LEARNING DIFFERENTIATED CURRICULUM DESIGN IN HIGHER EDUCATION

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BY

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ABOUT THE AUTHOR

John N. Moye is a native of Jacksonville, Florida, where he attended Jacksonville University. During his undergraduate and master's degree experience, he studied with a series of forward-looking thought leaders in education from which he developed an interest and belief in the science of learning and the power and importance of education for all learners. These interests have accompanied him throughout his career and led to a focus on the performance, effectiveness, and responsibilities of higher education.

Dr Moye continued his pursuit of the science of learning through his PhD studies at Florida State University, where he focused his research in the field of psychophysics. Heavily impacted by the burgeoning field of neuroscience, he examined the response of the human perceptual systems to sensory stimuli as a model for understanding learning as a psychophysical process for individuals and organizations. The conceptual frameworks contained in this text are based on the evidence of the psychophysics of learning that is still emerging in the academic learning literature.

Dr Moye has held curriculum development positions with numerous institutions of higher learning in the United States including Saint Mary's University of Minnesota, Capella University, and De Paul University, Chicago, Illinois, in which he has researched, developed, and applied these approaches to the development of relevant, innovative, and

effective learning environments. In addition, he has contributed to a wide array of other institutions of higher learning as a consultant, which has provided a comprehensive multidisciplinary perspective on the science of curriculum development.

Dr Moye believes the complexity of twenty-first-century disciplines requires a similarly complex approach to curriculum and instructional systems, which ensures access to learning for all learners, increases completion rates, ensures that learning prepares learners for the future, reflects the expectations of the external environment, and promotes life success. The research and development of learning differentiated curriculum for higher education is a focus of his ongoing professional efforts.

PREFACE

This work presents a systematic process for the design of the curriculum at all levels of higher education, which organizes and optimizes the learning experience for learners who pursue it. The learner is the recipient and consumer of the learning planned in a curriculum. To be effective, curricula articulate the intended learning from the perspective of the learner.

This work is intended to function as a quasi-handbook to offer a process without engaging in the broader debates while losing the articulation of thought upon which the system is based. It offers a systematic, aligned, interconnected approach to consider for effective curriculum design, which may be adopted or adapted to address multiple conceptions of the subject.

While there are many design curriculum design strategies in the literature, the growth of curricula designed by theories of learning has steadily grown over the past 15 years and has emerged as a major discussion in the creation of instruction for higher education. This work focuses on the configuration and organization of each component of the curriculum to create the most effective and efficient learning experience *for the learner* (Dinç, 2017). The additional consideration that sets this current offering apart is the use of the psychophysics of learning as the driver in the differentiation of component structure. This approach is driven by the view of the design

of the curriculum as the stimulus for individual learning. In other words, the curriculum is designed to present the shortest path to learning and create barriers to failure by considering the psychophysical attributes of the learner. To design effective learning experiences, defined as those that are successful with 90–95% (educational research significance level) of the learners, requires the designer to understand the performance attributes and processes involved in learning, which is the focus of psychophysical research.

The term "differentiation" describes the design variations created by applying discrete models of learning, instruction, and environment to optimize each component to provide the structure, processes, and conditions for the intended learning. In this design system, differentiation is achieved by using different templates to construct the language and syntax, which communicate the content and the structure of the total learning experience (Goldie, 2016).

The processes and procedures in this work describe a learning-driven, research-informed, and discipline-differentiated approach to curriculum design that is adoptable or adaptable to any learning situation. As proposed by Diamond (1998), the goal is to develop an "ideal" curriculum, which promotes and enhances learning. This approach assumes an "ideal curriculum" to be one that provides intellectual access to the content as the profession defines it (engagement), learning events (learning experiences) that reflect the intellectual organization, the thought systems contained within each discipline or profession (Gardner, 1999), and a learning environment that respects the noncognitive considerations that convert the social constraints of learning into social drivers of learning (Dinç, 2017; Goldratt, 1998). In this system, the overall curriculum structure is categorized by five different models of learning outcomes, including cognition, behavior, values, performance, and competence (Jones, Baran, & Cosgrove, 2018).

Each curriculum contains three functional dimensions of learning. These dimensions include learning engagement, learning experience, and learning environment, which are differentiated to reflect and accommodate the characteristics of the learning and the learner. This differentiation is achieved by applying the research of the psychophysics of perception, cognition, and learning to plan an effective and efficient learning experience (Ausubel, Novak, & Hanesian, 1978; Do Carmo Blanco, 2016: Kricos, Robert-Ribes, & Bernstein, 1996; Maia, Lefèvre, & Jozefowiez, 2018; Tsushima & Watanabe, 2009; Willingham, 2009). The result is a learning-centered curriculum design, which mirrors the intellectual structure of each discipline and the psychophysics of learning (Kornell & Bjork, 2008; Plaisted, Saksida, Alcántara, & Weisblatt, 2003).

This offering provides templates to design each component of a curriculum to facilitate efficient and effective learning. The collection of theories used in this work represent only a fraction of the theories that are available to curriculum designers to configure the components of curriculum (Culatta, 2018; Kebriaei, Rahimi-Kian, & Ahmadabadi, 2015). This group of theories focuses on the intellectual, psychological, and social processes involved in learning from a psychophysical perspective. The strategies and techniques used in this work transfer to other theories to align the curriculum with the faculty's conception of the "best way for a learner to learn the discipline" (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013).

The complexity of contemporary disciplines benefits from a curricular design that brings optimal order to the instructional system (Do Carmo Blanco, 2016: Kricos et al., 1996; Maia et al., 2018; Tsushima & Watanabe, 2009), which provides the scientific basis for this work. The curricula in this work may appear to be quite different than those used in

most institutions of higher education. However, the strategies presented in this work apply equally well to all disciplines, and delivery models as the driver of the design decisions are the psychophysics of the human learning system.

In addition to the content of the discipline, the curricula presented in this system also structure the learning process through the alignment and interconnectedness of the curricular components (Matthews & Mercer-Mapstone, 2018). This alignment and interconnectedness have a powerful effect on the ability of the learner to access the content and intellectually construct the learning. The format and structure of this verbiage are configured by adapting the theories of learning, instruction, and environment as templates with which to design each component to match the unique structure of each discipline.

CHAPTER 1

A SHARED DEFINITION OF CURRICULUM DESIGN

1.1. CURRICULUM DEFINED

As there are multiple meanings of the word "curriculum" in use, it is necessary to define this term as used in this work. This definition is not meant to suggest that this is the "one," "true," or "only" way to conceive of the term, but instead to suggest a useful and practical conceptual framework for curriculum as a multidimensional, dynamic, and causal component of an instructional system (Spelt, Luning, van Boekel, & Mulder, 2017). Since no definition currently exists that meets these parameters, it is necessary to develop a definition to serve as the conceptual framework for this work.

The term curriculum derives from a Latin word (*currere*) denotes "a race course" (Etymology Online, 2018). Educators in the sixteenth century borrowed this denotation for what is now higher education to increase "order" in the learning processes and improve learning (Hamilton, 2013). This etymology of the word creates a metaphor with rich meaning when applied to the design of a learning system. First is the

concept of a race course as a path to follow toward a goal. This concept focuses attention on curriculum as a path to pursue to achieve an outcome. The curriculum itself is not the goal but a path to guide toward a goal, which can be in the form of knowledge, behaviors, values, performance, competence, or other learning outcomes.

This system of curriculum design conceives of a curriculum as a blueprint that articulates and communicates an optimal path to follow to achieve a specified learning outcome. This blueprint creates an implied contract with the learner: "If you follow this plan, you will achieve the outcome." A system of curriculum design assumes the responsibility for configuring the "path" to generate learning success as a professional accountability of the curriculum designer. The goal of the curriculum designer is to create an "ideal" curriculum.

The second concept implied in the etymology of "curriculum" is that a race course offers rails, fences, or limits to prevent "going astray." This attribute of a curriculum embeds strategies that focus the attention and efforts of the learners on relevant activities and excludes activities that distract from the intended learning. This strategy seeks to limit or eliminate the time a learner spends in "off-task" activities that frustrate, disengage, and confuse the learner (Hayes, 2009).

The third implicit concept is the original purpose of the curriculum in education, which was to provide "order" to the learning process and construct the intended learning outcome (Irish, 2005). In other words, a curriculum is a dynamic tool in the learning process, which configures and facilitates the learning process (Galloway, 1971; Laine, Polonyi, & Abari, 2014).

Synthesizing the above information, for this work, curriculum is defined as a coherent series of aligned and interconnected learning events, which transform the content and structure of a discipline into an ordered series of learning

experiences to communicate and define the parameters of learning for the learner.

1.2. PURPOSE AND FUNCTION OF CURRICULUM IN LEARNING

The organization and structure of a curriculum engineers the learning for the learners. The curriculum provides informed order to the learning process (purpose), which allows learners to access (understand) the learning, participate in the instructional events, and benefit from the learning environment (Curry & Wergin, 1997).

In this curriculum design system, three global dimensions are configured to align the structure of the curriculum with the structure of the intended learning. These global dimensions determine a learner's ability to engage with, learn from, and demonstrate the intended learning (Claus, Thomas, & Mads, 2008).

1.2.1. Learning Engagement

The first dimension of curriculum design is the ability of the curriculum to engineer the "learner engagement" with the desired learning. Configuring the components of the curriculum to present the content and organization of the discipline to the learner in a manner that effectively communicates the content of the discipline and engages the learner facilitates learning engagement. In other words, it makes the content (including the organization of that content) accessible (knowable) to learners. The fundamental learning theories provide the best evidence of the most effective ways to differentiate this dimension of a curriculum (Craddock, O'Halloran,

McPherson, Hean, & Hammick, 2013). In this model of curriculum design, templates adapted from these theories configure the instructional objectives to facilitate learning engagement.

1.2.2. Learning Experience

The second dimension of curriculum design is the "learning experience." In this dimension, the curriculum creates an ordered path to achieve the intended learning. The learning experience is composed of three instructional processes: instructional engagement, instructional experience, and instructional environment. The instructional processes adapt fundamental theories of instruction as design templates to order the learning processes. In this model of curriculum design, the instructional components are configured with templates adapted from the theories of instruction to facilitate the learning experience.

1.2.3. Learning Environment

The third global dimension is the learning environment, which promotes the ability of the learners to integrate the learning into their experience. This curricular dimension addresses the noncognitive considerations of learning, which catalyze or inhibit the ability of individuals to learn from the instructional process. The environment generates, promotes, and enhances learning through aligning the instructional processes with the socio-cultural predispositions of a population of learners. These noncognitive considerations may also inhibit, constrain, and reduce learning if they conflict with the implicit social order of the learners. The curriculum

design organizes the learning environment to enhance the learning of all learners. In this model of curriculum design, templates adapted from the theories of social learning configure the instructional environment to order the learning environment.

The configuration of these three curricular dimensions can be differentiated to design a learning experience in which all characteristics align and interconnect to create a learning synergy (Mills et al., 2014). This curriculum design system assumes that each component of a curriculum can be configured to promote and enhance the ability of the learner to achieve the learning objectives. Promoting and enhancing the learning experience facilitates a greater "depth of learning" (Mehta, 2018), which in this system defines academic rigor.

Collectively, the deliberate, differentiated, and evidence-based engineering of the curriculum generates informed order, which was the original intention of curriculum design in higher education (Dym, Agogino, Eris, Frey, & Leifer, 2005; Hamilton, 2013). The use of an ordered or structured learning process results in an effective and efficient learning experience, which facilitates learning. The absolute truth or accuracy of the theories is less important than the order they contribute to the learning process when used as design frameworks (Agarwal, 2018). The effectiveness of the theory as applied to a specific situation is a matter of authentic measurement instead of predictive assumption (Oksiutycz, & Azionya, 2017). Together, these strategies generate a synergy between the design of curriculum and learning, which generates a quantum learning experience (ideal curriculum) where the sum of the learning exceeds the sum of the parts (Hargreaves et al., 2010; Masliani, 2018).

Support for this instructional systems design (ISD) approach (Dick, Carey, & Carey, 2009) is also referred to in

the literature as "brain-based learning" (Boer, Toit, & Bothma, 2015; Jensen, 1995), "learning by design" (Wiggins & McTighe, 1998), multimodal learning (Kress & Sealander, 2012), and problem-based learning, as well as other terms. Each of these systems assumes learning to be a complex, nonlinear phenomenon generated by the articulation (order, interconnection) of the curricular components (Vagle, 2015).

1.3. THE PSYCHOPHYSICS OF LEARNING

To design a curriculum for a human learner requires an understanding of the characteristics of the human perceptual systems and how those systems make sense of external stimuli through all senses. The perceptual response of an individual to an external stimulus is the subject of the field of psychophysics, and the response of each system to an external stimulus has been codified. While this work is not complete, we do have an understanding of the attributes of the human response to external stimuli, which mirrors a learning process (Jaeggi & Shah, 2018).

The science of psychophysics studies the response of the human perceptual and intellectual system to a stimulus (Do Carmo Blanco, 2016; Kricos, Robert-Ribes, & Bernstein, 1996; Maia, Lefèvre, & Jozefowiez, 2018; Skrandies, & Jedynak, 1999; Stevens, 2017; Willingham, 2009; Zirk-Sadowski, 2014). In this system of curriculum design, the curriculum is the stimulus and learning is the response in a coherent learning system.

The global conclusions of psychophysical research studying multiple senses contribute some global considerations for the curriculum design process (Moye, 1991). These are

discussed further in the context of specific curriculum applications and can be summarized as follows:

- Learning engagement is nonlinear. A specific stimulus can produce multiple responses.
- Learning engagement is highly sensitive to initial conditions.
- The learning experience is unpredictable. Specific stimuli produce multiple responses, depending upon the context of the delivery.
- The learning experience does not require complete information to achieve a response.
- The learning experience is a dynamic process. It is the interconnectedness of multiple aligned stimuli that most effectively achieves the intended learning.
- The learning experience is more stable and predictable when it is multidimensional and less predictable when it is unidimensional.
- The learning environment provides the context that stabilizes and catalyzes the response to the stimulus.
- Complexity is more effective than simplicity. Complexity produces durable, long-term learning.

A curriculum plans and orders a process of learning, which is designed to construct learning within an individual learner. The stimulus to the learning process begins with the perception of language, which is structured by the syntax of the language in use. Additionally, the "order" of the words and the "patterns" with which that language is structured can have a significant influence on the processes that transform that stimulus into meaning (Pyc, Agarwal, & Roediger, 2014).

The word choice (content), patterns (structure), and delivery are design variables that can be engineered to produce a plausible response (learning). As a nonlinear, dynamic self-forming (unpredictable) phenomenon, the learning process is highly sensitive to initial conditions. Therefore, the design of the initial conditions (curriculum) is a powerful factor in the learning process (Çetin, Çimen, & Yetkiner, 2016; Nemeth, Janacsek, Polner, & Kovacs, 2013; Zhao, Li, Liu, & Xu, 2017). This factor is discussed in more detail in the next chapter.

The assumption that learning is a response to curriculum design provides a practical strategy for designing a learning-centered curriculum (Hubball, Gold, Mighty, & Britnell, 2007; Irish, 2005; Vaina, Belliveau, Des Roziers, & Zeffiro, 1998; Willingham, 2009). The characteristic of the human perceptual system is an essential consideration of the design of effective curriculum in this system of curriculum design. In a technical sense, the design of a curriculum is a blueprint of the neuro-psychological processes required to achieve the intended learning (Andreatta, 2015; Inglis, 2014; Rohrer, & Pashler, 2010; Vaina et al., 1998).

One of the more relevant findings of psychophysical research is that the brain does not need complete information to make sense of sensory input, which has significant implications for curriculum and learning (Erman, 2017; Kebriaei, Rahimi-Kian, & Ahmadabadi, 2015; Kühn & Stamatescu, 2007; Zhao et al., 2017). The brain accounts for missing information by using the available information as "hints and clues" to inform a perception of the stimulus (Bergmann, Kühn, & Stamatescu, 2009). This characteristic reveals an essential capability of the human perceptual system to "look beyond" the data to find meaning in sensory information (Seitz et al., 2005). For curriculum, this characteristic provides a decision-making framework to design a synergistic