knowledge for one group may detract for another group (Kalyuga, Chandler & Sweller, 2001; Schnotz & Rasch, 2005). Recent research on cognitive load focuses on how much information we can take in at a given time to make sense of it all (Sweller, 1988; Clarke, Ayres, & Sweller, 2005). Care must be taken not to overload novice learners who experience frustration and failure with too much information to hold and rehearse in working memory. Experts, in contrast, have an extensive array of experiences stored in rich databases that enable them to taken in new information without overloading their mental resources. Learning experiences must be designed to develop databases with accurate representations and awareness of relationships among them to promote ready access.

Motivational Factors and Role of Persistence

An important construct, especially for online environments in which attrition remains an important concern, is persistence. It is generally acknowledged that online learning "requires a higher degree of self-motivation, self-directed learning, and greater persistence and commitment from the learner" than traditional instruction (Martinez, as cited in LSI, 2004). Current research suggests that traditional measures of learning styles, however, do not impact persistence. A longitudinal study looking at attrition rates among graduate students participating in a distance learning program (n=216) included learning styles as indicated by Kolb's Learning Style Inventory as one of the four predictors for program completion (Terrell, 2005). Terrell concluded that preferred learning style did not affect completion rates and further hypothesized that learning style may have actually changed over the term of the seven year study.

Recent work by Deimann and Keller (2006) provides insights into the challenges of learning in multimedia environments by looking at the impact of cognitive overload, distractions, and navigation problems. Specifically, they examined the role of volition and its role in self-regulation finding that strategies of

scaffolding and prompting enabled students to perform significantly better than those who were not prompted (Stark, Tyroller, & Krause, as cited in Deimann & Keller, 2006). The impact of factors affecting learners' selective attention such as seductive detail (Deimann & Keller, 2006) may also guide in the design and development of effective and efficient instruction for all learners.

What Does This Mean for Designing Training?

Research does not provide compelling evidence to use learning style or preference inventories to test an individual and prescribe an approach for all learning tasks. Research does, however, continue to offer insight into the ways the brain functions to make sense of the environment using all resources available. Efforts to understand how the brain processes information have resulted in a large body of research with an emerging view of the brain as a "complex system that seeks coherence and consistency even as it allows for the detection of novelty and revision of knowledge to form new views of the world (Meyer, 2003, p.1). Rather than focusing on identifying and classifying learners, training designs must be grounded in the science of learning directly addressing today's varied learning environments and guiding learners in developing effective learning strategies.

Next Steps for Research Agenda

More promising lines of research associated with specific constructs addressing efficient and effective learning are identified in the literature. We suggest the following topics as a research agenda:

Measuring the impact of learning strategies based on both subject matter and learners' prior knowledge. Current requirements demand innovative ways based on best practices research to integrate skills development within subject matter content to support learning (Clark & Mayer, 2003, Shulman, 1986). For example, learners, especially those who equate learning with memorizing, may be unaware of deliberate strategies that can facilitate problem solving and decision making (Bereiter, 2002). Embedding these strategies within learning content can promote skill development; however it also stresses the importance of providing skill development by scaffolding for those who require it without slowing down those who have already developed the targeted skills (Van Merrienboer, Kirschner, & Kester, 2003). Research efforts should focus on the types and frequency of strategies such as prompting or reflective activities.

Developing learners' metacognitive skills: Making learners better consumers and more knowledgeable about their own learning. The focus should be on their ability to monitor and assess their understanding and then make accommodations to adjust their approaches when their strategies are ineffective. These skills are particularly vital as learners are required to learn independently and encouraged to seek out learning opportunities. Knowing how one learns and how to adjust to new situations prepares them for success.

Examining factors associated with self-motivation: Promoting persistence and self-regulated learning. As the distributed and blended environments place more responsibilities on learners, they in turn must engage in higher levels of self-motivation, self-directed learning, and persistence than in traditional instruction environments. They are also confronted with the challenges of multimedia learning environments that make them susceptible to factors that can impede the learning process, including cognitive overload, distractions, and navigation problems. Research on strategies to address the relationships among these may provide important direction for improving performance. Opportunities to conduct research in various environments will provide the empirical evidence linking instructional strategies for teaching specific knowledge and skills to desired learning outcomes. Raising the skills and confidence of learners to detect when they are comprehending and progressing successfully may well provide greater benefits than trying to develop instruments to identify the myriad constructs that fall under the title of learning styles.

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