LEARNER MODAL PREFERENCE AND CONTENT DELIVERY METHOD
PREDICTING LEARNER PERFORMANCE AND SATISFACTION

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Dissertation Prepared for the Degree of

DOCTOR OF PHILOSOPHY

UNIVERSITY OF NORTH TEXAS

August 2016

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The purpose of the study was to investigate how the online, computer-based learner’s personal learning profile (Preference), the content delivery method supplemented with visual content based on Neil Fleming’s VARK (visual, aural, read/write, kinesthetic) model (Content), and the interaction of Preference and Content, influenced learner performance (Performance) and/or learner self-reported satisfaction (Satisfaction). Participants were drawn from a population of undergraduates enrolled in a large public southwestern research university during the fall 2015 semester. The 165 student participants (13.79% completion rate) were comprised of 52 (31.5%) females and 113 (68.5%) males age 18-58+ years with 126 (76.4%) age 18-24 years. For race/ethnicity, participants self-identified as 1 (0.66%) American Indian/Alaska Native, 21 (12.7%) Asian/Pacific Islander, 27 (16.4%) Black, non-Hispanic, 28 (17%) Hispanic, 78 (47.3%) White, non-Hispanic, 10 (6.1%) other. Reported socioeconomic status was 22 (13.3%) withheld, 53 (32.1%) did not know, 45 (27.3%) low, 13 (7.9%) moderately low, 16 (9.7%) middle, 8 (4.8%) upper middle, and 8 (4.8%) upper.
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ACKNOWLEDGEMENTS

Appreciation is extended to Jack Baier for his initial insight and guidance, and D. L. Fawcett of SJSU for her unexpected responses and gracious time. Appreciation is also extended to Neil Fleming of VARK Learn Limited for his candid insight and support over many years, Zane L. Berge of UMBC for his quick response and support, and Don Clark of Big Dog, Little Dog for his quick response and support. All the instruments used in this study were used with permission.
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CHAPTER 1
INTRODUCTION

Overview

Marshall McLuhan (1966) believed that the way we interact with information changes us apart from what we learn from the information content; but if the way we interact can impact us, it may also impact the learning process. Similarly in defining human learning, Alexander, Schallert, and Reynolds (2009) said

As mature individuals, we cannot draw aside the veil of life experiences to see the world as we did in our childhood. We may seek to “remember” what we thought or felt, but those memories are never replications or duplications. This phenomenon occurs in part because of the recursive and iterative nature of learning; processes result in products that in turn influence subsequent processes. (p. 180)

McLuhan (1966) observed that computing automation is “an integrated system of information handling” (p. 248) that happens instantly, whereas mechanization automation is done by segmentation; therefore, online learning is the integration of multiple processes that can impact learners immediately. The interaction of human and information processes is called information logistics; and we observe that changes in the recursive sociology of information, learning, teaching, technology, economy, bureaucracy, and education (Rudolph, 1990) created obscure historical synergies that changed information logistics.

Changes in technology (Moore, 1965; Intel, 2005), economic, and bureaucratic synergies that resulted in proliferation of commodity computing (Supercomputer Network Study Act of 1986, High Performance Computing and Communication Act of 1991), and availability of home Internet conditioned education for a revolution in distance-learning programs. Increased online course enrollment created concern for the quality of college and university programs. Garman argued that some trade schools operated as diploma mills creating their own learner-economic
synergies by eliminating teachers and education (as cited in Sawicki, 2006). The United States Senate and House of Representatives responded to this concern in 1992 by amending the Higher Education Act of 1965 that had expanded access to higher education to include funding limitations for telecommunication and correspondence oriented programs that account for at least 50% of all courses (Higher Education Amendments of 1998, 1998; Stedman, 2004) to show support for traditional programs.

Further changes in technology, availability of high-speed Internet (Anderson, Boyles, & Rainie, 2012; Kang, 2010), and desire for increased competition in higher education to reduce costs, prompted the federal government to remove the financial barriers to distance-learning programs in 2005 (U.S. Department of Education, 2005). The U.S. Congress redefined telecommunication, telecommunication courses, and telecommunication students, starting July 1, 2006, to allow for otherwise eligible institutions to participate in the Title IV HEA program funding (Deficit Reduction Act of 2005, 2005). This funding change allowed students seeking “a program of study of [one] year or longer, or a recognized associate, baccalaureate, or graduate degree” (Deficit Reduction Act of 2005, 2005, §481(b), §484(l)(1)), to complete all course-work online. This change also codified accredited virtual institutions and brick and mortar institutions as equal partners competing for both students and funding.

Economic strife and under-employment after 1999 fueled an increase in higher education enrollment for 18 to 24 year olds (Fry, 2009). This increased enrollment led naturally to increased online enrollment because students returning to higher education were likely to have different priorities compared to traditional students. Returning students were looking for ways to accelerate graduation due to family and other obligations (Njumbwa, 2008; Buchen, 2014). Many online courses are asynchronous and offer greater flexibility (Miller, 2015). The impact of
increased reliance on education using online courses, however, is not well understood given that content delivery method taxonomies differ in classification and statistical reliability (Dunn & Dunn, 1975; Dunn & Dunn, 1987; Dunn, Griggs, Olsen, Beasley & Gorman, 2001; Burke & Dunn, 2003; Fleming, 2006). However, it must be acknowledged that online courses represent a fundamental change in information logistics from teacher-centered instruction to student-centered learning (Cubukcu, 2008; Pedersen & Williams, 2004).

Problem Statement

Multiple learning style theories include learner modal preference as a critical factor for learner performance. Learner modal preference interacts with learner performance (Dunn et al., 2001; Li, Zhong, Wang, Guo, & Quan, 2010) and study choices clearly impact learning. Measuring learner performance to establish a basis for funding is being discussed and studied at all levels (The White House, United States Government, 2013; U.S. Congress, 2011; United States, The Web-Based Education Commission [WBEC], 2000). The METRICS Act, focused on elementary and secondary education, died in committee in 2011 (U.S. Congress, 2011), but metric-based funding may be inevitable. President Barak Obama is calling for a new higher education metric and wisely allocated funding to "ensure the best return on investment" (The White House, United States Government, p. 5). Due to scarce academic funding, legislation, and technological advances, student-centered web-based distance-learning programs are being used increasingly in favor of instructor-centered teaching. Therefore, it is important to understand the interaction effect of learner modal preference and content delivery method to determine the impact, or lack of impact, on learner performance and learner self-reported satisfaction.
Purpose of the Study

The purpose of the study was to investigate whether or not the online, computer-based learner’s personal learning profile (Preference), the content delivery method supplemented with visual content (Content), or the interaction of Preference and Content, influenced learner performance (Performance) and/or learner self-reported satisfaction (Satisfaction). Because online learning is the integration of multiple processes, a quasi-experimental, mixed-method, longitudinal research methodology was used to investigate whether the Preference, the Content, or the interaction influence learner performance and/or learner self-reported satisfaction—regardless of whether the influence is positive or negative. Finally, a causal-comparative, mixed method, longitudinal research methodology was used to investigate whether learner demographics and barriers to online learning had positive or negative relationships with Performance and/or Satisfaction to consider which predictors need to be investigated in future research.

Conceptual Framework

The conceptual framework for the study is a synthesis of multiple theories in the absence of a comprehensive web-based online learning theory. Online content is rarely singularly modal due to all the elements that make up a web page: word and screen layout, buttons and icons, and static-images and contextual-interfaces are all information available to the learner. The Dunn and Dunn learning style model (1987) provided a basis for investigating the interaction of content and learner modal preference on learner performance and learner self-reported satisfaction. Dunn and Dunn’s model was developed prior to the development of web-based online learning; therefore online information available to the learner needs to be considered in relation to the model. The human brain perceives the structure of a book differently from text
within an electronic environment (Ackerman & Goldsmith, 2011; Jabr, 2013), so a preference may not translate directly from the physical to the virtual world. The Muilenburg and Berge learning barrier model (2005) identifies which students might face barriers "when attempting to learn online" based on individual differences (p. 29). A general conceptual framework was established linking these theories.

The Dunn and Dunn learning style model is based on grounded theory representing more than 60 university studies over more than 35 years (Dunn, Beaudry & Klavas, 2002; Burke & Dunn, 2003). The Dunn and Dunn model, known as the learning style inventory (LSI), “describes learning style as the way in which twenty-one different elements” (Burke & Dunn, 2003, p. 168), impact an individual’s environmental, emotional, sociological, physiological and cognitive preferences (Dunn & Dunn, 1987). “When students are taught with approaches that match preferences as identified by the learning style inventory (LSI), they demonstrate statistically higher achievement and attitude test scores” (Dunn, 1990). Content delivery method is the lowest level interaction between learner and content that instructors can influence directly. Word and screen layout, buttons and icons, and static-images and contextual-interfaces certainly could be stylistic or strategic choices according to McLuhan (1966), but those choices follow from the content delivery method chosen. Learner modal preference exists in the physiological elements above psychological elements in Dunn and Dunn's learning styles inventory (Hawk & Shah, 2007; Stevenson & Dunn, 2001).

Learning style and instructional preference are unresolved constructs (Pashler, McDaniel, Rohrer, & Bjork, 2008; Fleming, 2006; Keefe, & Ferrell, 1990; O’Neil, 1990). Fleming extended the Dunn and Dunn’s LSI model “discarding the narrower notion of the threesome (V, A, and K)” (p. 44), in favor of recognizing four learner modal preferences: visual (V), aural (A),
read/write (R/W) and kinesthetic (K). Fleming (2006) created the VARK model to examine instructional preference (p. 1), as a single element of learning style, not as a single learner modal preference. The research of a concept neither accepted by all theorists nor able to be statistically substantiated by classical research design is a daunting task. Fleming noted that, “VARK characteristics are not hard-wired at birth. Any set of human preferences is likely to be dynamic rather than static in the long term” (p. 56) and is likely to vary between environments (Rose, Hair, & Clark 2011; Cubukcu, 2008).

The VARK model is based on research in classroom instruction, but it considers all content types available in web-based online learning (Fleming, 2006). Learner modal preference interacts with teaching aids and impacts learner performance and learner self-reported satisfaction (Dunn et al., 2001; Li et al., 2010). Fleming believed learner performance and learner satisfaction may be greater when content delivery method is matched to learner modal preference. McLuhan (1966) suggested that the way we interact with our environment, in the case of online information the way we interact with our content delivery method, may have a message so strong that the content delivery method itself may change the audience apart from the message content, in spite of our will or knowledge to not be changed. This unexpected effect implies the learner modal preference and the content delivery method could have an interaction effect separate and apart from the content itself and impact learner performance and learner satisfaction differently. The interaction effect of both was considered.

McLuhan’s (1966) view also considered content delivery method as a potential barrier in addition to being information. The Muilenburg and Berge Model (2005) included demographics in addition to barriers that impact online learning. Demographic characteristics can be used to consider outcome relationships. Distance-learning places a higher burden on the learner (Rose,
Hair, & Clark, 2011). According to Barker, Pistrang, and Elliott (2002), the "actor–observer effect, is the tendency for people to say that their own behavior is caused by situational factors and that other people’s behavior is caused by dispositional factors" (p. 96). Self-reported characteristics can be seen as threatening to a person’s self-image and are therefore subject to distortion (Walsh, 1967) in addition to bias (Barker et al.). Self-reported material can be suspect depending on the type of material being measured. Objective data can control for error by utilizing specific wording (Crocket, Schulenberg, & Petersen, 1987). Subjective data is more dynamic and by definition is influenced by individual demographics therefore it should be investigated beyond face validity. Peer ratings and informant views are commonly used as validity controls (Crandall, 1976), however, they are not realistic in an online environment; therefore, face validity will be used to evaluate the Muilenburg and Berge Model and statistical analysis will be used for evaluating the integrity of responses to the carefully worded questions. Characteristics that correlate with changes in learner performance and learner satisfaction measures may help predict learner outcomes.

Distance-learning systems were synergized by changes in available technology have utilized varying degrees of multi-modal content (Jones & Knezek, 1994). Online courses represent a fundamental change from teacher-centered instruction to student-centered learning (Pedersen & Williams, 2004; Cubukcu, 2008). Consistent with Pashler, McDaniel, Rohrer, and Bjork (2008), intentional controls and measures need to be incorporated in study designs to investigate learner differences (Dowaliby & Schumer, 1972). Models were chosen to measure student-centered characteristics. The VARK model measures modal preference (Fleming, 2006) and content was created using VARK taxonomies. The quasi-experimental mixed method longitudinal research methodology used the VARK model to investigate Preference, Content,
and their interaction on learner performance and learner self-reported satisfaction. The Muilenburg and Berge model (2005) measures demographics and barriers to distance-learning. The causal-comparative mixed method longitudinal methodology used the Muilenburg and Berge model to investigate demographics and barrier to online learning on learner performance and learner self-reported satisfaction. Because the impact of increased reliance on education using online courses is not well understood and no comprehensive generally accepted web-based learning theory exists, these models are important because together they provide a basis to investigate web-based learning.

Definition of Terms

Content delivery method – content being delivered using aural, read/write, or kinesthetic each supplemented with visual content all based on the VARK model.

Learner modal preference – VARK model measured learner modal preference developed by Neil Fleming.

Learner’s personal learning profile – learner modal preference.

Learner performance – pretest, matching posttest, and content module performance scores on continuous ratio scale 0 to 10 on each measure.

Learner satisfaction – mean of eight content module satisfaction scores on continuous ratio scale 0 to 7 each.

Learning stimuli – five level taxonomy of environmental, emotional, sociological, physiological and cognitive hemisphere preferences (Stevenson & Dunn, 2001, para. 5).

Learning style – "Characteristics and preferred ways of gathering, organizing, and thinking about information" (Fleming, 2006, p. 1).
Learning style inventory – "Eighteen or more different elements [that] may affect the way a person learns" (Dunn & Dunn, 1975, p. 44).

Read/write – Content primarily based on alphanumeric text representations of verbal language.

Research Questions

The following research questions were formulated to accomplish the purpose of the study:

1. What is the effect of learner modal preference on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

2. What is the effect of content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

3. What is the interaction effect of learner modal preference and content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

4. What is the effect of learner modal preference on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

5. What is the effect of content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?
6. What is the interaction effect of learner modal preference and content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online, computer-based learners?

Significance of Study

Research theorists suggest that learner modal preference as a part of learning style makes a difference to both learner performance and learner satisfaction (Dunn et al., 2001); however, there is no consensus that learning styles even exist (Henry, 2007; Greenfield, 2007). Because learner modal preference interacts with content delivery method and content delivery method is a fundamental part of learning style, if learning style makes a difference then learner modal preference and content delivery method play a part in that difference. We can consider removing learner modal preference and content delivery method from future discussions on what impacts learner performance and learner self-reported satisfaction if we can show that learner modal preference (Preference), content delivery method (Content) and the interaction of Preference and Content do not make a statistically significant difference to outcomes. However, if we can show that the Preference, Content, or the interaction effect do make a statistically significant difference, then higher education distance-learning programs may need to design their programs with respect to learner modal preference and content delivery method in order to be fair to all learners (Baldwin & Sabry, 2003, November; Junus, Santoso, Isal, & Utomo, 2015). The study examined learner modal preferences, content delivery method, and the interaction effect of each on learner performance and learner self-reported satisfaction to inform future distance-learning discussions.
CHAPTER II
LITERATURE REVIEW

Overview

This chapter provides the review of literature addressing conflicting information and challenges related to distance-learning. Over the last few centuries, studies have been conducted to define constructs that model human behaviors (Gardner, 2006). Various attempts have been made to define and investigate human learning (Gray, Jung, Watson, Jia, & Frick, 2012).

New technologies have developed quickly and scholars have had to consider a new definition of learning (Alexander, Schallert & Reynolds, 2009). Many studies have focused on the relationship of humans to various forms of information (Dunn & Dunn, 1987; Fleming, 2006). Quantitative methodology models are taxed by qualitative constructs and individualized experiences.

Although the researchers have used similar theoretical models, strife continues to challenge acceptance of most axioms. Previous scholarly research focused on the issues impacting and relevant to technology-based distance-learning. This review of literature was important to examine popular constructs of learning, models of modal preference, identify conflicting information, develop theoretical research methods, and propose suggestions for future research.

Educational Psychology

Houwer, Barnes-Holmes, and Moors (2013) said that learning has been a central topic in the study of psychology since its inception, and went on to state that the concept of learning is broad and abstract. In trying to define learning, Alexander, Schallert, and Reynolds (2009) constructed their own word out of fear of prior connotations, but failed to discuss learner fears.
They established as their first principle that “learning is change” (p. 178). Econ (2013) held that this principle is deficient, in that it ignored internal “existing sources of knowledge and expertise” (p. 113). Econ suggested that sometimes we are staged to learn using existing knowledge and simply make connections using “symbolic learning” (p. 113). Alexander, Schallert, and Reynolds (2009) acknowledged a “primordial matter from which learning emerges over time” (p. 182), but stopped short of recognizing *symbolic learning*. At the synaptic level, a neurologist might argue these connections represent a physical change in our brain, and, to their credit, Alexander et al. acknowledged that “change might be understood as arising from the evolved, innate processing capabilities of the human brain/mind” (p. 178); but then they posited “change that happens in the learner, be it dramatic or imperceptible, or immediate or gradual, exerts a reciprocal effect on the learner’s surroundings” (p. 178). While this was consistent with most textbook definitions of learning (Houwer, Barnes-Holmes, and Moors, 2013), it dismissed the importance of learning basic facts that might later help us understand something more complex. This overt display is inconsistent with Econ’s *symbolic learning* and implied that knowledge must be displayed to exist, even though Alexander et al. (2009) contradicted this point later calling learning tacit and below the surface.

Alexander et al. (2009) discussed both education and psychology and determined that “learning refers to both a process and a product” (p. 180); however, that blurred the line between information and education, facts and knowledge, and learning and doing. Consistent with Slepkov (2008), Alexander et al contended that “any comprehensive rendering of learning must regard this construct as both process and product” (p. 180). This clearly ignored the situation in which the process has already taken place, and the product is simply a new symbolic awareness consistent with Econ (2013).
In the presence of philosophical disagreement, Alexander et al. (2009) even admitted to trying to set aside “personal agendas and theoretical perspectives” (p. 177), yet they still experienced conceptual barriers threatening to end their efforts to define learning. Muilenburg and Berge (2005) and Jones and Knezek (1994) noted that learners also experience barriers, but even a generally accepted theory that defined human learning fifty years ago would have been missing the psychological barriers of humans to online environments and learner-centered technology fears in the absence of instructor-led classes (McCombs, 2015) because online learning did not yet exist. At best, changes in technology and access to technology have extended the definition of learning and at the same time complicated how we determine when learning occurred.

Higher Education

Layton (1999) reported and Russell (1999, 2001) argued that in 355 studies no significant difference was found when comparing distance-learning to alternate methods. Rightly so, Oblinger and Hawkins (2006) countered “that to receive a valid answer, one needs to ask a good question” (p. 14). According to Layton, the question Russell asked had compared distance-learning to alternate methods, and argued “few studies, if any, studies were located in which the employment of technology for purposes of providing instruction or teaching was found to be statistically significantly superior in terms of learning to other modes of instruction” (p. 142). Pedersen and Williams (2004) reported that how online assessments are measured is of little concern to students, but consistent with traditional research they found that students performed better when they knew they would be graded. Muilenburg and Berge (2005) questioned how “a great deal of evidence exists showing that no significant differences should be expected.
regarding the effectiveness of well-designed online learning compared with well-designed in-person learning” (p. 29), and yet students’ perceived the experience differently.

Contrary to Russell, the question McLuhan (1966) asked concerned the effect of the medium and argued that “all electronic forms whatsoever have a decentralizing effect, cutting across the older mechanical patterns” (p. 185). McLuhan’s finding is at the very least consistent with Chang and Smith’s (2008) observation that online education had shifted to a learner-centered teaching style and Cornelius-White’s (2007) assertion that positive online instructional relationships used constructivist learner-centered models (p. 113). McLuhan further noted that computing technology advanced from performing calculations to theoretical modeling real problems, but computing technology has also had significant deficiencies. Jabr (2013) in a Scientific America advertisement noted that “research suggests that reading on paper still boasts unique advantages” (p. introduction). Jabr was referring to Ackerman and Goldsmith (2011) who observed that learning and performance differences existed between on-paper and on-screen learning. This was consistent with the findings of Dillon, McKnight and Richardson (1988) who found that “by far the most common experimental finding is that reading from screen is significantly slower than reading from paper” (p. 457). Ackerman and Goldsmith summed up the findings as “slower, less accurate, more fatiguing, accompanied by reduced comprehension, and subjectively less effective than reading from paper” (p. 18). While Ackerman and Goldsmith questioned the validity of the older study, they found that recent studies “indicate a dislike of on-screen reading even among young adults studying with current state-of-the-art displays” (p. 18). The various sizes of computer monitors has required information to be reformatted dynamically and the devices used to access the information have supported varying
versions of software. Software development has always lagged behind hardware (Salchow, 2011) and research on distance-learning has trailed them both.

Alexander, Schallert, and Reynolds (2009) identified the duplicity of meaning that scholars struggle with researching online learning in the following way,

One of many domains in which contextual influences have been studied is reading. Context has come to mean many things within this domain. It sometimes pertains to the texts themselves, including their organization, structure, and features (Chambliss & Calfee, 1998; Meyer & Poon, 2001; Schallert, 1976). Context can also refer to the physical place in which the reading occurs, such as in the home (Purcell-Gates, 2007), in the classroom (e.g., reading class or other content domains; Jetton & Alexander, 2004), or in out-of-school environments (e.g., libraries, museums, or everyday locales; Moje & O’Brien, 2001). Or it can relate to the mode or medium of delivery, (e.g., online or hypermedia environments; Leu et al., 2007). Also, the where of reading can focus on the human resources that are present and that may serve to facilitate or inhibit the learning process or its outcomes. (p. 183)

Similarly, Fleming (2006) had found that humans identify with multiple modal preferences and that those preferences change over time. Consistent with Alexander, Schallert and Reynolds (2009) and Bourne, Harris and Mayadas (2005), Jones and Knezek (1994) noted that as the cost of technology decreased, and the abilities and availability of the personal computer increased, the changes in technology and cost sparked a change in business and education practices. Like Jones and Knezek, Shachar and Neumann (2010) also found that changes in commodity computing power and high-speed Internet had allowed home and mobile computers access to high-bandwidth content delivery methods: audio, videos, and graphics. Consistent with Finn (2015), Shaw, Tham, Hogle, and Koch (2015), and Yoo and Huang (2013), Buchen (2014) also found these changes had prompted higher education to include a wider-range of content delivery types, to create more online program, and encouraged older populations to utilize online learning programs due to their own personal complex needs.
Instructional Design

Consistent with Owusu-Ansah, Neill, and Haralson (2011), although technology enhancements and cost reductions were desirable, Chang and Smith (2008) argued that there was insufficient time for traditional higher education institutions to effectively manage increased demand at all institutional levels: marketing, financial-aid, and instruction. They went as far as to note that some instructors were unprepared for “the shift from the traditional teacher-centered to the learner-centered teaching style” (p. 409) because they lacked knowledge of online course design and available tools. Chang and Smith also found that other instructors simply doubted that real-time classroom concepts could work in an online environment, therefore made no effort to change the content for online environments. Further, Chang and Smith found that some courses simply had used the online learning tools as a way to share documents.

Christie and Jurado (2009) offered a brighter outlook concerning online pedagogy. They had studied teacher perceptions toward learning management systems (LMS) and found that most instructors expected expanded use, perceived benefits for students as well as instructors, and possessed positive attitudes toward LMS. Conversely, while Chang and Smith (2008) had noted the importance of including learner concerns in learner processes, Christie and Jurado had noted teachers are indecisive when considering the LMS and teaching processes. This suggested that teachers in the Christie and Jurado study see the LMS as a tool for learners and a tool for teachers, but not as a tool for effective communication between learner and teacher. This was more consistent with Chang and Smith’s concern that some only see online environments as a learner or teacher tool, but not as a medium for effective communication between them. However, Chang and Smith agreed with Christie and Jurado that online content is presented to the learner to provide a learning opportunity, and this may have been the basis of Christie and
Jurado’s concern. In the absence of the ability to control the learner’s online experience, the teacher’s may have felt that the lack of control was a barrier to instruction. This may have implied the teacher’s did not understand how constructivist theory related to learner-centered instructional design in an online environment (Burns, 1998).

Content Validation

Salmon and Wright (2014) noted that advancements in technology and appropriate training on those advancements can shorten the time it takes to establish a course online, but expert review and input was still necessary to verify and validate online content. Further, they noted the verification and validation process was inherently time consuming. This was consistent with McCombs’ observation in Howell, Williams, and Lindsay (2003), that “instructional approaches are becoming more learner-centered: recursive and non-linear, engaging, self-directed, and meaningful” to the learner (p. sect 16), but logically review could only happen after a course is established online. Creating quality computer-based content was, therefore, a function of the time taken to create and review that content and the technology used to present that content.

Although researchers struggled with how to define learning, McComb (2015) held that “research over the past fifteen years has led to a research-validated definition of ‘learner centered’ in a variety of online and traditional classroom and school environments” (p. 57). Consistent with Howell et al. (2003), Deal (2003) suggested online content is considered cheaper than traditional content because materials do not have to be reprinted to be updated. Nichols (2010) also noted online content was also considered flexible because content can be dynamic and focused for each learner; however, Miller (2015) and Locatis, Gaines, Liu, Gill, and Ackerman (2014) warned that limitations of online environments, complex tools, training
constraints, and lack of administrative support can make updates more cumbersome. Salmon and Wright (20014) and Christie and Jurado (2009) similarly advised that the time required to properly review proposed changes and update production systems can be exacerbated by these type of limitations and impede effective learning opportunities.

Human Development

Eliot (1971) suggested that the human base-function has not appreciably changed, despite the vast changes that have occurred in man’s behavior and culture since the emergence of Homo Sapiens a quarter to half million years ago. “In addition, McLuhan (1966) quoted Jung to note that the subconscious is affected by our surroundings and interactions whether or not we are aware we are changing. McLuhan went on to discuss Roman slavery. The slave and his psychology flooded ancient Italy, and every Roman became inwardly, and of course unwittingly, a slave. McLuhan noted that living constantly in the atmosphere of slaves, he became infected through the subconscious with their psychology. McLuhan felt no one could shield himself from such an influence. He was suggesting that the way we interacted with our environment, in the case of online information our content delivery method, may have had a message so strong, in and of itself, that it changed the audience apart from the content message and in spite of our will or knowledge to not be changed. Conversely, Carr (2011) discussed this same point stating:

The technology of the medium, however astonishing it may be, disappears behind whatever flows through it – facts, entertainment, instruction, conversation. When people start debating (as they do) whether the medium’s effects are good or bad, it’s the content they wrestle over. (p. 2)

This narrow view may be shaped more by Carr than by McLuhan. For the first few decades after the invention of the television, parents warned children not to sit too close to televisions for fear of radiation – the medium was the danger not the message.
Focusing on the content of the message may be more a change in societal focus than abandon of medium concerns but it does highlight a problem: the message needs to be communicated. While McLuhan (1966) argued that the medium is the message as much as the content of the message itself, Chang and Smith (2008) and Christie and Jurado (2009) argued that online tools are not seen as effective communication mediums. Howell et al. (2003) argued that as learning becomes more mobile, how to utilize technology become more important. Duncombe (2011) similarly observed, that “as adoption of mobile phones increases it becomes important to research and understand their impact” (p. 268). This is different than understanding an industrial change in automation technology, because mobile computing has increased access to the information in those messages that need to be communicated, provided varied experiences based on the type of device the operator used, and extended the subjective experience of education globally.

Paradigm Shift

Jung (1928) noted “The mind would be well understood to be a system of adaption formed by conditions of an earthly environment” (p 99). Piaget (1963) made the same point, but placed the environment in action in the following passage,

Mental assimilation is thus the incorporation of objects into patterns of behavior, these patterns being none other than the whole gamut of actions capable of active repetition. Conversely the environment acts on the organism and, following the practice of biologists, we can describe this converse action by the term "accommodation", it being understood that the individual never suffers the impact of surrounding stimuli as such, but they simply modify the assimilatory cycle by accommodating him to themselves. Psychologically, we again find the same process in the sense that the pressure of circumstances always leads, not to a passive submission to them, but to a simple modification of the action affecting them. This being so, we can then define adaption as an equilibrium between assimilation and accommodation, which amounts to the same as an equilibrium if interaction between subject and object. (p. 185)
Piaget stated further, “Now in the case of organic adaption, this interaction, being of a material nature, involves an interpenetration between some part of the living body and some sector of the external environment” (1963, p. 8). McLuhan (1966) argued the same point more concisely, noting how technology integrates and automates with its own message apart from the content. Stated differently, Jung, Piaget and McLuhan were saying that learning happens naturally as the result of the interaction between a learner and a content delivery method.

McCombs (2015) would argue that web-based online learning is student-centered learning, but the content delivery method is the course and the instructor in a real sense. Fleming (2006), Dunn and Dunn (1987), and Piaget (1963) agreed with Alexander, Schallert, and Reynolds (2009), acknowledging that it is well-understood that different students learn differently at different times in their lives; therefore, electronic-content is a good choice for servicing various student needs because it can be dynamic (WBEC, 2000). Zabkar et al. (2015) agreed that the dynamic features of automation are important because learning is at best categorized as a qualitative science if for no other reason, than “people most often reason qualitatively” (p. 1604).

Table 1

*Dunn and Dunn’s Learning Styles Inventory*

<table>
<thead>
<tr>
<th>Stimuli</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENVIRONMENTAL</td>
<td>Sound, Light, Temperature, Design</td>
</tr>
<tr>
<td>EMOTIONAL</td>
<td>Motivation, Responsibility, Persistence, Structure</td>
</tr>
<tr>
<td>SOCIOLOGICAL</td>
<td>Self, Pair, Peers, Team, Adult, Variety</td>
</tr>
<tr>
<td>PHYSIOLOGICAL</td>
<td>Perceptual, Intake, Time of Day, Mobility</td>
</tr>
<tr>
<td>PSYCHOLOGICAL</td>
<td>Analytic, Global, Reflective, Impulsive</td>
</tr>
</tbody>
</table>
Scholarly Consensus

Dunn and Dunn’s (1987) seminal work on the Learning Style Inventory (LSI) considered the qualitative impact an individual’s environmental, emotional, sociological, physiological and cognitive preferences might have on their learning experience (Dunn & Dunn, 1987). The LSI model is shown in Table 1. Stevenson and Dunn (2001) noted that it was only recently that brain hemisphere dominance was included in learning style considerations, to suggest that the way we build mental maps matters to learning—global as opposed to analytical views.

Dunn and Dunn (1987) as well as Fleming (2006) argue that students are more satisfied when they content matches their learning preference. Similarly, Manochehri and Young (2006) found no significant difference based on learning style, they did find a significant difference based on teaching methodology in looking at classroom versus web-based instruction. Conversely, Chang and Smith (2008) found that the instructor-student and student-content interactions mattered, and that prior experience with content was not statistically significant. Interestingly, Jan (2015) argued that learner satisfaction is more a measure of academic self-efficacy and prior experience in online environments than teaching methodology.

Glasser’s choice theory (1997) suggested students will do what is most satisfying even in the face of knowing they are being graded. Similarly. Ford-Conners, Dougherty, Robertson, and Paratone (2015) identified teaching actions rather than grades as motivators of student engagement. This suggested that educators have a responsibility to motivate students to engage learning material, separate and apart from the student goals; therefore, online content has to motivate and engage learners as well.

Ford-Conners et al. (2015) was consistent with Glaser’s (1997) finding that students come to education with various needs; therefore, online educational environments may have a
largely diverse and highly susceptible audience. *Choice theory* suggested that if the content was not in some appealing form matching the student’s preference, student's would be responsible for motivating themselves to find something satisfying about the course material or they may choose to do something else. This meant poor course design or delayed changes to address design issues may disserve some students and ultimately cause affected students to change programs, change schools, or exit education. Howell et al. (2003) found contradictory information regarding online education’s impact on retention and attrition; however, consistent with Smith (2014), one point was clear—retention and attrition concerned educational institutions.

Eagle and Brennan (2007) found that students were not oblivious to their impact on educational institutions. Eagle and Brennan reported recent trends in higher education focused on students as consumers. Sultan and Wong (2012), Hemsley-Brown and Oplatka (2010), and Korisa, Örtenblad, Kerema, and Ojala (2015) all observed that higher education was marketing education using business models to student-customers. Consistent with the WBEC (2000), Mourad, Ennew, and Kortam (2010) and Korisa et al. (2015) identified available options, convenience, and flexibility as key factors that concerned students. The WBEC (2000) directly linked business and education by stating that "business should play a much larger role in helping schools make technology support their educational needs" (p. 121) and supporting choice for the future. Consistent with Mourad, Ennew, and Kortam, Eagle and Brennan warned that students presented with a choice may be motivated to try other institutions when online course work was perceived as unfair or too complex to matriculate, and may adopt a consumerist perspective expecting higher grades. Korisa and Nokelainen (2015) found conflicting studies on student-consumer expectations with respect to grades, and reported that they found students’ generally did not expect grading to be student-oriented.
According to Mourad, Ennew, and Kortam (2010), economic conditions, changes in educational models and utilization of business practices in administration created increased attention on higher education. Korisa et al. (2015) argued that some believed higher education institutions are expected to brand themselves and market their university as a product while others believed this cheapens higher education making it a training provider (p. 31). This was not inconsistent with states and the federal government tying funding to proof that education is working (The White House, United States Government, 2013). Global economic constraints caused stake holders at all levels to demand proof that students are learning.

The WBEC (2000) reported that increased stake holder interest to reduce waste and promote economies of scale in educational funding while showing effectiveness were requiring universities and colleges to create constructs that measured success in new ways. Educational efficacy metrics had been a recent trend in higher education to respond to that new focus. The founder of the Online Education Database (OEDb), Hagans reported, "that there were no mainstream rankings for online schools" before the OEDb (as cited in Kolowich, 2009, para. 4). According to Hagans, the OEDb used eight metrics, but this did not imply they are accepted or accredited by any agency. The article highlighted the importance of knowing how programs rank, but did not establish even a baseline for accepted metrics. In fact, according to Hagans in Kolowich, the OEDb published all their raw data "so people can produce their own rankings if they want" (para. 7).

Educators at each higher education institution have had to decide what is necessary for online learning in the absence of a global metric. Jones and Knezek (1994), warned of the false assumption, "that higher bandwidth (greater capacity) in a delivery system, which enables greater fidelity and interactivity, directly translates into better learning" (p. 6). They also noted
that more bandwidth provides the flexibility to design courses that use technology with greater bandwidth requirements, but more bandwidth does not guarantee a "successful teaching-learning experience" (p. 6). Higher education has a duty to understand how content delivery method impacts student learning and satisfaction due to the possible impact on completion rates and funding, but there is no global or national consensus of which metric to use.

Learner Models

According to Fleming (2006), the VARK model, a construct based on the Dunn and Dunn’s (1987) Learning Style Inventory (LSI), has been used around the world as a popular measure of learner modal preference (Preference). Sinclaire (2012) found no overall difference in Preference between traditional classroom and online students, and no overall difference in satisfaction by student Preference, however she did note a statistically significant difference in satisfaction between traditional classroom and online students. As noted in Sinclaire, this is in stark contrast to Manochehri and Young (2006) who found higher student-based satisfaction with traditional classes.

Leung, McGregor, Sabiston, and Vriliotis (2014) found a significant difference between when comparing learner performance between traditional classroom micro and macro-economic courses. Conversely, Urval et al. (2014) using the VARK and Lu, Yu, and Liu (2003) using Group Embedded Figures Test (GEFT) found no relationship. While Urval et al. focused on the influence of sex and academic performance in traditional classroom courses of medical students and found that while learning style preference, more concisely Preference, is not influenced by gender and has no relationship to academic performance, conflicting results have been found in the few studies that were available for comparison,

A study among nurses showed a correlation between good performance and multimodal learning. However, a similar study among dental students showed no statistical
association. Two studies among physiology students showed a relatively poor performance by students who preferred the kinesthetic modality. Similar to the influence of sex, no generalized conclusions could be drawn with regard to the influence of academic performance. (p. 219)

Similarly, Lu et al. (2002) also reported in Urval et al. (2014),

found that graduate students’ learning styles, patterns of learning in a WebCT MIS environment, and demographic factors, such as gender, age group, job status, number of Web-based classes taken, and number of MIS classes taken, did not have any [statistically] significant impact on learning performance in the class. (sect. discussion)

Consistent with Urval et al. (2014), Dowaliby and Schumer (1972) suggested that content method did not make a difference in "college classroom instruction" (p. 125). Consistent with Dowaliby and Schumer, Greenfield (2007) argued learning styles, which included content methods, are nonsense that attempt to explain complex processes (p. 25). Shayo et al. (2012) offered additional concerns based on Mayer’s research, suggesting that information needed to be presented in narration rather than text-based and that animation needed to include narration, and Shayo et al. warned that phonological and visual/spatial refresh overload may be a problem for some learners. In the presence of such conflict, clearly modal preference has been a complicated issue; however preference is more than choice, in some cases it was inherent in the context of information.

In discussing learning, Fleming (2006) described multimedia as a mix of content methods including visual, aural, read/write (text-based), and kinesthetic methods. Kinesthetic learning is a form of learning by doing and repetition, and according to Fleming, it could be represented by images, movies and animated websites. However, Fleming (2011) also noted that kinesthetic content could include lecturers that use real world examples. Contrary to Fleming, Greitzer identified muscle memory as an example of kinesthetic learning developed over time. This issue
is consistent with the controversy over the definition of learning as a process and a product, however here the issue is *content movement* versus *learner movement*.

While McLuhan (1966) might have argued differently, Sheedy, Tai, Subbaram, Gowrisankaran, and Hayes (2008) argued that visual content is not the dot images themselves we call pixels on computer screens, but the way these pieces come together in the medium: spacing, kerning, placement, white-space, grouping and symbols. Jones and Knezek (1994) argued that online learning environments utilize multi-modal systems, this is to say they may utilize read/write and kinesthetic content but offer visual navigation cues like arrows or buttons. Consistent with Jones and Knezek, Fleming (2006) encouraged curriculum designers to consider online content types and noted that screen-based research in scarce and inconclusive with respect to modal preference. Dowaliby and Schumer (1972) had suggested that online, "it may be that the only way to detect treatment differences is to incorporate into the designs and analyses relevant individual difference measures" (p. 126). Shayo et al. (2012) focused on access and overload of impaired learners, but noted that stress and fatigue can impact all learners. Palmer, Economou, Cruz, Abraham-Cook, Huntington, Maris, Makhija, Welsh, and Maley (2014) however, were more cautious and warned that “little is known, however, about how these effects impact learning challenges when compared to their counterparts without learning difficulties” (p. 198). Although these individual differences are yet to be understood, many studies have been done to assess the learner to determine the most effective instruction.

Inconsistent Terminology

Gardner (2006) reported that more than one-hundred years ago developing testing methods to understand students became critical due to unexpected cultural and social changes. According to Gardner, early studies like focused on evaluating human intelligence. He even
noted that in America and Europe the Scholastic Aptitude Test (SAT) began what would eventually become a required test for college admission; however aptitude and intuition definitions are sometimes confused and accepted definitions are unclear.

Common definitions for aptitude ranged from "innate or acquired capacity for something" (Dictionary.com, 2013) to "acquired or natural ability for learning and proficiency in a specific area" (BusinessDictionary.com, 2013) to "tendency to a particular action" (ThinkExist.com, 2013). Formal definitions for aptitude have changed with use. Buckley, Kavanagh, Traynor, and Neary (2012) used the common definition of an "innate ability" (p. 116). Schunk (2008) used a less technical definition so broad it obscured the meaning, "aptitudes are student characteristics, for example abilities, attitudes, personality variables, and demographics" (p. 304).

Common definitions for intuition ranged from, "the quality or ability of having such direct perception or quick insight" (Dictionary.com, 2013), to "unconscious thought process that produces rapid, uninferred knowledge" to "any object or truth discerned by direct cognition" (ThinkExist.com, 2013). Formal definitions also varied widely within studies. Anderson (1926) quoted Fritz-James Stephens to define intuition in two ways "talent of judging right upon imperfect materials, [and of] making a wise choice between several possible views" (p. 365). Dearborn (1916) directly addressed the multiple definition issue, "it has been pointed out that there are in the present mind of philosophy at least three more or less distinct concepts labeled intuition" (p. 456), but goes on to name four: "unlearned primary truth", "insight into foresight" (p. 465), "Bergson--'instinct become disinterested'", and "insight in regard to the future" (p. 466).

Gardner (2006) offered a “pluralist view of the mind, recognizing many different and discrete facets of cognition, acknowledging that people have different cognitive strengths and
cognitive styles” (p. 5). This was consistent with Fleming’s (2006) flexible model of learning preferences that changed slightly over time, and Alexander, Schallert, and Reynolds’ (2009) duplicity of meaning due to context. These broad and inconsistent definitions and multiple applications complicated the discussion of learning and modal preference and resulted in scholars searching for a research foundation.

Statistical Foundation

Genovese (2004) warned that some teaching and learning models have questioned the concepts of intelligence and aptitude in favor of learning opportunities and learning styles. Genovese said,

Many models of learning styles share the assumption that a better knowledge of student’s learning difference could help improve instruction, both through modifications in teaching and improved student self-knowledge. Although this approach has strong intuitive appeal results have been mixed. (p. 169)

He went on to discuss interest in Kolb’s Learning Style model and issues with its theoretical basis, then focused on the complexities of Felder and Soloman’s Index of Learning Style (ILS) model that classified students along four dimensions: Sensing – Intuitive, Visual – Verbal, Active – Reflective, and Sequential – Global (p. 169-170). According to Atkinson (1991), Kolb Learning Styles Inventory was similarly complex and also yielded four types: accommodator, assimilator, converger, and diverger (para. 9). Genovese however, noted validity issues with both instruments: Kolb Learning Styles Inventory, the thinkers always outperform the feelers, and Felder and Soloman’s Index of Learning Style, though widely used has been found to have low internal validity.

Similar to Genovese, Baldwin and Sabry (2003) offered that for learning styles “the underlying thesis is that learners learn more effectively when information is presented in a manner that fits in with their preferred method of acquiring and processing information” (p. 337).
According to Smaldino, Russell, Heinich, and Molenda (2005), "you can make more effective use of technology and media if you have a basic grasp of our current understanding of how we learn" (p. 5); however Schunk (2008) went further to suggest "teachers might use measures of ability, learning styles, and motivation during instructional planning to tailor instruction to individual differences" (p. 311). So while Smaldino et al. are noting that properly used technology could improve learning, Schunk was directly making the point to customize instruction to the learner’s style.

According to Fleming (2006), some research suggested that students tend to choose study methods which most closely align with their modal preference (p. 39). Consistent with Dunn and Dunn (1987), Fleming implied that content delivery method is the lowest level interaction between learner and content that instructors can influence directly (p. 11). Dunn and Dunn included learner modal preference in the physiological elements above psychological elements in their learning styles inventory (Tully, Dunn, & Hlawaty, 2006; Hawk & Shah, 2007; Stevenson & Dunn, 2001), and Fleming used the Dunn and Dunn model as a basis for research on his VARK model which included mixed modal theory. Holder (2008) "found that there was a significant increase in learning from multimedia" (p. 21), but his study does not consider learner modal preference.

According to Fleming (2006), the VARK model was not predictive (p. 60). Fleming said the VARK model was "designed as an advisory tool for student and faculty development" (p. 60). Fleming suggested that antedotal evidence showed "when students and teachers are matched in terms of their VARK preferences, then learning is more likely to be facilitated" (p. 60) although Fleming offered no modal focused research on predictive validity. Researchers may be intentionally excluding learner modal preference because they cannot alter modal preference or
because it does not offer predictability; however, student modal preference may impact learning if students are making the wrong choices because they prefer the content rather than because the content is helpful.

Conflicting Models

Dunn and Dunn (1972) argued for 18 learning style elements, and the same Dunn and Dunn (1983) argued later for 21 elements later. Some research suggested that aptitude testing is modal independent (Shlesinger & Pöchhacker, 2011) and others argued that learning styles do not exist at all and are simply nonsense categories trying to understand a complex process.

Susan Greenfield was quoted in a 2007 interview,

The rational for employing VAK learning styles appears to be weak. After more than 30 years of educational research into learning styles there is no independent evidence that VAK, or indeed any other learning style inventory, has any direct educational benefits. (para. 8)

Although a learning modal preference is only one element of Dunn and Dunn’s learning style inventory, according to Fleming (2006) “it is the medium in which learning occurs” (p. 1). Clark (1998) and Fleming both created modal preference inventories; however, where Clark identifies visual, aural, and kinesthetic for the VAK model, Fleming pulled textual information out of visual and established an additional read/write category in the VARK model. Blau and Loveless (1982) discussed the Gillingham visual, aural, and kinesthetic (G-VAK) and the Fernald visual, aural, kinesthetic, and tactile (F-VAKT) as a basis for a more progressive design that considered impairments toward a TAK/v model with neural hemispheric routing where the visual was literally removed, if necessary, by blindfolding the learner. Interestingly, other than Fleming’s extension of the VAK model, all researchers seemed to leave room for other models with Blau and Loveless going so far as to state the “hemispheric routing-TAK/v is not offered as a panacea” (p. 461). The basic premise of all these learning constructs was to discover which
content deliver method worked best for a given learner, and this concept has now been extended to impaired learners.

Schunk (2008) referenced Clark and Salomon to recommend that researcher "determine the conditions under which computers facilitate instruction and learning" (p. 319). Consistent with Smaldino et al. (2005), this implied that there are technology conditions, if not choices, that affect instruction and learning. The WBEC (2000) goes further and noted that adaptive instruction is a desired trend. According to Fleming (2006), understanding the human-computer interaction was important because "students tend to choose strategies aligned with their [modal preferences]." (p. 39). Understanding the interaction extends beyond learning opportunities because funding has become performance-based.

The WBEC (2000) reported that the Higher Education Amendments of 1998 (1998) increased accountability and reinforced institutional funding (. He noted the changes attempted to address the planned growth of distance-learning programs by establishing the Web-based Education Commission. The commission final report challenged the reader to

imagine if schools, on demand, could apply research technologies to profile what a student needs to learn, how he or she learns best, what his or her learning style is, and what worked or did not work in the past, with continuous feedback to teachers, parents, and student. (p. 61)

The WBEC noted that the report concluded with a call "to adequately fund web-based learning opportunity" targeted programs in addition to traditional funding (p. 134); therefore they were effectively calling for a universally accepted benchmark to use as a measure to avoid misleading rhetoric. As early as 1978, Cameron identified the complexities of trying to measure organization effectiveness. Cameron noted that “focusing only on inputs may have damaging effects on outputs” (p. 604), but seems to ignore that focusing only on output may impact the quality of the output—the graduate. Cameron settled on a unitary measure being insufficient
then focused on a more obscure sliding scale measure to accommodate differences. Consistent with the WBEC, Middaugh (2010) argued that the “linkage between planning and assessment as characteristics of effective colleges and universities … has not always been emphasized or valued in higher education” (p. 1).

Model Necessity

Cameron’s (1978) study was just before the period Middaugh (2010) identifies as “the good old days” (p.1) of a “charmed existence”; however, the complexities Cameron identified are just as significant today as they were in 1978—not all institutions provide the same resources therefore it is difficult to use a static metric. The Texas Higher Education Coordinating Board (THECB) (2010) was specifically tasked with eliminating costly duplication” (p. 1), which further complicates comparing institutions because sometimes they are not allowed to offer the same programs. At the same time the THECB recommended “changes in the formulas for allocation of state funds to public institutions” (p. 1) in order to help meet its broad obligation. At the very least tying institutional effectiveness to funding has highlighted the call for higher education accountability.

Green (2012) concluded that The Campus Computing Project was “the largest continuing study of the role of computing, eLearning, and information technology in American higher education” (para. 1). According to Bourne et al. (2005) education programs were increasingly utilizing once controversial web-based student-centered methods to deliver web-based material over the Internet (distance-learning). Initially excluded, according to the WBEC (2000), the 2005 federal government relaxed federal funding guidelines by defining eligible program to include accredited-curriculums offered completely online effective for any loan on or after July 7, 2007 (p. 118). Colleges and universities need to understand and show how these technological
changes impact students, if at all (Ahmed, 1992), to be able to show that the delivered content does yield effective learning outcomes and therefore deserves funding.

Model Complexity

Bourne et al. (2005) observed that technology enhancements had increased distance-learning, and Jones and Knezek (1994) observed that these changes had altered barriers toward an anytime-anywhere learning opportunity. Yoo and Huang (2013) found that some content delivery methods enhanced media by utilizing aural, read/write, kinesthetic and visual modal content in what was both multimedia and multitask oriented, but that multitask-orientation required the receiver to attend multiple inputs or outputs at the same time. This was consistent with McLuhan’s (1966) observation that the interface of media, that a learner is interacting with, has its own inherent message that can over-power the learner. Given the state of human development as defined by Eliot (1997), this ability must be a skill and therefore would be more developed in some learners than others. It could be argued that Greenfield (2007) does not accept McLuhan’s view or Eliot’s view because she rejected the concept of learning style inventories. Conversely, Dunn and Dunn (1987) found that learner characteristics could be theoretically linked to a learning style construct.

Dunn and Dunn (1987) had always considered content mode a dimension of learning style, but according to Fleming (2006) some researchers erroneously consider modal preference a general type of learning style (see Appendix B). Sinclaire (2012) is guilty of using the VARK and labeling it a learning style, rather than a tool to inform learning style discussions (Fleming, 2011). Fleming noted that aural learners were most comfortable with information that is vocalized. He reported that visual learners were most comfortable with iconic information, but that did not include text-based words or movement oriented images in the VARK model.
Fleming clarified that visual preferences included any relationship you can see and that teachers can establish meaning with any combination of those relationships, but did not include still and moving pictures because simulation belonged with Kinesthetic (p. 1). Fleming found that learners using read/write content based on the VARK modality were most comfortable with text-based information; but inconsistent with Clark (1998), Fleming classified iconic symbols that represented text-based information as visual. Blau and Loveless (1982) divided the kinesthetic paradigm noting that kinesthetic learners are slightly different from tactile learners because tactile learners possess a connection to the practical. This was consistent with Alexander, Schallert, and Reynolds (2009) contention that learning was a process and a product. Consistent with Brand, Dunn, and Greb, (2002) and Angeli (2008), recall that Zabkar et al. (2015) noted that learning is at best categorized as a qualitative science if for no other reason, than “people most often reason qualitatively” (p. 1604). So, while some conclusion or more obvious than others, it is important to note that these are quantitative models for qualitative life experiences.

Information Logistics

McLuhan (1966) speculated in this electronic age, "today the action and the reaction occur almost at the same time. We actually live mythically and integrally, as it were, but we continue to think in the old, fragmented space and time patterns of the pre-electric age" (p. 4). McLuhan was saying that technology may overwhelm the user who is still used to physical world patterns where a book can be an entity to itself apart from the computer.

Introna and Ilharco (2006) and Rose, Hair, and Clark (2011) argued technology can perform differently depending on what content is being conveyed—technology can disappear or technology can be ever present. This was certainly consistent with McLuhan’s (1966) contention that the medium is the message, but it also contains a message, which might require more mental
Consistent with Cubukcu (2008) a book used in a course was not the message of the course itself whether a course is face-to-face or online, and highlights why Jones and Knezek (1994) argued that “the teacher and the learner must be examined in order to understand the complete model” of distance education.

Technology Impact

Nichols (2010) held that systems were being created to respond to individual needs and automatically produce dynamic content. Computers have had the ability to easily overwhelm the user from the start, but today an Internet search can instantly return millions of matches. Stiles (2008) held that "the view of biological development as the product of the inseparable influences of inherited and environmental factors has been bolstered by recent work suggesting that environmental factors can be transmitted across generations” (p. 362). Consistent with Jung’s (1928) adaption trait, Stiles’ was suggesting that what overwhelms us today may be less of a barrier in the future adaptive evolution. Consistent with Stiles, Jones and Knezek (1994) found that technology change resolved some barriers and introduced others.

Similarly, Introna and Ilharco (2006) observed that as the reading delivery method shifted to online media, learner interactions changed. Previously, a learner may have spread books to encompass all desk space available before books were stacked impacting readability. Introna and Ilharco noted that online documents would grow to consume considerably smaller screen space until they were stacked, yet the thickness of pages yet to be read would be lost. Introna and Ilharco observed that books had inherent traits including size, color and thickness that could still be seen when stacked and provided cues for direct access, but online the tactile contact and features were lost. Introna and Ilharco found that these online mechanisms created an online operational pattern of immediacy and use, but lacked all the cues physical books possessed and
that muscle memory might have provided. Consistent with Intra and Ilharco, McLuhan (1966) found that technology had an inherent message and limitation within itself that may have required more mental acuity from the learner. Contrary to McLuhan, Intra and Ilharco noted that, “what seems most evident when looking at a screen is the content being presented on the screen—the text, images, graphics, and so on” (p. 520); however, Intra and Ilharco noted that when content was digitized the screen seemed ever present. This was consistent with Alexander, Schallert, and Reynolds (2009) duplicity of context and recognized the how and where impact of technology.

Muilenburg and Berge (2005) warned that student barriers are not well understood in the presence of increasing online education. Jones and Knezek (1994) and Shachar and Neumann (2010) found that mobile computing access was more available to learners now than ever before, and Duncombe (2011) noted that mobile technology extended access to low income countries. Gordon (2013) warned that technology had created smaller physical collections in libraries and increased quantities of digitized texts thereby reducing the Dewey Decimal Classification System to unique islands of localized standards specific to their users. Worse may be a future where reading and research skills are significantly attenuated or lost than one where users simply have different experiences; however, because students will have different experience and have to overcome barriers, it is important to understand the effect of instructional design choices on learners to avoid bias and help students attain their goals.

**Summary**

We lack a universally accepted definition of human learning (Alexander, Schallert & Reynolds, 2009), and technology has at the very least expanded the definition of learning (Jones & Knezek, 1994). There are conflicting agendas within fields of knowledge (Zemplen, 2007),
and online courses possess conflicting design theories (Gray et al., 2012). Technology may have changed too fast for higher education to properly consider the impact of technology on learning while teachers feel a lack of support (Chang & Smith, 2008; Owusu-Ansah, Neill, & Haralson, 2011). Technology can outperform humans on repeatable tasks, but humans can make mistakes and need the proper resources and support when moving to technology-based learning (Salmon & Wright, 20014; Christie & Jurado, 2009). Human base-function has not appreciably changed in centuries (Eliot, 1971), but how we interact with technology has changed substantially in the last few decades (Linday, 2003; Duncombe, 2011).

Humans have learned to interact with new technologies, but researchers disagree on how technology-based learning is different for learners (WBEC, 2000). Various models have been adapted for online learning to consider the impact of technology on learning (Fleming, 2006). The VARK model is a popular but unresolved measure of learner modal preference (Fleming). Multiple conflicting models and definitions exist that try to explain human characteristics (Fleming; Gardner, 2006).

Experts tend to agree that a clear understanding of learner's leads to better instructional design (Genovese, 2004), but experts have failed to gather a consensus on how to design those learner constructs (Urval et al., 2014; Felder & Brent, 2005; Lu et al., 2003; Dunn, 1990). It has also proven difficult to design a universal measure to compare educational effectiveness (WBEC, 2000). State and federal governments are supplementing higher education with tax dollars, and have a responsibility to use those funds efficiently (WBEC, 2000). Technology changes have removed some barriers and uncovered others (Jones and Knezek, 1994), but ultimately learning is a subjective experience (Zabkar et al., 2015). The learner is not independent of the world
around them; therefore, their experiences each have a unique context (Introna & Ilharco, 2006; Cubukcu, 2008; Rose, Hair, & Clark 2011).

While research-based definitions of student-centered learning have proven less difficult, learning efficacy and motivation are still a developing construct and complicated by technology. Technology has changed how individuals perceive information and manage informational cues, but experts disagree on how to even categorize delivery modes. Learning performance has been tied to learner efficacy, and learner satisfaction has been tied to both efficacy and motivation. Experts disagree whether learning style preferences matter and whether they exist at all (Urval et al., 2014; Sinclaire, 2012; Manochehri & Young, 2006; Fleming, 2006). Research has attempted to validate the VARK Questionnaire, but the design has made it difficult to statistically validate (Fleming).

One of the long-standing concerns in research is whether or not extremely small statistically significant effects matter. This concern is complicated when those effects are found in extremely focused research. If automation technology consolidates and integrates (McLuhan, 1966) while at the same time has subtle impacts, finding those effects may be complicated by using only focused models. It may be necessary to build cohesive models that examine the combined effects. The study investigated whether or not the online learner’s modal preference, also known as a personal learning profile (Preference), the content delivery method supplemented with visual content (Content), or the interaction of Preference and Content, influenced learner performance and/or learner self-reported satisfaction using web-based distance-learning class modules at a large southwestern research university.
CHAPTER III
RESEARCH METHODS

Introduction

This chapter presents the study methodology: data collection, data analysis, sampling, assumptions, delimitations, and limitations. The six research questions were studied within a causal-comparative and quasi-experimental mixed method longitudinal study design using a theoretical framework to explore possible relationships between learner modal preference and modal focused content delivery method with learner performance and learner self-reported satisfaction within a web-based distance-education environment.

The causal-comparative mixed method longitudinal research analysis investigated the relationship of learner demographic characteristics and barriers to distance-learning to investigate relationships with learner performance and learner self-reported satisfaction. The quasi-experimental mixed method longitudinal research analysis investigated the effect of learner modal preference (Preference), the effect of modal-focused content delivery methods (Content) and the interaction effect of Preference and Content on learner performance and learner self-reported satisfaction. Self-reported satisfaction scores were measured prior to module grades. Module grades were used as a measure of learner performance. A pilot study was conducted to test the online system and explore the measures prior to the study.
Data Collection

This researcher created an interactive online web-based learning environment to implement web-based instruments via HTML forms. Participants were required to answer the Fleming VARK Questionnaire, Muilenburg and Berge Survey of Student Barriers to eLearning, and a content pretest in the introductory module. Content modules were delivered via web-page embedded modules over a semester.

A pretest, matching posttest, and eight modal focused content modules each included a ten item multiple-choice quiz to measure performance over a single semester. Learner modal preference was measured by the VARK Questionnaire in the pretest and matching posttest. Demographics and barriers to distance-learning were measured during the pretest using the Muilenburg and Berge barriers instrument (2005). Learner satisfaction was measured via an interactive web form following each content offering. Learner performance was measured via sequential interactive web forms delivered one question at a time following the self-reported satisfaction measure. Sequential forms were used to prevent participants changing answers based on subsequent questions. Content pretest, matching posttest, module content, learner satisfaction instruments, learner performance instruments, and the web-based delivery system were all created by this researcher.

Population

*Enrollment, Gender, and Degree*

The study was conducted using modal focused web-based distance-learning style modules at a large, public southwestern research university during the fall 2015 semester. The university reported enrollment as 30,503 undergraduates, 37,175 overall, and awards bachelor through doctoral degrees. Enrollment was 51.82% female and 48.12% male with 82.05%
undergraduate and 17.95% graduate. The graduate breakdown as 2.46% post-bachelor, 10.52% masters, 4.85% doctoral, and 0.12% special professional.

**Enrollment Credit Hour**

The university reported 39% of undergraduate students enrolled in 15 or more hours and 91% enrolled in 9 or more hours, 5% of post-baccalaureate students enrolled in 15 or more hours and 36% enrolled in 9 or more hours, 2% of master students enrolled in 15 or more hours and 48% enrolled in 9 or more hours, less than 1% of doctoral students enrolled in 15 or more hours and 91% of undergraduates enrolled in 9 or more hours, and 36% of special profession students enrolled in 15 or more hours and 82% enrolled in 9 or more hours.

**Enrollment Ethnicity and Admit Status**

The fall 2015 university statistics reported ethnicity as 50.21% white overall and 40.55% undergraduate, 13.71% African-American overall and 12.15% undergraduate, 20.86% Hispanic overall and 18.82% undergraduate, 6.75% Asian and Pacific Islander overall and 5.95% undergraduate, 1.46% American Indian overall and 1.24% undergraduate, 0.99% Other overall and 0.75% undergraduate, and 6.02% Non-resident alien overall and 2.60% undergraduate. University statistics showed first time in college student as 19.55% white, 6.45% African American, 11.83% Hispanic, 4.54% Asian and Pacific Islander, 0.49% American Indian, 0.28% other, and 0.14% non-resident. University statistics showed new undergraduate transfer student as 18.43% white, 5.84% African American, 8.90% Hispanic, 2.19% Asian and Pacific Islander, 0.65% American Indian, 0.46% other, and 0.23% non-resident. University statistics showed new students with degrees as 8.75% white, 1.61% African American, 2.07% Hispanic, 0.67% Asian and Pacific Islander, 0.17% American Indian, 0.27% other, and 0.62% Non-resident.
Instruments

**VARK Model**

The VARK is a widely used measure of learner modal preference (Fleming, 2006). The VARK Questionnaire is a tool for examining learner study preferences, but does not limit learners to a single dominate preference. The VARK model is sometimes mislabeled as a learning style (Sinclaire, 2012; Fleming, Appendix B) and can be misused to find a singular learning modal preference based on individual scores (Fleming). Preferences are not the same as strengths, and therefore a person may have two equal preferences and not be equally skilled at both (p. 14). The VARK model is complicated further because modal preferences can be subdivided into 23 possible group combinations (Fleming). Study groups were assigned using the VARK Questionnaire to investigate the impact of misusing the VARK to identify a single dominate preference. A single preference was selected from participates multimodal preferences when multiple preferences existed, and preference strengths were considered equal.

The VARK Questionnaire was available for download via the web-based system, and learner modal preferences were self-reported via a web form. VARK copyright prevented implementing this instrument in an interactive online form. Learner modal preference was self-scored by participants using a downloaded postscript (PDF) copy of the VARK Questionnaire. The VARK Questionnaire 7.8 in Appendix A was the latest available VARK instrument at the time. The VARK instrument contained 16 questions, and each question had four possible answers. Each answer was closely associated with one of the four VARK categories, and all categories are represented on each question: visual, aural, read/write, and kinesthetic. Participants were asked to select all that apply on each question.
**VARK Controversy**

It is important to note that the study considered video lecture modules as kinesthetic and limited the definition of visual to images, graphs, charts and animation. This was consistent with VARK classifying kinesthetic content as lecturers that use real world examples (Fleming, 2011), but inconsistent with VARK classifying videos as visual content. This controversy exists in the literature and practice. Adobe Connect is a distance-learning tool sold by Adobe Systems Inc., and their marketing blog How to Cater Your Content to Your Audience’s Learning Styles with Rich Media, listed videos, animations, and quizzes as effective materials for kinesthetic learners (Watson, 2015). The study was conducted online and used mixed method quizzes across all content modules to measure learner performance and learner satisfaction.

**VARK Use**

Generally the questionnaire can be completed in less than ten minutes. The questionnaire is available in both written, interactive web-based, and subscription forms, but the subscription service available online from VARK Learn Limited is restricted to 150 per group. Licensing issues prevent hosting an interactive instrument locally and using tools available through the subscription service; therefore a VARK postscript file (PDF) obtained from VARK Learn Limited through Neil Fleming was used. The VARK Questionnaire was used with permission (see Appendix B). Scores were recorded using a web-based interface and those scores were used for group assignment in the study (see Appendix C).

**Muilenburg and Berge Model**

Participant demographics and barriers to distance-learning were measured using the Muilenburg and Berge instrument (2005). The current instrument available at the time of the study was based on the Muilenburg and Berge model that used 11 demographic questions and 46
barrier questions (see Appendix D). The Muilenburg and Berge demographic questions were extended by this researcher to 24 demographic questions to investigate more granular relationships (see Appendix E), the 46 barrier questions were left intact. Extending the questionnaire allowed further analysis into possible confounding factors due to participant age variations.

The demographics and barriers to distance-learning were in separate sections and utilized different designs. The demographics were independent variables and the barriers to distance-learning were designed to be used as factor scores. The Muilenburg and Berge instrument was used with permission (see Appendix F).

*Muilenburg and Berge Model: Demographics*

Student demographic characteristics were measured using a modified online version (see Appendix G) of the Survey of Student Barriers to eLearning by Muilenburg and Berge. The Muilenburg and Berge (2005) demographics portion used 11 questions including (a) gender; (b) age; (c) self-reported ethnicity; (d) type of learning institution they attended (e.g., community college, undergraduate, graduate, business/corporate/non-profit, and government/military); (e) ability and confidence with online learning technology (from “not currently using these technologies” to “being comfortable and confident with online learning technologies”); (f) learning effectiveness in the online environment (from “cannot learn as well online,” through “no difference between online and traditional classroom,” to “learn better online”); (g) learning enjoyment in the online classroom (from “enjoy online learning significantly less,” to “enjoy online learning significantly more than the traditional classroom”); (h) the number of online courses completed; (i) the number of online courses dropped; (j) the likelihood of taking a future online course; and (k) whether or not students experienced prejudicial treatment in the traditional classroom due to cultural background, disability, or other personal characteristic. (p. 30)

Question 11 referred to above as (k) was rescaled to increase granularity. The new scale more closely matches the other question scales. These demographic characteristics were extended by 13 questions to include additional socio-economic indicators with
consideration for self-report limitations (actor-observer distortion and bias): learner
study-strategy, level of education high school (graduation or general equivalence), high
school GPA, level of education higher education, higher education GPA, number of
bathrooms in childhood home, number of childhood pets, marital status, school funding
method, number of dependents, age of first computer use, age of first computer
ownership, and socio-economic status (see Appendix E).

_Muilenburg and Berge Model: Barriers_

Student barrier characteristics were measured using an online version (see Appendix A)
of the Muilenburg and Berge Survey of Student Barriers to eLearning. The Muilenburg and
Berge (2005) barrier portion uses 46 questions. A 2005 investigative factor analysis by
Muilenburg and Berge yielded the following eight factors (1) Administrative/instructor issues,
(2) social interactions, (3) academic skills, (4) technical skills, (5) learner motivation, (6) time
and support for studies, (7) cost and access to the Internet, and (8) technical problems.

_Muilenburg and Berge Use_

The Muilenburg and Berge questionnaire can be completed in less than 20 minutes. The
questionnaire was obtained from Zane L. Berge in electronic format. The Muilenburg and Berge
questionnaire was offered in an online format, and the instructions were left substantially intact
(see Appendix G). The name and date fields were omitted because the online system maintained
participant anonymity.

_Pretest and Posttest Model_

Baseline content knowledge was measured during the initial module as a pretest
using an instrument created by this researcher. The same instrument was used again as a
posttest to measure change across the study. The pretest and posttest were the same 15
questions. The first 10 questions were based on the study modal focused content modules and selected to be increasingly more difficult. The remaining five questions were selected to be closely related but different content to function as a control for maturation across the study period. Question responses included the option “I have no idea” as a mechanism for removing random guesses from mean plots to allow evaluation of question operation.

Pretest and Posttest Use

The pretest and matching posttest was designed to be completed in less than 10 minutes. The pretest and matching posttest was offered in an online format. No content was offered directly with either module. The pretest and posttest measure were used as measure of content on learner performance and control of learner maturation over time.

The quasi-experimental study portion included pretest and posttest scores with content module scores to calculate overall learner performance. Content modules were modal focused web-based distance-learning style modules. The interaction effect of learner modal preference and modal focused content delivery method was investigated on learner performance.

Modal Focused Content Model

The VARK was used as a basis to create three versions of the same eight content modules. The VARK model categorizes content mode as visual, aural, read/write, or kinesthetic. Visual content cannot effectively convey complex concepts (Fleming, 2006); therefore visual content was not utilized as an independent method. Model taxonomies differ on whether videos or lectures are kinesthetic depending on what modes they utilize. Content was created using the VARK aural, read/write, and kinesthetic taxonomies and increasingly supplemented with visual content across the three categories.
Each set of eight modules was designed using a single VARK categorical modal focused content delivery method (aural, read/write, or kinesthetic), but content was supplemented with VARK categorical visual content: aural supplemented with visual content, read/write supplemented with visual content, or kinesthetic supplemented with visual content. Visual content was increasingly used as appropriate within each method. VARK-based aural content included a single image within the media player on the web page. VARK-based read/write modal content utilized images within the text. VARK-based kinesthetic content utilized still images, movement, and animation within the media player.

Module content face validity was reviewed by a panel of three content experts. Each expert was asked to review the written module content for issues with the verbal language. Panel input was incorporated final content, and then aural and kinesthetic modules were created.

Learner satisfaction and learner performance were measured over an eight week period using instruments created by this researcher. Each participant received eight modal focused content modules released one a week over eight weeks. The content modules were based on a college freshman level textbook Communication: A Critical/Cultural Introduction by Warren and Fassett (2011, 2015). A pilot study was used to investigate learner performance and learner satisfaction measures and three content questions were modified.

Modal Focused Content Model: Satisfaction

Learner self-reported satisfaction was measured after each content interaction using an instrument created by this researcher. The satisfaction instrument contained 10 closely related questions. Four questions were based on content satisfaction, three questions were based on stressors resulting from fatigue, one question was based on energy level, one question was based on content preference, and one question was based
on prior knowledge. The prior knowledge question varied with the content, to inquire if participants had recent experience with that specific content source chapter from which the module was created. The instrument was designed with the assumption all elements were related to build a single measure of satisfaction, (see Table 2).

Table 2

_Satisfaction Instrument_

<table>
<thead>
<tr>
<th>Measure</th>
<th>Coding</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stressor</td>
<td></td>
<td>1. I am in a hurry and/or distracted right now.</td>
</tr>
<tr>
<td>Energy Level Stressor</td>
<td>Reverse</td>
<td>2. I am currently excited and/or energized.</td>
</tr>
<tr>
<td>Stressor</td>
<td></td>
<td>3. I feel tired and/or frustrated right now.</td>
</tr>
<tr>
<td>Stressor</td>
<td></td>
<td>4. I feel bored right now.</td>
</tr>
<tr>
<td>Dislike</td>
<td></td>
<td>6. I found the module content confusing and/or difficult to follow.</td>
</tr>
<tr>
<td>Dislike</td>
<td>Reverse</td>
<td>7. I enjoyed the content more than I thought I would.</td>
</tr>
<tr>
<td>Content Preference</td>
<td></td>
<td>8. I prefer to watch television more that read a book.</td>
</tr>
<tr>
<td>Dislike</td>
<td></td>
<td>9. I am more frustrated after reviewing the module content, than before reviewing it.</td>
</tr>
<tr>
<td>Dislike</td>
<td></td>
<td>10. When I think of how I prefer content to be delivered, I disliked this content.</td>
</tr>
</tbody>
</table>

_Framework Focused Content Model: Performance_

Learner performance was measured after each content interaction following the learner self-reported satisfaction measure using an instrument created by this researcher.
Each performance instrument contained 10 content questions varying in level of
difficulty. Questions for each module were designed using the same framework: (1)
rational but truncated extension of discussed point, (2) direct reword requiring specificity,
(3) utilizing meaningless distracter, (4) understanding all the parts, (5) most fundamental
elements, (6) direct wording with familiar distracters, (7) direct wording allowing for
partial knowledge, (8) direct wording with comparatives, (9) direct wording with familiar
distracters, (10) direct unusual word with distracters.

*Modal Focused Content Use*

The learner performance measures were designed to be completed in less than ten
minutes. Participants were instructed not to refer back to content materials. Content questions
were selected across each module and questions were written to measure various knowledge
levels from recall to cognition.

*VAK Model*

Learner modal preference was measured during the post-test using an online version of
the VAK instruments created by Clark (1998). The VAK instrument contains 3 sections, each
section has 12 questions, and each question contains 5 affective answers from *almost never
applies to almost always applies*. Each section is closely associated with one of the three VAK
categories: visual, aural, and kinesthetic. Participants are asked to weight the applicability of
each question. Each section score is summed to reference a weight for that preference.

*VAK Use*

The VAK Survey in Appendix L is the latest instrument designed using the VAK model
to measure learning modal preference. The VAK was sought as a possible replacement for other
measures. The VAK was considered as another theoretical grouping variable to inform future research. The VAK Survey was used with permission (see Appendix K).

Data Analysis

This researcher utilized the statistical computer software Predictive Analytic Software (PASW) Statistics 18 Release 18.0.0 to conduct the causal-comparative and quasi-experimental mixed method longitudinal research analyses. An online Parallel Analysis Engine was considered within the context of an exploratory factor analysis. A PASW item analysis script was downloaded from the Internet to investigate content performance instruments, see Appendix M. A statistic with at least a probability of $p = .05$ was the level of statistical significance for the study.

A confirmatory factor analysis was performed using PASW on the Muilenburg and Berge instrument to consider factor loadings with the study sample. A Cronbach $\alpha$ analysis was performed using PASW on the Muilenburg and Berge barriers to distance-learning instrument. An item analysis was performed using PASW on the pretest, matching posttest, and content performance instruments. An exploratory factor analysis was performed on the learner satisfaction instrument. Cronbach $\alpha$ were performed on each satisfaction measure factor and an overall theoretical satisfaction factor.

The study used a repeated measure analysis of variance (RM-ANOVA) to examine the quasi-experimental mixed method longitudinal study portion. The study investigated the RM-ANOVA main and interaction effects of learner modal preferences and content delivery method on learner performance and learner satisfaction separately using a full factorial model with sum of squares type 3 analysis over 10 measures utilizing the Difference contrast. The RM-ANOVA included Post Hoc tests using the Tukey honestly significant difference correction to reduce
Type I family-wise errors and indicate which mean differences were noteworthy for any differences found in the a priori contrasts.

The study used a Pearson’s $r$ correlation to explore the mean relationships for the causal-comparative longitudinal study portion. Demographics and barriers to distance learning were correlated with overall learner performance to investigate mean relationships. Demographics and barriers to distance learning were also correlated with learner satisfaction factor scores to investigate mean relationships.

Instruments

VARK Application

This causal-comparative and quasi-experimental mixed method longitudinal study considered both the theoretical basis of the VARK model and the misapplication of the VARK model to web-based online distance-education content. The VARK model was used as a basis to create module content: aural supplemented with visual content, read/write supplemented with visual content, or kinesthetic supplemented with visual content. Participants were assigned into a group based on their selected dominate VARK classification and each group received a different modal focused content for the duration of the study.

VARK Interpretation

The VARK Questionnaire was used to classify participant learner modal preference: visual, aural, read/write, or kinesthetic. Multiple superior scores were addressed by random assignment to a single category from all superior categories for each participant. Theoretically if both preferences were equally dominant, then either should be equally effective; however, modal mastery was not assessed.
The VARK modal preference was one grouping variable with 4 levels: visual, aural, read/write, or kinesthetic. The VARK focused categorical content delivery method was the second grouping variable: aural content supplemented with visual content, read/write content supplemented with visual content, or kinesthetic content supplemented with visual content. The quasi-experimental mixed method longitudinal study portion examined the interaction of learner modal preference and modal focused content delivery method on learner performance and learner self-reported satisfaction using modal focused web-based distance-learning style modules.

*Muilenburg and Berge Application*

This causal-comparative study portion considered demographics and barriers to distant learning as possible predictors for learner performance and/or learner self-reported satisfaction using modal focused web-based distance-learning style modules. Demographic scores were considered individual scores. Barrier scores were calculated using factor mappings from the author’s study. Learner performance learner and satisfaction scores were correlated with demographic variables and barrier factor scores using the Pearson $r$ statistic to investigate relationships that warrant further examination.

*Muilenburg and Berge Interpretation*

Muilenburg and Berge demographic characteristics were used as individual scores. Barrier to distance-learning factor scores were calculated based on the 2005 Muilenburg and Berge study. Overall learner performance and learner satisfaction scores were summed from individual module scores. Overall learner performance and learner satisfaction scores were correlated with Muilenburg and Berge demographic scores and barrier factor scores using the Pearson $r$ statistic to examine relationships that might warrant further examination.
Pretest and Posttest Application

The quasi-experimental portions of the mixed method longitudinal study investigating the modal focuses content model included the first ten questions of the pretest and posttest as part of learner performance measures. An additional five questions were included to investigate instrument reliability and study-maturation. The use of a pretest and posttest allowed the study to consider the efficacy of the online modules by measuring before and after the exposure.

Pretest and Posttest Interpretation

The first 10 questions of the pretest were summed to calculate a single score for Module 0 where possible values ranged from 0 to 10. The first 10 questions of the posttest were summed to calculate a score for Module 9 where possible values ranged from 0 to 10. Module 0 and Module 9 were used to calculate overall learner preference scores for the modal focused content.

Modal Focused Content Application

Both the causal-comparative and the quasi-experimental portions of the mixed method longitudinal study used learner performance and learner satisfaction measures. The theoretical basis of the VARK model and the misapplication of the VARK model to real web-based online distance-education were used to investigate the interaction of learner modal preference and modal focused content delivery on learner preference and learner satisfaction. Participant demographics and barriers to distance-learning were correlated with learner performance and learner satisfaction factor scores to investigate possible relationships.

Modal Focused Content Interpretation

Overall learner preference scores were summed from individual module performance scores, and included the pretest and post test scores. Overall learner satisfaction scores were summed using factor scores. Overall learner performance and learner satisfaction factor scores
were correlated with Muilenburg and Berge demographic scores and barrier to distance-learning factor scores using the Pearson $r$ statistic to examine relationships between demographics and barriers to distant learning. The interaction of learner modal preference and modal focused content delivery on learner preference and learner satisfaction across modules were analyzed using a repeated measures analysis of variance (RM-ANOVA).

**VAK Application**

The VAK was included only in the posttest material as an alternate method of grouping learner modal preferences. Theoretically, if the VARK is directly relatable to the VAK, given the VAK was the basis for the VARK (Fleming, 2006), and both instruments are equally valid, then content modules created to match VARK categories aural, read/write, and kinesthetic might show relationships with VAK classifications. If however, the VARK and VAK did not correlate, and the RM-ANOVA was not significant using the VARK taxonomies, the VAK taxonomies might prove significant. Clark (1998) noted, “A learning style is a student's consistent way of responding to and using stimuli in the context of learning” (sec. styles). Clark went on to specifically state,

This survey was designed as a learning tool for use in training programs, such as leadership development and learning-to-learn (metalearning), rather than a research tool, thus it has not been formally checked for reliability or validity. However, in order to be of any use to the learners, it has to be fairly accurate. (para. 1)

**VAK Interpretation**

No effort was made to validate the VAK instrument or to evaluate content taxonomies compared to the VARK Questionnaire. The VAK content taxonomies might vary widely from the VARK and therefore any statistical analysis with content may be questionable given content was created using VARK taxonomies. The VAK was included to consider whether any relationship holds between the two instruments.
Hypothesis

Research Question 1

What is the effect of learner modal preference on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

Hypothesis for Main Effect A. There is a statistically significant difference between performance of learners (mean of module grades) reporting similar VARK modal preferences (visual, aural, read/write, kinesthetic) across all VARK–based content delivery methods (aural, read/write, kinesthetic) supplemented with the visual content delivery method among online computer-based learners.

The following is the null hypothesis for Main Effect A:

There is a statistically significant difference between performance of learners reporting similar modal preferences across all content delivery methods supplemented with the visual content delivery method among online computer-based learners.

Ho: \( \mu_1 = \mu_2 = \mu_3 = \mu_4 \)

H\(_1\): \( \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \)

Expected Outcome Main Effect A. Learner model preference will have a statistically significant effect but minimal practical effect on learner performance. VARK-based learner read/write modal preference will on average have higher learner performance score.

Research Question 2

What is the effect of content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?
*Hypothesis for Main Effect B.* There is a statistically significant difference between performance of learners (mean of module grades) using similar VARK-based content delivery methods supplemented with the visual content delivery method across all VARK-based content delivery methods (aural, read/write, kinesthetic) supplemented with the visual content delivery method among online computer-based learners.

The following is the null hypothesis for Main Effect B:

*There is not a statistically significant difference between performance of learners using similar content delivery methods supplemented with the visual content delivery method across all content delivery methods supplemented with the visual content delivery method among online computer-based learners.*

\[ H_0: \mu_1 = \mu_2 = \mu_3 \]

\[ H_1: \mu_1 \neq \mu_2 \neq \mu_3 \]

*Expected Outcome Main Effect B.* VARK-based content delivery method supplemented with the visual content delivery method will not have a statistically significant effect on learner performance.

*Research Question 3*

What is the interaction effect of learner modal preference and content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

*Hypothesis for the Interaction Effect A.* There is a statistically significant difference between performance of learners (mean of module grades) when VARK-based modal preferences (visual, aural, read/write, kinesthetic) and VARK-based content delivery methods (aural, read/write,
kinesthetic) supplemented with the visual content delivery method interact across all content delivery methods (aural, read/write, kinesthetic) supplemented with the visual content delivery method among online computer-based learners.

The following is the null hypothesis for Interaction Effect A:

*There is not a statistically significant difference between performance of learners when modal preferences and content delivery methods supplemented with the visual content delivery method interact across all content delivery methods supplemented with the visual content delivery method among online computer-based learners.*

\[ H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 = \mu_7 = \mu_8 = \mu_9 = \mu_{10} = \mu_{11} = \mu_{12} \]

\[ H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6 \neq \mu_7 \neq \mu_8 \neq \mu_9 \neq \mu_{10} \neq \mu_{11} \neq \mu_{12} \]

*Expected Outcome Interaction Effect A.* The interaction effect of VARK-based learner modal preference and VARK-based content delivery method supplemented with the visual content delivery method will have a statistically significant effect and on average small practical impact on learner performance. Learners with a learner modal preference matching content delivery method supplemented with the visual content delivery method will on average have higher learner performance scores.

**Research Question 4**

What is the effect of learner modal preference on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

*Hypothesis for Main Effect A.* There is a statistically significant difference between self-reported satisfaction of learners reporting similar VARK-based modal preferences (visual, aural, read/write, kinesthetic) across all VARK-based content delivery methods (aural, read/write,
kinesthetic) supplemented with the visual content delivery method among online computer-based learners.

The following is the null hypothesis for Main Effect A:

*There is not a statistically significant difference between self-reported satisfaction of learners reporting similar modal preferences across all content delivery methods supplemented with the visual content delivery method among online computer-based learners.*

\[ H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 \]

\[ H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \]

*Expected Outcome Main Effect A.* VARK-based learner model preference will have a statistically significant effect but on average small practical effect on learner self-reported satisfaction. Learners with a visual learner modal preference will on average have higher learner self-reported satisfaction score.

*Research Question 5*

What is the effect of content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across all content delivery methods (aural, read/write, kinesthetic) supplemented with the visual content delivery method among online computer-based learners?

*Hypothesis for Main Effect B.* There is a statistically significant difference between self-reported satisfaction of learners using similar VARK-based content delivery methods supplemented with the visual content delivery method across all VARK-based content delivery methods (aural, read/write, kinesthetic) supplemented with the visual content delivery method among online computer-based learners.
The following is the null hypothesis for Main Effect B:

*There is not a statistically significant difference between self-reported satisfaction of learners using similar content delivery methods supplemented with the visual content delivery method across all content delivery methods supplemented with the visual content delivery method among online computer-based learners.*

$H_0: \mu_1 = \mu_2 = \mu_3$

$H_1: \mu_1 \neq \mu_2 \neq \mu_3$

*Expected Outcome Main Effect B.* VARK-based content delivery method supplemented with the visual content delivery method will not have a statistically significant effect on learner self-reported satisfaction.

*Research Question 6*

What is the interaction effect of VARK-based learner modal preference and VARK-based content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

*Hypothesis for the Interaction Effect B.* There is a statistically significant difference between self-reported satisfaction of learners when modal preferences (visual, aural, read/write, kinesthetic) and content delivery methods (aural, read/write, kinesthetic) supplemented with the visual content delivery method interact across all content delivery methods (aural, read/write, kinesthetic) supplemented with the visual content delivery method among online computer-based learners.
The following is the null hypothesis for Interaction Effect B:

There is not a statistically significant difference between self-reported satisfaction of learners when modal preferences and content delivery methods supplemented with the visual content delivery method interact across all content delivery methods supplemented with the visual content delivery method among online computer-based learners.

\[ H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 = \mu_7 = \mu_8 = \mu_9 = \mu_{10} = \mu_{11} = \mu_{12} \]

\[ H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6 \neq \mu_7 \neq \mu_8 \neq \mu_9 \neq \mu_{10} \neq \mu_{11} \neq \mu_{12} \]

Expected Outcome Interaction Effect A. The interaction effect of VARK-based learner modal preference and VARK-based content delivery method supplemented with the visual content delivery method will have a statistically significant effect and on average small impact on learner self-reported satisfaction. Learners with a learner modal preference matching content delivery method supplemented with the visual content delivery method will on average have greater learner self-reported satisfaction.

Variables

Independent variables included learner modal preference (Preference) as a singular dominant characteristic of their VARK learning profile, and modal focused content supplemented with visual content (Content) delivered in an online web-based distance-learning system. The dependent variable varied depending on the research question being investigated. The first three research questions investigated interaction with overall learner performance.

The remaining three research questions investigated overall learner satisfaction. Overall learner performance was calculated as the summation of pretest, matching posttest and module content questions. Overall learner self-reported satisfaction scores were calculated as the
summation of the module content satisfaction factor scores. Each question listed with related variables follows.

Research Question 1

What is the effect of learner modal preference on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

Independent Variables

- Modal Preference
- Content Delivery Method Supplemented with the Visual Content Delivery Method (Treatment Group)

Dependent Variable

- Learner Performance (Module grades) Mean

Research Question 2

What is the effect of content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

Independent Variable

- Modal Preference
- Content Delivery Method Supplemented with the Visual Content Delivery Method (Treatment Group)

Dependent Variable

- Learner Performance (Module grades) Mean
Research Question 3

What is the interaction effect of learner modal preference and content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

Independent Variable

- Modal Preference
- Content Delivery Method Supplemented with the Visual Content Delivery Method (Treatment Group)

Dependent Variable

- Learner Performance (Module grades) Mean

Research Question 4

What is the effect of learner modal preference on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

Independent Variable

- Modal Preference
- Content Delivery Method Supplemented with the Visual Content Delivery Method (Treatment Group)

Dependent Variable

- Self-reported Satisfaction
**Research Question 5**

What is the effect of content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

*Independent Variable*

- Modal Preference
- Content Delivery Method Supplemented with the Visual Content Delivery Method (Treatment Group)

*Dependent Variable*

- Self-reported Satisfaction

**Research Question 6**

What is the interaction effect of learner modal preference and content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

*Independent Variable*

- Modal Preference
- Content Delivery Method Supplemented with the Visual Content Delivery Method (Treatment Group)

*Dependent Variable*

- Self-reported Satisfaction
Quasi-Experimental Analysis

Learner Performance

The PASW software was used to answer the first three research questions using a mixed-method design. A two-way 4 x 3 repeated measures analysis of variance (RM-ANOVA) with a Post hoc analysis was performed using a Difference contrast over 10 measures using a sum of squares type 3 analysis to investigate the effects of learner modal preference (Preference) and modal focused content delivery method supplemented with the visual content delivery method (Content) on learner performance (Performance). The two independent variables were Preference (within-subjects: aural, read/write, kinesthetic, visual) as measured by the VARK Questionnaire and Content (between-subjects: aural with visual cues, read/write with visual cues, kinesthetic with visual cues) created by this researcher to match the VARK modal taxonomies. The dependent variable measures were Performance on pretest, matching posttest and module content question scores. Repeated observations of the dependent variable Performance are continuous ratio measures from 0 to 10 of each individual module score.

The study investigated the RM-ANOVA main and interaction effects for differences between learner modal preferences and content delivery method using a full factorial model with sum of squares type 3 analysis. The RM-ANOVA included Post Hoc tests using the Tukey honestly significant difference correction to reduce Type I family-wise errors to indicate which mean differences were noteworthy for any differences found in the a priori choice of all pairwise comparisons. A statistical probability cutoff of $p = .05$ was considered statistically significant for the study.
**Research Question 1**

Research question asked, “What is the effect of learner modal preference on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?”

To answer this question the impact of repeated measures (Time) and learner personal learning profile (Preference) on the measure learner performance (Performance) was investigated within-subjects and Content on the Performance was investigated between-subjects using a repeated measures analysis of variance (RM-ANOVA) with Post hoc analysis.

**Research Question 2**

What is the effect of content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

To answer this question the impact of repeated measures (Time) and content delivery methods supplemented with the visual content delivery method (Content) on the measure learner performance (Performance) was investigated within-subjects and Content on the Performance was investigated between-subjects using a repeated measures analysis of variance (RM-ANOVA) with Post hoc analysis.

**Research Question 3**

What is the interaction effect of learner modal preference and content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?
To answer this question the impact of repeated measures (Time), learner personal learning profile (Preference), and content delivery methods supplemented with the visual content delivery method (Content) on the measure learner performance (Performance) was investigated within-subjects and Content on the Performance was investigated between-subjects using a repeated measures analysis of variance (RM-ANOVA) with Post hoc analysis.

**Learner Satisfaction**

The PASW software was used to answer the last three research questions using a mixed-method design. A two-way 4 x 3 repeated measures analysis of variance (RM-ANOVA) was performed using a *Difference* contrast using a sum of squares type 3 analysis over 10 measures to investigate the effects learner modal preference (Preference) and modal focused content delivery method supplemented with the visual content delivery method (Content) on learner self-reported satisfaction (Satisfaction). The two independent variables were learner modal preference (within-subjects: aural, read/write, kinesthetic, visual) as measured by the VARK Questionnaire and focused categorical content delivery methods supplemented with the visual content delivery method (between-subjects: aural with visual cues, read/write with visual cues, kinesthetic with visual cues) created by this researcher to match the VARK modal categories. The dependent variable measures were learner self-reported module satisfaction scores. Repeated observations of the dependent variable learner self-reported module satisfaction scores are continuous ratio measures from 1 to 5, strongly disagree to strongly agree, of each individual module score.

The study investigated the RM-ANOVA main and interaction effects for differences between learner modal preferences and content delivery method using a full factorial model with sum of squares type 3 analysis. The RM-ANOVA included Post Hoc tests using the *Tukey honestly significant difference* correction to reduce Type I family-wise errors and indicate which
mean differences were noteworthy for any differences found in the a priori choice of all pair-wise comparisons. A statistical probability cutoff of $p = .05$ was considered statistically significant for the study.

*Research Question 4*

What is the effect of learner modal preference on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

To answer this question the impact of repeated measures (Time) and learner personal learning profile (Preference) on the measure learner self-reported satisfaction (Satisfaction) was investigated within-subjects and Content on the Performance was investigated between-subjects using a repeated measures analysis of variance (RM-ANOVA) with Post hoc analysis.

*Research Question 5*

What is the effect of content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

To answer this question the impact of repeated measures (Time) and content delivery methods supplemented with the visual content delivery method (Content) on the measure learner self-reported satisfaction (Satisfaction) was investigated within-subjects and Content on the Performance was investigated between-subjects using a repeated measures analysis of variance (RM-ANOVA) with Post hoc analysis.

*Research Question 6*

What is the interaction effect of learner modal preference and content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across
all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

To answer this question the impact of repeated measures (Time), learner personal learning profile (Preference), and content delivery methods supplemented with the visual content delivery method (Content) on the measure learner self-reported satisfaction (Satisfaction) was investigated within-subjects and Content on the Performance was investigated between-subjects using a repeated measures analysis of variance (RM-ANOVA) with Post hoc analysis.

Causal-Comparative Analysis

Analysis then examined mean correlations. The Muilenburg and Berge (2005) demographics and barriers to distance-learning factor scores were correlated with learner performance and learner satisfaction factor scores. The Pearson r statistic was used to analyze correlations.

Sampling Method

Students were invited to the online web-based learning system via an introductory email. Students were assigned a unique random identification number when first assessing the system, maintained basic contact information in a contact profile database, and were offered to participate in the study. Students choosing to access the study are considered participants.

All participant study data were coded with the unique random identifier and stored separately from contact profile data. Participant modal preference (Preference) was determined during the pretest using the VARK Questionnaire. Participant with the lowest random identifier within each VARK modal preference were randomly assigned to an initial content delivery methods (aural, read/write, or kinesthetic) then stratified across content delivery methods in
unique random identification number order until all participants were assigned. The process was repeated for each remaining VARK modal preference.

Power

The *a priori* sample size required for the study was investigated using the G*Power tool, a tool to determine sample size requirements to achieve meaningful statistical power. G*Power was downloaded from the Internet source Heinrich-Heine-Universität Düsseldorf. G-Power allows uses study parameters as inputs to determine a minimum sample size.

An *a priori* repeated measures analysis of variance (RM-ANOVA) using 12 groups over 8 Satisfaction measures was considered with the program G*Power (Faul, Erdfelder, Lang, & Buchner, 2007; Faul, Erdfelder, Buchner, & Lang, 2009). Cohen’s (1977) standard was used $f = .25$, the default value because a small effect size was hypothesized. The tool recommended a total sample size of 60 participants, or 5 participants per group.

An *a priori* repeated measures analysis of variance (RM-ANOVA) using 12 groups over 10 Performance measures was considered with the program G*Power (Faul, Erdfelder, Lang, & Buchner, 2007; Faul, Erdfelder, Buchner, & Lang, 2009). Cohen’s (1977) standard was used $f = .20$, because a slightly smaller effect size was hypothesized. The tool recommended a total sample size of 84 participants, or 7 participants per group.

Assumptions

The study protected the identity of the participants and disassociated the responses by assigning unique random identifiers in order to elicit honest responses. Only the researcher and the faculty advisor had access to participant identifiers. Participants were informed of their anonymity at the beginning of each module and informed consent was required from participants at the beginning of each module before they could participate further.
The study used the existing instrument, the VARK Questionnaire, to measure participant learner modal preference. The VARK Questionnaire is still an unresolved construct (Fleming, 2006). This is partially due to the instrument design; however the construct itself must also be valid. The study assumed the VARK-based construct categories are valid: visual, aural, read/write, kinesthetic. The VARK Questionnaire measures learner modal preference, but does not differentiate instructor-centered processes from learner-centered processes; therefore this researcher assumed the learner modal preference is valid across both domains.

The study used the Muilenburg and Berge (2005) modified version 2 instrument to measure demographics and barriers to online learning. Demographics are not psychometric, therefore no statistical basis was considered but the instrument was extended to gather more granular detail. Demographics included the age of first use as 3 years old due to the inability to distinguish memories prior to that age (Fiske & Pillemer, 2006, p. 57; Reese, 1996, p. 36; Nelson, 1993, p. 8). Demographics also considered the first computer ownership starting at 5 years old due to the inability to distinguish ownership prior to that age (Blake & Harris, 2009, p.141).

The Muilenburg and Berge (2005) barriers to distance-learning instrument items scale to factor scores and those scores were calculated and used in the study by this researcher. The factor analysis in the Muilenburg and Berge study used a 47 item instrument, but the one provided to this researcher was an updated version of the instrument omitting one item. The 46 items were mapped onto the Muilenburg and Berge factors without issue. A confirmatory factor analysis and Cronbach α were performed to investigate the factor reliability with the shortened Muilenburg and Berge instrument. The study performed by this researcher assumed the 2005 factors apply to the instrument provided and assumed the factors are valid.
The study design assumed that students do not have a bias against online learning that would prevent them from participating. One student contacted this researcher complaining about the system itself, without offering any specific concerns when probed for details. A separate student refused to participate via the online system, but did ask for written copies to participate. That student was informed it was not possible to provide written materials due to the study design. More than 10 students over the course of the semester complained about various issues assessing the system. The most common complaint related to browser cookies. The researcher was aware that the Google Chrome default browser settings make it incompatible with the study tool. In each of these cases, the browser was confirmed to be the issue by the participant when the researcher sought clarification. Those participants were instructed to change browsers and it is assumed they did change their browser to continue.

Participant learner performance and learner satisfaction instruments were created by this researcher and used with VARK modal focused content modules. Item analysis was performed to consider instrument performance to evaluate the adequacy of each measure in terms of item function (Yurdugül, 2006). Factor analysis was done on learner satisfaction measures to consider an overall satisfaction factor. The study assumed separate content could be consistently delivered across multiple modal delivery methods.

Delimitations

The study utilized a causal-comparative and quasi-experimental mixed method longitudinal research design. The research design included pretest, posttest, and repeated measures to ameliorate inherent method inadequacies (Pike, 1992). A list of all students 18 years old or older on the twelfth day of classes in the fall 2015 semester was obtained from the registrar from a large southwest university. The sample of learner participants was only
contacted once to introduce the study via e-mail. The sample was limited to students that chose to participate out of all available students 18 years old or older. Students that chose to participate were assigned a unique random identification number.

Random assignment of all learners to groups was not considered due to the use of the VARK Questionnaire to categorize participants using learner modal preference. Complete learning style inventories were not utilized as the primary research questions assume that content modal preference can be researched as a precursor to the other dimensions of learning style. Participant VARK Questionnaires were self-scored by participants, and equal weight scores were assumed to be of equal strength.

Limitations

The quasi-experimental mixed method longitudinal research design allowed this researcher to consider whether learner performance and learner self-reported satisfaction can be predicted based on the interaction of learner modal preference and content delivery method supplemented with the visual content delivery method. The causal-comparative mixed method longitudinal research design allowed this researcher to investigate the relationship of learner demographics and learner barrier to distance-learning with outcomes based one learner modal preference and content delivery method. Predictability and relationships do not constitute cause; therefore, whether a given learner modal preference using a given content delivery method are able to predict learner performance and/or learner self-reported satisfaction does not mean that a self-aware learner cannot overcome a predicted outcome either by chance or effort.

Learners chose to participate based on personal circumstances. Participants were adult learners and, therefore, their personal choices and motivation differ based on current life circumstances that the study may not measure. The Muilenburg and Berge (2005) barriers to
distance-learning instrument was needed for the study and it included a demographics section. The Muilenburg and Berge demographic instrument does not consider age based barriers. The Muilenburg and Berge demographics section was extended by this researcher to include more granular responses.

Relevance of learner modal preference is an unresolved issue. The VARK model is a widely used learner modal preference measure (Fleming, 2006). The VARK has shown to be useful based on available research, but it has problems when examined for reliability and statistical significance. The VARK model was not designed for prediction. The lack of a single dominate consistent score over time inhibits longitudinal testing. Because the VARK Questionnaire developed by Fleming provides a fluid learner profile, reliability testing is like chasing a moving target because the profile is expected to change over time. The substantial research-base of the VARK model was based on classroom teaching.

Lack of longitudinal research using VARK models in online environments made comparing studies difficult. The study performed by this researcher used research-based content and instruments based on the VARK model. Determining the educational efficacy of the web-based interventions requires structurally valid measures (Hinerman, 2014). The study intentionally incorporated treatment into the research design consistent with Dowaliby and Schumer (1972), and used a custom delivery system.

Of the 37,175 overall population, only 1196 students or 3.22% of the overall population, signed into the survey system. Those logging in were considered participants. A total of 165 participates completed the study, representing 0.004% of the overall population. While the study findings may not generalizable to other educational settings, they provide insight into the efficacy of learner modal preference and content delivery methods for this sample.
CHAPTER IV

RESULTS

Introduction

The study considered whether the learner’s personal learning profile (Preference) as measured by the VARK Questionnaire, aural, read/write, or kinesthetic categorical content delivery methods supplemented with the visual content delivery method (Content), or both, using web-based online distance-learning modules had a statistically significant effect on Performance, Satisfaction, or both. The reliability of each survey instrument was investigated. Six research questions were explored with respect to the research hypotheses. This chapter presents the study results and findings for each research question.

Population

The study was performed at a large public southwestern research university during the fall 2015 semester. The study was offered via email to the entire population of 37,175 students 18 year of age or older. The student researcher and 258 other students were ineligible because they participated in the pilot study during the spring 2015 semester, and only 51 of those participating completed the pilot study due to experimental mortality. There were no other restrictions that limited participation.

In all, 37,657 emails were sent out during the study, because student records included multiple emails for some students. No paring of duplicate email addresses or multiple emails addresses per student was performed. Data were exported in text format from the online tool and imported into Excel to truncate partial cases.
Sample

There were 1196 participates in the fall 2015 study. Only participants that completed the entire survey were retained, so 1196 represents 3.22% of the overall population. A total of 165 participates completed the study due to experimental mortality, representing 0.004% of the overall population. The HTML form for recording VARK scores allowed participants to enter all 0’s, so 3 participant’s follow-up VARK scores were invalid. The invalid follow-up VARK scores did not invalidate those participants. The remaining participant data were imported into Predictive Analytic Software (PASW) Statistics 18 Release 18.0.0 and individual responses were coded for analysis.

There was a total of 113 male and 52 female participants in the study. The study participants included 73.33% that self-identified as undergraduates, 90 male and 31 female students with 76% of those being 18 to 24 years-old. The study participants included 24.85% that self-identified as graduates, 20 male and 21 female students with 16.97% of those being 18 to 24 years-old. The study participants included 1.82% that self-identified as other, 3 male students with 33.33% of those being 18 to 24 years-old. The participants self-identified ethnicity as 47.27% white overall and 70.51% of that undergraduate, 16.36% African-American overall and 74.07% of that undergraduate, 16.97% Hispanic overall and 85.71% of that undergraduate, 12.73% Asian and Pacific Islander overall and 54.14% of that undergraduate, 0.61% American Indian and Alaska Native overall and 100% of that undergraduate, 6.06% Other overall and 90.00% of that undergraduate.

Undergraduate

The undergraduate sample included 121 individuals. A single female participant self-reported being 18 to 24 years old and just starting an Associate’s degree program. A group of 8
males and 1 female, all self-reported being 18 to 24 years old and undergraduate, just starting bachelor’s degree program. A group of 9 males and 3 females all self-reported being 18 to 24 years old and undergraduate freshman, 29 hours or less program. A group of 20 males and 9 females all self-reported being 18 to 24 years old and undergraduate, sophomore, 30 to 59 hours program. A group of 32 males and 10 females, where males self-reported as 23 being 18 to 24 years old, 4 being 25 to 31 years old, 3 being 32 to 38 years old, a single being 45 to 51 years old, a single being 52 to 57 years old, where females self-reported as 7 being 18 to 24 years old, a single being 25 to 31 years old, 2 being 32 to 38 years old, all self-reported as undergraduate, junior, 60 to 89 hours program. A group of 21 males and 7 females, where males self-reported as 15 being 18 to 24 years old, 2 being 25 to 31 years old, 2 being 39 to 44 years old, where females self-reported as 7 being 18 to 24 years old, all self-reported as undergraduate, senior, 90 of more hours program.

Graduate

The graduate sample included 41 individuals. A single female, self-reported being 39 to 44 and a Graduating Senior, last semester of program. A group of 8 males and 7 females, where males self-reported as 6 being 18 to 24 years old, 1 being 25 to 31 years old, a single being 32 to 38 years old, where females self-reported as 4 being 18 to 24 years old, 2 being 25 to 31 years old, a single being 32 to 38 years old, all self-reported as just starting a master’s degree program. A group of 7 males and 5 females, where males self-reported as 5 being 18 to 24 years old, 2 being 25 to 31 years old, where females self-reported as 3 being 18 to 24 years old, a single being 25 to 31 years old, a single being 32 to 38 years old, all self-reported as taking master’s degree program classes. A group of a single male and 4 females, where the single male self-reported as being 58 or above, where females self-reported as 2 being 18 to 24 years old, 1 being
25 to 31 years old, a single being 52 to 57 years old, all self-reported as just starting doctorate degree program classes. A group of 4 male and 4 female, where males self-reported as 3 being 18 to 24 years old, a single being 25 to 31 years old, where females self-reported as 4 being 18 to 24 years old, self-reported as taking doctorate program classes.

Other and Ethnicity

A group of 3 male, where males self-reported as a single being 18 to 24 years old, a single being 32 to 38, a single being 45 to 51, all self-reported as other. The participants self-identified ethnicity as 47.27% white overall and 70.51% of that undergraduate, 16.36% African-American overall and 74.07% of that undergraduate, 16.97% Hispanic overall and 85.71% of that undergraduate, 12.73% Asian and Pacific Islander overall and 54.14% of that undergraduate, 0.61% American Indian and Alaska Native overall and 100% of that undergraduate, 6.06% other overall and 90.00% of that undergraduate.

VARK Results

The study used the VARK Questionnaire to measure the learner’s personal learning profile as a grouping variable for data analysis. Participants by gender and preference are shown in Table 3 and Table 4. There were 197 dominate modal preferences measured in the initial module (Module 0), and 194 in the follow-up module (Module 9).

The effective Preference for each participant was the single dominate preference as measured by the VARK Questionnaire, or randomly selected VARK modal preference from the group of multiple dominate preferences for each participant. The 52 female effective VARK modal preferences were 9 visual, 9 aural, 13 read/write, and 21 kinesthetic. The 113 male effective VARK modal preferences were 20 visual, 16 aural, 25 read/write, and 52 kinesthetic.
There were a total of 165 participants that completed the study where 58 received aural, 61 received read\write, and 46 received kinesthetic content, (see Table 3).

Table 3

VARK Modal Preferences

<table>
<thead>
<tr>
<th></th>
<th>Effective</th>
<th>Study</th>
<th>Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td>Preference</td>
</tr>
<tr>
<td>K</td>
<td>21</td>
<td>52</td>
<td>73</td>
</tr>
<tr>
<td>R</td>
<td>13</td>
<td>25</td>
<td>38</td>
</tr>
<tr>
<td>RK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>9</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>AK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>9</td>
<td>20</td>
<td>29</td>
</tr>
<tr>
<td>VK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VRK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VARK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SKIPED</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Second column of each module represent multiple loadings.*
Two *a priori* power analyses were done using G*Power* (Faul, Erdfelder, Lang, & Buchner, 2007; Faul, Erdfelder, Buchner, & Lang, 2009) and the more conservative sample size recommendation was chosen for the study. The G*Power* tool recommended a total sample size of 84 participants, or 7 participants per group. All groups had at least 7 participants except participants that prefer aural content and received kinesthetic content which had 5, (see Table 4).

Table 4

*Participant Groups by Gender and Preference*

<table>
<thead>
<tr>
<th>Content</th>
<th>Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Visual</td>
</tr>
<tr>
<td>Male Aural</td>
<td>8</td>
</tr>
<tr>
<td>Read/Write</td>
<td>6</td>
</tr>
<tr>
<td>Kinesthetic</td>
<td>6</td>
</tr>
<tr>
<td>Female Aural</td>
<td>4</td>
</tr>
<tr>
<td>Read/Write</td>
<td>1</td>
</tr>
<tr>
<td>Kinesthetic</td>
<td>4</td>
</tr>
</tbody>
</table>

Reliability

Existing attempts to show that the inventory was reliable proved inconclusive for multiple reasons (Fleming, 2006). The VARK instrument allowed the respondent to choose multiple responses to address each question (Fleming), this made a factor analysis difficult because the respondents could cross-load themselves on factors by choosing multiple responses to each question. The VARK model conceptually ignored personality which is part of the
Dunn’s learning style model (Fleming, 2011). It is possible that the VARK instrument was too loosely fit for measuring the model effectively for statistical validity. Even with this limitation, the content validity of the VARK model was considered strong by Fleming (2006). Fleming, Hurd and Bonwell found that students chose to use learning strategies associated with their VARK profile (2006), this suggested the VARK model does reflect baseline individual student preferences.

Fleming (2006) found that modal preferences were singular 40.4% of the time and multi-modal 59.6% of the time. The correlation coefficients were greatest and represented statistically significant medium effects (Cohen in Field, 2009) for VARK-based content on the visual, $r = .46$, $p < .001$, aural, $r = .44$, $p < .001$, read/write, $r = .54$, $p < .001$, and kinesthetic, $r = .44$, $p < .001$ subscales when study strategies matched modal preference (Fleming, p. 57). Fleming has supported other researcher’s efforts to confirm both validity and reliability of the VARK Questionnaire. "The reliability estimates for the scores of the VARK subscales were .85, .82, .84, and .77 for the visual, aural, read/write, and kinesthetic subscales, respectively, which are considered adequate" (Leite, Svinicki, & Shi, 2010, p. 334).

The study performed by this researcher was not investigating the VARK model. Only VARK modal preference categorical scores were recorded for the pretest and posttest measures. The correlation coefficients between the pretest and posttest VARK scores were statistically significant for all correlations except for the pretest read/write and the posttest kinesthetic and the pretest kinesthetic and posttest read/write correlations. With the exception of kinesthetic, the correlation coefficients were greatest and represented statistically significant large effects (Cohen in Field, 2009) for VARK-based content on the visual, $r = .59$, $p < .001$, aural, $r = .58$, $p < .001$, and read/write, $r = .65$, $p < .001$, subscales when pretest and posttest were paired with the same
category. The posttest kinesthetic and pretest visual correlation coefficient representing a medium effect, \( r = .41, \ p < .001 \), was slightly greater than when pretest and posttest kinesthetic scores were paired and also represented a medium effect, \( r = .34, \ p < .001 \), for this sample.

In addition to personality, the VARK also ignored time, need, and state of being as factors that influence choice. Urgency, goal, stress, and social convention may change participant choices, and the VARK model does not account for those influences. The questions did not include phrases like, if you were in a hurry, if someone on a street corner asked, or if your family normally did. These phrases imply context, immediacy, lack of resources, and social convention that the questions did not account for when determining learner preference. Fleming (2006) acknowledged that modal preferences change, but does not consider situational factors that might influence learner preferences.

Muilenburg and Berge Demographic Results

**Reliability**

The demographic questions by Muilenburg and Berge were designed to be independent questions (2005, p. 1). A Pearson \( r \) correlation analysis revealed various statistically significant relationships at the \( p < .05 \) and \( p < .001 \), but most of these relationships represented a small effect (Cohen in Field, 2009). The strongest relationship showed a medium effect for ability and confidence with online learning technology and the number of online courses completed, \( r = .37, \ p < .001 \). These relationships might be expected in basic demographic characteristics, because they all apply to the same person; however, these two questions are logically related. It makes sense that someone who believes in their ability and confidence with online learning technology would have a higher number of online courses completed.
The 13 additional questions had no independence restriction; however the additional questions were designed to get more granular data. A Pearson $r$ correlation analysis revealed various statistically significant relationships at the $p < .05$ and $p < .001$, but most of these relationships represented a small effect (Cohen in Field, 2009) with four exceptions. The strongest relationship showed a particularly large effect for type of learning institution they attended and level of education higher education, $r = .77$, $p < .001$. The analysis showed a moderately large effect for age related to marital status $r = .70$, $p < .001$, age of first computer use $r = .61$, $p < .001$, and age of first computer ownership $r = .51$, $p < .001$.

Table 5

Demographic Age and Race

<table>
<thead>
<tr>
<th>%</th>
<th>Age Range</th>
<th>%</th>
<th>Race</th>
</tr>
</thead>
<tbody>
<tr>
<td>76.4</td>
<td>18 to 24</td>
<td>0.6</td>
<td>American Indian or Alaska Native</td>
</tr>
<tr>
<td>13.3</td>
<td>25 to 31</td>
<td>12.7</td>
<td>Asian or Pacific Islander</td>
</tr>
<tr>
<td>5.5</td>
<td>32 to 28</td>
<td>16.4</td>
<td>Black, non-Hispanic</td>
</tr>
<tr>
<td>1.8</td>
<td>39 to 44</td>
<td>17.0</td>
<td>Hispanic</td>
</tr>
<tr>
<td>1.2</td>
<td>45 to 51</td>
<td>47.3</td>
<td>White, non-Hispanic</td>
</tr>
<tr>
<td>1.2</td>
<td>52 to 57</td>
<td>6.1</td>
<td>Other</td>
</tr>
<tr>
<td>0.6</td>
<td>58 or above</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Background

A reported 76.4% of participants were 18 to 24 years old, 13.3% as 25 to 31 years old, 5.5% as 32 to 38 years old, 1.8% as 39 to 44 years old, 1.2% as 45 to 51 years old, 1.2% as 52 to 57 years old, and 0.6% reported being 58 years old or older, (see Table 5). A reported 47.3% reported as white non-Hispanic, 17% Hispanic, 16.4% Black non-Hispanic, 12.7% Asian
or Pacific Islander, 0.6% American Indian or Alaska Native, and 6.1% other. The institution hosting the study allowed secondary education students to complete their high school diploma while taking higher education classes, but all students participating in the study were required to be 18 years old or older.

**Socio-Economic**

Participants reported as 87.3% single never married, 3.0% married, 7.9% married with one child, 0.6% married and divorced with one or more children, and 1.2% divorced with one or more children. Participants socio-economic status varied with 32.1% being $0 or not known, 27.3% being up to $25,000, 7.9% being to $40,960, 9.7% being to $61,400, 4.8% being up to $125,000, 4.8% being $125,000 and up, but 13.3% withheld their status. Participant’s education were reported as 6.7% self-funded, 11.5% relatives, 12.1% grants, 12.1% scholarships, 13.3% loans, 41.2% self-funded, relative, grant, loan and/or scholarship, and 3.0% other. When studying for courses, participants reported 1.8% do nothing, 3.0% repeat silently, 2.4% repeat aloud, 7.3% read silently, 1.2% read aloud, 22.4% write things down, and 61.8% use a combination.

**Secondary Education**

No participants reported to still be completing high school. The participant’s secondary educational backgrounds varied with 0.6 reporting tenth being the highest grade passed, 1.2% passing General Equivalence Diploma (GED) without studying, 3.0% passing GED with studying, and the remaining 95% completing twelfth grade. Participant’s High School GPA’s were reported 0.6% less than 1.0, 1.2% above previous less than 2.0, 0.6% above previous less than 2.5, 6.7% above previous less than 3.0, 28.5% above previous less than 3.5, 43.0% above previous less than 4.0, and 19.4% 4.0 or higher.
**Higher Education**

All participants reported higher education experience with 74.5% being primarily university undergraduate students, 24.8% being primarily university graduate students, and 0.6% being primarily community college students. (see Table 6). Participants level of higher education complete varied where 48.5% reported some coursework without a degree, 24.2% completed Technical School, Junior College or Community College, 17.0% completed a Bachelor’s degree, 9.1% completed a Master’s degree, 0.6% studied to pass Doctoral exams, and 0.6% complete a doctoral degree. Participant’s Higher Education GPA’s were reported 1.2% less than 1.0, 0.6% above previous less than 2.0, 3.6% above previous less than 2.5, 10.3% above previous less than 3.0, 24.8% above previous less than 3.5, 49.1% above previous less than 4.0, and 10.4% 4.0 or higher.

Table 6

**Participant by Classification**

<table>
<thead>
<tr>
<th>%</th>
<th>Classification</th>
<th>%</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6</td>
<td>Community College</td>
<td>0.6</td>
<td>Just starting Associates degree program.</td>
</tr>
<tr>
<td>74.5</td>
<td>University Undergraduate</td>
<td>5.5</td>
<td>Just starting Bachelor's degree program.</td>
</tr>
<tr>
<td>24.8</td>
<td>University Graduate</td>
<td>17.6</td>
<td>Undergraduate, Sophomore, 30 to 59 hours in program.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.5</td>
<td>Undergraduate, Junior, 60 to 89 hours in program.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17.0</td>
<td>Undergraduate, Senior, 90 or more hours in program.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.6</td>
<td>Graduating Senior, last semester of program.</td>
</tr>
</tbody>
</table>
**Computer Experience**

Participant’s first compute-use varied as 31.5% at 3 up to but not including 8, 49.1% at 8 up to but not including 12, 13.9% at 12 up to but not including 16, 1.8% at 16 up to but not including 20, 2.4% at 20 up to but not including 25, 0.6% at 25 up to but not including 30, and 0.6% at 30 or later. Participant’s first computer ownership including mobile Internet device was reported as 1.2% 5 up to but not including 8, 16.4% 8 up to but not including 12, 38.8% 12 up to but not including 16, 32.7% 16 up to but not including 20, 8.5% 20 up to but not including 25, 1.2% 25 up to but not including 30, and 1.2% 30 or later. The majority of participants reported no prejudice or bias experience that would significantly affect classroom learning as 79.4%, while 20.6% did report some negative experience, (see Table 7).

Table 7

**Characteristic Effects Classroom Experience**

<table>
<thead>
<tr>
<th>%</th>
<th>Level of Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>79.4</td>
<td>Not at all</td>
</tr>
<tr>
<td>8.5</td>
<td>Somewhat</td>
</tr>
<tr>
<td>3.6</td>
<td>Less than average</td>
</tr>
<tr>
<td>4.2</td>
<td>Average</td>
</tr>
<tr>
<td>3</td>
<td>More than average</td>
</tr>
<tr>
<td>0.6</td>
<td>Mostly</td>
</tr>
<tr>
<td>0.6</td>
<td>Constantly</td>
</tr>
</tbody>
</table>
Table 8

Participant Beliefs Toward Online Learning

<table>
<thead>
<tr>
<th>%</th>
<th>Expectation</th>
</tr>
</thead>
<tbody>
<tr>
<td>39.4</td>
<td>Learn more effectively in the classroom than online.</td>
</tr>
<tr>
<td>26.1</td>
<td>Do not see much difference online versus classroom.</td>
</tr>
<tr>
<td>10.9</td>
<td>Learn more effectively in the online than classroom.</td>
</tr>
<tr>
<td>16.4</td>
<td>No online experience, predict online less effective.</td>
</tr>
<tr>
<td>5.5</td>
<td>No online experience, predict no difference.</td>
</tr>
<tr>
<td>1.8</td>
<td>No online experience, predict online more effective.</td>
</tr>
</tbody>
</table>

Table 9

Participant Enjoyment Online Learning

<table>
<thead>
<tr>
<th>%</th>
<th>Enjoyment</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.5</td>
<td>Enjoy online experience significantly less.</td>
</tr>
<tr>
<td>25.5</td>
<td>No difference online versus classroom enjoyment.</td>
</tr>
<tr>
<td>20.6</td>
<td>Enjoy online experience significantly more.</td>
</tr>
<tr>
<td>15.2</td>
<td>No online experience, predict online less enjoyable.</td>
</tr>
<tr>
<td>5.5</td>
<td>No online experience, predict no difference.</td>
</tr>
<tr>
<td>1.8</td>
<td>No online experience, predict online more enjoyable.</td>
</tr>
</tbody>
</table>

Online Education

No one reported that he or she did not currently use online technologies for themselves, but 21.8% reported they do not use them much for education or training. An additional 18.2% reported they are unsure of their skills when learning online, while 60.0% reported they have learned online and feel comfortable. Participants reported 11.5% definitely would not take an
online course unless required, 35.2% probably would not, while 34.5% probably would, and
18.8% definitely would take an online course. Participant views toward learning effectiveness
and learning enjoyment were similarly distributed with two notable differences. Participants
reported that 39.4% learner more effectively in the classroom and 10.9% learn more effectively
online, where 31.5% enjoy online learning less and 20.6 enjoy online learning significantly
more, (see Tables 8 and 9). Participants reported that 83.0% had dropped no classes, 12.1%
dropped 1 class, 3.6% dropped 2 classes, and 1.2% dropped 4 classes, (see Table 10).

Table 10

*Online Class Completion*

<table>
<thead>
<tr>
<th>Range</th>
<th>Completed</th>
<th>Dropped</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>27.3</td>
<td>83.0</td>
</tr>
<tr>
<td>1</td>
<td>18.8</td>
<td>12.1</td>
</tr>
<tr>
<td>2</td>
<td>12.1</td>
<td>3.6</td>
</tr>
<tr>
<td>3</td>
<td>12.1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8.5</td>
<td>1.2</td>
</tr>
<tr>
<td>5 to 7</td>
<td>11.5</td>
<td></td>
</tr>
<tr>
<td>8 to 10</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>11 to 13</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>14 or more</td>
<td>6.1</td>
<td></td>
</tr>
</tbody>
</table>

Muilenburg and Berge Barriers to eLearning

*Reliability*

The barrier questions by Muilenburg and Berge were redesigned between version 1 and
version 2; fifteen questions were dropped (Muilenburg & Berge, 2005). A factor analysis was
performed in the Muilenburg and Berge 2005 study using 47 questions that identified eight
factors. Further analysis by Muilenburg and Berge led to a 46 question version provided by Zane L. Berge to this researcher (see Appendix D). A confirmatory principal component factor analysis (PCFA) with Varimax rotation was performed to extract eight factors using the sample from the study.

The Kaiser–Meyer–Olkin Measure of Sampling Adequacy (MSA) was .873 for the entire matrix. The MSA value is above the 0.80 meritorious level (Kaiser & Rice, 1974), which is consistent with the 2005 study. A Cronbach $\alpha$ analysis was performed using the factors identified in the 2005 study, and the factors identified by the confirmatory factor analysis (see Appendix H). The Cronbach $\alpha$ statistic based on the original study factors (2005) yielded similar but slightly better overall reliability statistics, (see Table 11).

Table 11

*L. Y. Muilenburg and Z. L. Berge Factor Analysis*

<table>
<thead>
<tr>
<th>Factors</th>
<th>Original Factor Cronbach $\alpha$</th>
<th>Confirmatory Factor Cronbach $\alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Administrative/instructor issues.</td>
<td>0.901</td>
<td>0.905</td>
</tr>
<tr>
<td>(2) Social interactions.</td>
<td>0.837</td>
<td>0.865</td>
</tr>
<tr>
<td>(3) Academic skills.</td>
<td>0.912</td>
<td>0.912</td>
</tr>
<tr>
<td>(4) Technical skills.</td>
<td>0.794</td>
<td>0.732</td>
</tr>
<tr>
<td>(5) Learner motivation.</td>
<td>0.870</td>
<td>0.870</td>
</tr>
<tr>
<td>(6) Time and support for studies.</td>
<td>0.785</td>
<td>0.699</td>
</tr>
<tr>
<td>(7) Cost and access to the Internet.</td>
<td>0.711</td>
<td>0.746</td>
</tr>
<tr>
<td>(8) Technical problems.</td>
<td>0.755</td>
<td>0.693</td>
</tr>
</tbody>
</table>

*Note:* Cronbach $\alpha$ on Original and Confirmatory factor loadings using the study sample.
Barriers

The Muilenburg and Berge (2005) barriers to distance learner are shown as factor scores in Table 12, but the scale items are detailed in Appendix I. The majority of participants did not consider Academic Skills, Technical Skills, or Technical Problems barriers reporting no issues as 74.5%, 71.1%, and 60.1% respectively. Almost half of the participants reported no issues with Time and Support for Studies or Cost and Access to the Internet, at 49.2% and 49.1% respectively. Another 42.3% and 38.2% respectively reported Time and Support for Studies or Cost and Access to the Internet as weak or moderate barriers. Close to four-tenths reported no concern with Administrative or Instructor Issues, Social Interactions, and Learner Motivation at 43.0%, 41.5%, and 36.8% respectively. Although few considered these barriers were strong or very strong issues, 47.3%, 40.9%, and 42.9% respectively considered the barriers were weak to moderate issues, (see Table 12).

Table 12

L. Y. Muilenburg and Z. L. Berge Factor Scores

<table>
<thead>
<tr>
<th>Factors</th>
<th>No</th>
<th>Weak</th>
<th>Moderate</th>
<th>Strong</th>
<th>Very</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Administrative/instructor issues.</td>
<td>43.0%</td>
<td>28.3%</td>
<td>19.0%</td>
<td>7.1%</td>
<td>2.6%</td>
</tr>
<tr>
<td>(2) Social interactions.</td>
<td>41.5%</td>
<td>21.3%</td>
<td>19.6%</td>
<td>10.7%</td>
<td>6.9%</td>
</tr>
<tr>
<td>(3) Academic skills.</td>
<td>74.5%</td>
<td>15.5%</td>
<td>7.3%</td>
<td>1.8%</td>
<td>1.0%</td>
</tr>
<tr>
<td>(4) Technical skills.</td>
<td>71.1%</td>
<td>20.5%</td>
<td>5.6%</td>
<td>2.3%</td>
<td>0.8%</td>
</tr>
<tr>
<td>(5) Learner motivation.</td>
<td>36.8%</td>
<td>23.3%</td>
<td>19.6%</td>
<td>13.3%</td>
<td>6.9%</td>
</tr>
<tr>
<td>(6) Time and support for studies.</td>
<td>49.2%</td>
<td>24.7%</td>
<td>17.6%</td>
<td>5.7%</td>
<td>2.8%</td>
</tr>
<tr>
<td>(7) Cost and access to the Internet.</td>
<td>49.1%</td>
<td>21.2%</td>
<td>17.0%</td>
<td>6.9%</td>
<td>5.8%</td>
</tr>
<tr>
<td>(8) Technical problems.</td>
<td>60.1%</td>
<td>26.6%</td>
<td>9.9%</td>
<td>3.0%</td>
<td>1.2%</td>
</tr>
</tbody>
</table>
Pretest and Posttest

Reliability

The pretest and posttest content question mean plots are listed in Figure 1. The pretest and matching posttest were designed to minimize random guesses from question responses. Review of the mean plots show the content questions performed consistently lower across measurements.

![Figure 1. Pretest and posttest question mean plots.](image)

The pretest and posttest control question mean plots are listed in Figure 2. Pretest and matching posttest were designed to minimize random guesses from question response graphs. Review of the mean plots shows the content questions performed consistently higher across measurements.
A repeated measure analysis of variance (RM-ANOVA) was performed to investigate the effect of learner modal preference and modal focused content delivery method on learner performance using web-based distance-learning pretest and posttest scores. There was a statistically significant effect of time on learner performance at the $p < .05$ level for the participants $F(1, 153) = 5.073, p = .026$. There were no other significant effects observed. The presence of a statistically significant effect of time on learner performance suggests the modal content may have had an impact on participants.

A repeated measure analysis of variance (RM-ANOVA) was performed to investigate the effect of learner modal preference and content delivery method over time on learner control using questions eleven through fifteen of web-based distance-learning pretest and posttest scores. There were no significant effects observed participants $F(1,
The lack of observed effects suggests no statistically significant maturation occurred over the semester on related content knowledge. The lack of a statistically significant effect on the control questions and the presence of a statistically significant effect on learner performance suggest the modal content did have an effect over time apart from maturation.

Table 13

*Satisfaction Instrument Factor Analysis Factor Matrix by Module*

<table>
<thead>
<tr>
<th>Modules</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>.518</td>
<td>.549</td>
<td>.631</td>
<td>.592</td>
<td>.599</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>.546</td>
<td>.565</td>
<td>.530</td>
<td>.575</td>
<td>.598</td>
<td>.715</td>
<td>.531</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>.515</td>
<td>.522</td>
<td>.507</td>
<td>.560</td>
<td>.544</td>
<td>.567</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>.541</td>
<td>.532</td>
<td>.595</td>
<td>.561</td>
<td>.688</td>
<td>.593</td>
<td>.587</td>
<td>.777</td>
</tr>
<tr>
<td>7 Reversed</td>
<td>.519</td>
<td>.575</td>
<td>.595</td>
<td>.550</td>
<td>.532</td>
<td></td>
<td>.546</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>.603</td>
<td>.614</td>
<td>.580</td>
<td>.642</td>
<td>.679</td>
<td>.741</td>
<td>.545</td>
<td>.622</td>
</tr>
<tr>
<td>10</td>
<td>.670</td>
<td>.686</td>
<td>.551</td>
<td>.720</td>
<td>.603</td>
<td>.725</td>
<td>.585</td>
<td>.636</td>
</tr>
<tr>
<td>KMO</td>
<td>.676</td>
<td>.774</td>
<td>.772</td>
<td>.709</td>
<td>.766</td>
<td>.822</td>
<td>.786</td>
<td>.708</td>
</tr>
<tr>
<td>Cronback $a_1$</td>
<td>.692</td>
<td>.763</td>
<td>.761</td>
<td>.751</td>
<td>.790</td>
<td>.807</td>
<td>.775</td>
<td>.747</td>
</tr>
<tr>
<td>Cronback $a_2$</td>
<td>.696</td>
<td>.763</td>
<td>.761</td>
<td>.756</td>
<td>.792</td>
<td>.807</td>
<td>.772</td>
<td>.752</td>
</tr>
</tbody>
</table>

*Note:* Cronbach $a_1$ was based on factor loading coefficients for that factor. Cronbach $a_2$ was based on overall factor loading coefficients given all module factor loadings using questions: 1, 3, 4, 6, 7R, 9, 10. Questions 2R, 5R, and 8 pattern loading values were less than .5 and discarded.
Modal-Focused Content: Satisfaction

Reliability

An exploratory factor analysis using principal axis factoring (PAF) extraction to extraction a single factor was performed on each learner content satisfaction measurement to consider the underlying relationship between content module satisfaction variables and a universal construct. The Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy (MSA) for the eight content module satisfaction instruments was above 0.6 for each module (see Table 13). The sample was sufficient for investigating factors because each MSA value between mediocre and meritorious level (Kaiser & Rice, 1974).

Figure 3. Scree plot Module 1.
A Scree plot was included in the analysis to investigate the number of statistical factor of the satisfaction instrument. The Scree plot from Module 1 is shown in Figure 3. Interpreting the number of factors from a Scree plot is discouraged because arbitrary judgment can be used (Rao, Miller, & Rao, 2008). Although it seems obvious a single factor was dominate, the first four factors have Eigen values greater than 1.

The Parallel Analysis Engine to Aid Determining Number of Factors to Retain (Patil, Singh, Mishra, & Donovan, 2007) was used to assist in defining factors. The Parallel Analysis Engine (PAE) tool allowed inputs of number of variables, sample size, and type of analysis to create Random Data Eigen (RDE) values to compare with the factor analysis Total Variance Explained table. The tool also allowed the researcher to select between Principle Components (PC) analysis and Principal Axis Factoring (PAF) analysis. The tool recommended using PC setting, but when choosing PAF for the study all RDE values were less than 0.5. Interpretation of this case was unclear. The PAE was run again with PC for comparison and yielded one factor, consistent with expectations. The use of this tool may not be appropriate given available inputs, study design and sample size; therefore analysis continued given the original design assumption that all questions are related to a single factor.

The resulting question factor loadings are shown in Table 13. Questions 2, 5 and 8 did not load onto the first factor across content satisfaction measures. Questions 2, 5 and 8 not loading with pattern values below 0.5 was consistent with Table 2 when considering overall construct design. Given these questions were about content and not about content satisfaction, it makes sense that they did not correlate with a universal satisfaction construct.
A Cronbach $\alpha_1$ analysis was performed on the factors identified in the factor matrix using content module satisfaction measures. A separate Cronbach $\alpha_2$ analysis was performed based on overall factor loading coefficients given all module variable factor loadings: 1, 3, 4, 6, 7R, 9, 10 (see Table 13). Cronbach $\alpha_1$ and Cronbach $\alpha_2$ were similar across loading constructs. Module 1 Cronbach $\alpha_1$ and Cronbach $\alpha_2$ were questionable at just below the .70 cut-off (Gliem & Gliem, 2003). Module 6 Cronbach $\alpha_1$ and Cronbach $\alpha_2$ was good at just above the .80 cut-off. The remaining modules were acceptably internally consistent between the .70 and .80 cut-offs.

An second exploratory factor analysis using principal axis factoring (PAF) extraction, Direct Oblimin with Kaiser Normalization rotation, and extraction of factors with Eigen values greater than 1 was performed on each learner content satisfaction measurement to investigate the efficacy of the universal factor construct. The resulting question factor pattern loadings for factor 1 are shown in Table 14. Factors 2, 3, and 4 were inconsistent and not recoverable. Questions 2, 5 and 8 did not load, having pattern values below 0.5. Questions 2, 5 and 8 were not specifically related to content satisfaction, and therefore did not correlate with a universal construct given the study sample, as discussed before. Question 4 not loading on factor one may be an indication that this question is a weak copy of another question given variable relationships in the factor matrix above (see Table 14). Question 4 did not substantially contribute to explain total variance.
Table 14

Satisfaction Instrument Factor Analysis by Module

<table>
<thead>
<tr>
<th>Questions</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>.698</td>
<td>.652</td>
<td>.587</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>.697</td>
<td>.521</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>.635</td>
<td>.671</td>
<td>.615</td>
<td>.558</td>
<td>.619</td>
<td>.597</td>
<td>.768</td>
<td></td>
</tr>
<tr>
<td>7 Reversed</td>
<td></td>
<td>.599</td>
<td>.768</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.558</td>
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<td>9</td>
<td>.701</td>
<td>.673</td>
<td>.541</td>
<td>.734</td>
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<td>.693</td>
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<td></td>
</tr>
<tr>
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<td>.526</td>
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<td>.776</td>
<td>.759</td>
<td>.631</td>
<td>.523</td>
<td></td>
</tr>
<tr>
<td>Cronbach $\alpha_1$</td>
<td>.658</td>
<td>.715</td>
<td>.726</td>
<td>.658</td>
<td>.790</td>
<td>.787</td>
<td>.748</td>
<td>.764</td>
</tr>
<tr>
<td>Cronbach $\alpha_2$</td>
<td>.704</td>
<td>.746</td>
<td>.741</td>
<td>.732</td>
<td>.769</td>
<td>.791</td>
<td>.743</td>
<td>.743</td>
</tr>
</tbody>
</table>

*Note:* Cronbach $\alpha_1$ was based on factor loading coefficients for that factor. Cronbach $\alpha_2$ was based on overall theoretical factor loading coefficients given all module factors using questions: 1, 3, 6, 7R, 9, 10. Questions 2R, 4, 5R, and 8 pattern values were less than .5 on factor one and discarded.

A Cronbach $\alpha_1$ analysis was performed on the factors identified given each content module factor analysis. A separate Cronbach $\alpha_2$ analysis was performed based on overall factor loading coefficients given all module factors using questions: 1, 3, 6, 7R, 9, 10 (see Table 14). Module 1 and Module 4 Cronbach $\alpha_1$ were questionable at just below the .70 cut-off (Gliem & Gliem, 2003). Remaining Cronbach $\alpha_1$ and Cronbach $\alpha_2$ were acceptably internally consistent between the .70 and .80 cut-offs.
Modal Focused Content: Performance

Reliability

An item analysis was performed to consider instrument construction. Learner performance was measured using a multiple-choice test design in an online environment. Individual questions were written using a systematic framework to produce similar difficulty across instruments. Overall performance was consistent with a normal statistical bell curve distribution.

According to Singamanen, the quality of test items is a measure of the quality of the overall instrument (2011, p.15). Singamanen said,

In traditional achievement tests, items displaying values closer to 0 (indicating that almost all students got the item wrong) and 1 (indicating that almost everyone got the item correct) should be revised or removed, because they offer little ability to discriminate among students at varying proficiency levels. Items having difficulty ranges from .2 to .8 provide the maximum information about proficiency among students. (p. 15).

The .2 to .8 rule of thumb creates a potential problem known as the ceiling effect (p. 68). The ceiling effect is the potential for all participants to bunch together at the maximum score. Research measures needs to be able to discriminate between differences; therefore question difficulty needs to be carefully designed to measure learner growth and not just learner performance. Because easier questions provide less discrimination, questions were designed to be between .05 and .55 to avoid the potential ceiling effect and increase discrimination.

The results of the item analysis are listed in Table 15. There were two questions that stand out on the Module 1 learner performance measure, both question difficulty scores were above .8 based on the study sample. The remaining item scores across modules one through eight, ranged from .455 to .612 for easier questions and .036 to .188 for the more difficult
questions. The overall average item performance scores ranged from .096 to .606 in difficulty which was within .05 of the original design.

Table 15

*Module Item Analysis by Difficulty*

<table>
<thead>
<tr>
<th>Module</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.685</td>
<td>.873</td>
<td>.455</td>
<td>.612</td>
<td>.545</td>
<td>.600</td>
<td>.552</td>
<td>.533</td>
<td>.497</td>
<td>.709</td>
<td>.606</td>
</tr>
<tr>
<td></td>
<td>.661</td>
<td>.824</td>
<td>.424</td>
<td>.600</td>
<td>.539</td>
<td>.552</td>
<td>.467</td>
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<td></td>
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<td>.509</td>
<td>.382</td>
<td>.364</td>
<td>.424</td>
<td>.576</td>
<td>.479</td>
</tr>
<tr>
<td></td>
<td>.467</td>
<td>.455</td>
<td>.376</td>
<td>.521</td>
<td>.382</td>
<td>.461</td>
<td>.339</td>
<td>.321</td>
<td>.358</td>
<td>.558</td>
<td>.424</td>
</tr>
<tr>
<td></td>
<td>.358</td>
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<td></td>
<td>.042</td>
<td>.042</td>
<td>.188</td>
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<td>.060</td>
<td>.036</td>
<td>.055</td>
<td>.182</td>
<td>.109</td>
<td>.073</td>
<td>.096</td>
</tr>
</tbody>
</table>

*Note:* Module values are sorted independent of each other. Module average difficulty weights are at the bottom.

**VAK Reliability**

There was a statistically significant negative correlation representing a small effect (Cohen in Field, 2009) between pretest VARK aural and posttest VAK visual, $r = -.16$, $n = 165$, $p = .047$. There was a statistically significant negative correlation representing a small effect between pretest VARK read/write and posttest VAK aural, $r = -.18$, $n = 165$, $p = .023$. There was also a statistically significant negative correlation representing a small effect between pretest
VARK read\write and posttest VAK kinesthetic, $r = -.24$, $n = 165$, $p = .002$. There was a statistically significant positive correlation representing a small effect between pretest VARK kinesthetic and posttest VAK kinesthetic, $r = .20$, $n = 165$, $p = .009$. No other statistically significant relationships were observed between the pretest VARK and the posttest VAK.

There was a statistically significant negative correlation representing a small effect between posttest VARK aural and posttest VAK aural, $r = -.16$, $n = 165$, $p = .035$. There was also a small negative correlation between pretest VARK aural and posttest VAK kinesthetic, $r = -.19$, $n = 165$, $p = .014$. No other statistically significant relationships were observed between the posttest VARK and the posttest VAK.

Quasi-Experimental Longitudinal Study Results

Learner Performance

A two-way 4 x 3 repeated measures analysis of variance (RM-ANOVA) with a Post hoc analysis was performed using a Difference contrast over 10 measures to investigate the effects of learner modal preference (Preference) and modal focused content delivery method supplemented with the visual content delivery method (Content) on learner performance (Performance). The two independent variables were Preference (within-subjects: aural, read/write, kinesthetic, visual) as measured by the VARK Questionnaire and modal focused content delivery methods each supplemented with the visual content delivery method (Content) (between-subjects: aural with visual cues, read/write with visual cues, kinesthetic with visual cues) created by this researcher to match the VARK model taxonomies. The dependent variable measures were Performance on pretest, matching posttest, and module content question scores. Repeated observations of the dependent variable Performance were continuous ratio measures from 0 to 10 of each individual module score.
The study investigated the RM-ANOVA main and interaction effects for Difference contrasts between Preference and Content using a full factorial model with sum of squares type 3 analysis. The RM-ANOVA included Post Hoc tests using the Tukey honestly significant difference correction to reduce Type I family-wise errors to indicate which mean differences were noteworthy for any differences found in the a priori test of all pair-wise comparisons. A statistical probability cutoff of \( p = .05 \) was considered statistically significant for the study.

There was an observed statistically significant difference for Performance based on Time in Multivariate Tests, \( F(9, 145) = 9.980, p < .001; \) Wilk's \( \Lambda = 0.617, \eta_p^2 = .383 \) (see Figure 4). Mauchly's Test of Sphericity indicated that the assumption of sphericity was violated, \( \chi^2(44) = 89.621, p < .001. \) The Greenhouse-Geisser correction, \( \varepsilon = 0.877, \) and the Huynh and Feldt correction, \( \varepsilon = 0.996, \) were both closer to 1 than the lower bound estimate, \( \varepsilon = 0.111. \) Because "the more homogeneous the variances of difference, and hence the closer the data are to being spherical" (Field, 2009, p. 474-5), the Greenhouse-Geisser correction and Huynh and Feldt correction \( p \) values will be averaged to inform \( p \) value analysis. The main effect of Time on Performance for the Tests of Within-Subjects Effects Greenhouse-Geisser correction and Huynh and Feldt correction \( p \) values were averaged due to the statistically significant Mauchly's Test of Sphericity, and the overall value was observed statistically significant at \( p_{avg} < .001, \) therefore the more conservative Greenhouse-Geisser correction was used (Field, 2009, p. 477). The main effect of Time was observed statistically significant in Tests of Within-Subjects Effects, \( F(7.893,1207.645) = 12.437, p < .001, \eta_p^2 = .075. \)
Figure 4. Learner performance plot.

Table 16

Learner Performance Over Time

<table>
<thead>
<tr>
<th>Versus Previous</th>
<th>F</th>
<th>p</th>
<th>$\eta^2_p$</th>
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</thead>
<tbody>
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<td>Module 2</td>
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<td>Module 3</td>
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<td>.013</td>
<td>.040</td>
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<td>Module 4</td>
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<tr>
<td>Module 10</td>
<td>19.509</td>
<td>&lt; .001</td>
<td>.113</td>
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</table>
Because Time on Performance was observed to be statistically significant, Tests of Within-Subjects Contrasts for Time on Performance was investigated. A review of Within-Subjects Contrasts showed that there was no statistically significant change observed in Module 1 versus Module 2, the introductory module versus the first content module. Across all other repeated observations, statistically significant change was observed, (see Table 16).

Research Question 1

Research question asked, “What is the effect of learner modal preference on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?”

The study hypothesized there is a statistically significant difference between performance of learners reporting similar VARK-based modal preferences (visual, aural, read/write, kinesthetic) across all VARK-based content delivery methods supplemented with the visual content delivery method (aural, kinesthetic, read/write) among online computer-based learners. To answer this question the impact of repeated measures (Time) and learner personal learning profile (Preference) on the measure learner performance (Performance) was investigated within-subjects and Content on the Performance was investigated between-subjects using a repeated measures analysis of variance (RM-ANOVA) with a Post hoc analysis. There was not an observed statistically significant difference in Performance based on Time by Preference in Multivariate Tests, \( F(27, 424.117) = .877, p = .646; \) Wilk's \( \Lambda = 0.853, \eta^2_p = .052. \) The interaction effect of Time by Preference on Performance for the Tests of Within-Subjects Effects Greenhouse-Geisser correction and Huynh and Feldt correction \( p \) values were averaged due to the statistically significant Mauchly’s Test of Sphericity, and the overall value was observed not statistically significant at \( p_{avg} = .623, \) therefore the more conservative Greenhouse-Geisser
correction was used (Field, 2009, p. 477). The Tests of Within-Subjects Effects for Time by Preference was not statistically significant, $F(23.679,1207.645) = .889, p = .617, \eta^2_p = .017$. The Tests of Between-Subjects Effects for Preference was not statistically significant, $F(3,153) = .430, p = .732, \eta^2_p = .008$. No statistically significant effect was observed.

**Research Question 2**

What is the effect of content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

The study hypothesized there is a statistically significant difference between performance of learners using similar content delivery methods supplemented with the visual content delivery method across all learner modal preferences among online computer-based learners. To answer this question the impact of repeated measures (Time) and content delivery methods supplemented with the visual content delivery method (Content) on the measure learner performance (Performance) was investigated within-subjects and Content on the Performance was investigated between-subjects using a repeated measures analysis of variance (RM-ANOVA) with a Post hoc analysis. There was not an observed statistically significant difference in Performance based on Time by Content in Multivariate Tests, $F (18, 290.000) = .731, p = .778$; Wilk's $\Lambda = 0.915, \eta^2_p = .043$. The interaction effect of Time by Content on Performance for the Tests of Within-Subjects Effects Greenhouse-Geisser correction and Huynh and Feldt correction $p$ values were averaged due to the statistically significant Mauchly’s Test of Sphericity, and the overall value was observed not statistically significant at $p_{avg} = .208$, therefore the more conservative Greenhouse-Geisser correction was used (Field, 2009, p. 477).
The Tests of Within-Subjects Effects for Time by Content was not statistically significant, $F(15.786, 1207.645) = 1.265, p = .213, \eta_p^2 = .016$. The Tests of Between-Subjects Effects for Content was statistically significant, $F(2,153) = 5.375, p = .006, \eta_p^2 = .066$ (see Figure 5). The Post Hoc analysis showed the mean difference (MD) scores for modal focus content delivery method were statistically significantly different between Content based on the VARK model, read/write and aural (MD = .542, $p = .007$), and read/write and kinesthetic (MD = .697, $p = .001$). There was a statistically significant difference between learner performance using VARK-based read/write Content, $M = 3.930, SD = 1.281$, compared to aural Content, $M = 3.333, SD =$

![Figure 5. Content plots.](image-url)
105, and kinesthetic Content, M = 3.063, SD = .756, across all learner modal preferences among online computer-based learners.

Research Question 3

What is the interaction effect of learner modal preference and content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

The study hypothesized that there is a statistically significant difference between performance of learners when modal preferences and content delivery methods supplemented with the visual content delivery method interact among online computer-based learners.

To answer this question the impact of repeated measures (Time), learner personal learning profile (Preference), and content delivery methods supplemented with the visual content delivery method (Content) on the measure learner performance (Performance) was investigated within-subjects and Content on the Performance was investigated using a repeated measures analysis of variance (RM-ANOVA) with a Post hoc analysis. There was not an observed statistically significant difference in Performance based on Time by Content by Preference in Multivariate Tests, $F(54, 743.952) = 1.022, p = .433$; Wilk's $\Lambda = 0.694, \eta^2_p = .059$. The interaction effect of Time by Content by Preference on Performance for the Tests of Within-Subjects Effects was not statistically significant, $F(47.359, 1207.645) = .934, p = .611, \eta^2_p$
= .035. The Tests of Between-Subjects Effects for Content by Preference was not statistically significant, $F(6,153) = .929, p = .476, \eta^2_p = .035$. No statistically significant effect was observed.

Learner Satisfaction

The PASW software was used to answer the last three research questions using a mixed-method design. A two-way 4 x 3 repeated measures analysis of variance (RM-ANOVA) with a Post hoc analysis was performed using a Difference contrast over 8 measures to investigate the effects of learner modal preference (Preference) and modal focused content delivery method supplemented with the visual content delivery method (Content) on learner self-reported satisfaction (Satisfaction). The two independent variables were learner modal preference (within-subjects: aural, read/write, kinesthetic, visual) as measured by the VARK Questionnaire and focused categorical content delivery methods supplemented with the visual content delivery method (between-subjects: aural with visual cues, read/write with visual cues, kinesthetic with visual cues) created by this researcher to match the VARK modal categories. The dependent variable measures were learner self-reported module satisfaction scores. Repeated observations of the dependent variable learner self-reported module satisfaction scores are continuous ratio measures from 1 to 5, strongly disagree to strongly agree, of each individual module score.

The study investigated the RM-ANOVA main and interaction effects for differences between learner modal preferences and content delivery method using a full factorial model with sum of squares type 3 analysis. The RM-ANOVA included Post Hoc tests using the Tukey honestly significant difference correction to reduce Type I family-wise errors and indicate which mean differences were noteworthy for any differences found in the a priori test of all pair-wise
comparisons. A statistical probability cutoff of $p = .05$ was considered statistically significant for the study.

There was an observed statistically significant difference in Satisfaction based on Time in Multivariate Tests, $F(7, 146) = 2.674, p = .012$; Wilk's $\Lambda = 0.886, \eta_p^2 = .114$ (see Figure 6). Mauchly's Test of Sphericity indicated that the assumption of sphericity was violated, $\chi^2(27) = 79.655, p < .001$. The Greenhouse-Geisser correction, $\varepsilon = 0.845$, and the Huynh and Feldt correction, $\varepsilon = 0.947$, were both closer to 1 than the lower bound estimate, $\varepsilon = 0.111$. Because “the more homogeneous the variances of difference, and hence the closer the data are to being spherical” (Field, 2009, p. 474-5), the Greenhouse-Geisser correction and Huynh and Feldt correction $p$ values will be averaged to inform $p$ value analysis.

![Estimated Marginal Means of Satisfaction](image)

**Figure 6.** Satisfaction plot.
The main effect of Time on Satisfaction for the Tests of Within-Subjects Effects Greenhouse-Geisser correction and Huynh and Feldt correction $p$ values were averaged due to the statistically significant Mauchly’s Test of Sphericity, and the overall value was observed statistically significant at $p_{\text{avg}} = .004$, therefore the more conservative Greenhouse-Geisser correction was used (Field, 2009, p. 477). The main effect of Time on Satisfaction was observed statistically significant in Tests of Within-Subjects Effects, $F(5.917, 899.362) = 3.222, p = .004, \eta^2_p = .021$.

Because Time on Satisfaction was observed to be statistically significant, Tests of Within-Subjects Contrasts for Time on Satisfaction was investigated further. The Tests of Within-Subjects Contrasts for Time on Satisfaction was statistically significant between measure three (Module 3) versus previous, $F(1,152) = 7.229, p = .008, \eta^2_p = .045$, between measure four (Module 4) versus previous, $F(1,152) = 4.166, p = .043, \eta^2_p = .024$, between measure five versus previous, $F(1,152) = 10.041, p = .002, \eta^2_p = .062$, (see Table 17).

Table 17

*Learner Satisfaction Over Time*

<table>
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<tr>
<th>Versus Previous</th>
<th>$F$</th>
<th>$p$</th>
<th>$\eta^2_p$</th>
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</table>
Research Question 4

What is the effect of learner modal preference on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

The study hypothesized there is a statistically significant difference between learner self-reported satisfaction of learners reporting similar learner modal preferences across all content delivery methods supplemented with the visual content delivery method among online computer-based learners.

To answer this question the impact of repeated measures (Time) and learner personal learning profile (Preference) on the measure learner self-reported satisfaction (Satisfaction) was investigated within-subjects and Content on the Performance was investigated between-subjects using a repeated measures analysis of variance (RM-ANOVA) with a Post hoc analysis. There was not an observed statistically significant difference in learner self-reported satisfaction based on Time by Preference in Multivariate Tests, $F(21, 419.783) = 1.294, p = .174$; Wilk's $\Lambda = 0.835, \eta^2_p = .058$. The interaction effect of Time by Preference on Satisfaction for the Tests of Within-Subjects Effects Greenhouse-Geisser correction and Huynh and Feldt correction $p$ values were averaged due to the statistically significant Mauchly’s Test of Sphericity, and the overall value was observed not statistically significant at $p_{avg} = .287$, therefore the more conservative Greenhouse-Geisser correction was used (Field, 2009, p. 477). The Tests of Within-Subjects Effects for Time by Preference was not statistically significant, $F(17.751,899.362) = 1.159, p = .290, \eta^2_p = .022$. The Tests of Between-Subjects Effects for Preference was not statistically significant, $F(3,152) = 1.902, p = .132, \eta^2_p = .036$. No statistically significant effect was observed.
Research Question 5

What is the effect of content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

The study hypothesized there is a statistically significant difference between self-reported satisfaction of learners using similar content delivery methods supplemented with the visual content delivery method across all learner modal preferences among online computer-based learners.

To answer this question the impact of repeated measures (Time) and content delivery methods supplemented with the visual content delivery method (Content) on the measure learner self-reported satisfaction (Satisfaction) was investigated within-subjects and Content on the Performance was investigated between-subjects using a repeated measures analysis of variance (RM-ANOVA) with a Post hoc analysis. There was not an observed statistically significant difference in Satisfaction based on Time by Content in Multivariate Tests, \( F(14,292.000) = 1.234, p = .250; \) Wilk's \( \Lambda = 0.891, \eta_p^2 = .056. \) The interaction effect of Time by Content on Satisfaction for the Tests of Within-Subjects Effects Greenhouse-Geisser correction and Huynh and Feldt correction \( p \) values were averaged due to the statistically significant Mauchly’s Test of Sphericity, and the overall value was observed not statistically significant at \( p_{avg} = .249, \) therefore the more conservative Greenhouse-Geisser correction was used (Field, 2009, p. 477). The Tests of Within-Subjects Effects for Time by Content was not statistically significant, \( F(11.834,899.362) = 1.238, p = .253, \eta_p^2 = .016. \) The Tests of Between-Subjects Effects for Content was not statistically significant, \( F(2,152) = 1.228, p = .296, \eta_p^2 = .016. \) No statistically significant effect was observed.
Research Question 6

What is the interaction effect of learner modal preference and content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

The study hypothesized there is a statistically significant difference between learner self-reported satisfaction of learners across all modal preferences and across all content delivery methods supplemented with the visual content delivery method among online computer-based learners.

To answer this question the impact of repeated measures (Time), learner personal learning profile (Preference), and content delivery methods supplemented with the visual content delivery method (Content) on the measure learner self-reported satisfaction (Satisfaction) was investigated within-subjects and Content on the Performance was investigated using a repeated measures analysis of variance (RM-ANOVA) with a Post hoc analysis. There was not an observed statistically significant difference in Satisfaction based on Time by Content by Preference in Multivariate Tests, $F(42,688.253) = 1.273, p = .119$; Wilk's $\Lambda = 0.704, \eta^2_p = .057$.

The interaction effect of Time by Content on Satisfaction for the Tests of Within-Subjects Effects Greenhouse-Geisser correction and Huynh and Feldt correction $p$ values were averaged due to the statistically significant Mauchly’s Test of Sphericity, and the overall value was observed not statistically significant at $p_{avg} = .195$, therefore the more conservative Greenhouse-Geisser correction was used (Field, 2009, p. 477). The Tests of Within-Subjects Effects for Time by Content by Preference was not statistically significant, $F(35,501,899.362) = 1.198, p = .189, \eta^2_p = .045$. No statistically significant effect was observed. The Tests of Between-Subjects
Effects for Content by Preference was not statistically significant, $F(6,152) = .642, p = .697, \eta^2_p = .025$. No statistically significant effect was observed.

Causal-Comparative Study Results

Mean correlations were examined to consider causal-comparative relationships. The Muilenburg and Berge (2005) demographics and barriers to distance-learning factor scores were correlated with learner performance (Performance) and learner self-reported satisfaction (Satisfaction) factor scores. The Pearson $r$ statistic was used to evaluate correlations.

Learner Performance

A Pearson $r$ statistic was computed to explore statistically significant relationships between Muilenburg and Berge (2005) demographics and Performance. There was a statistically significant positive correlation representing a small effect (Cohen in Field, 2009) between age and Performance, $r = .22, n = 165, p = .004$. There was a statistically significant positive correlation small effect between marital status and Performance, $r = .12, n = 165, p = .010$. There was a small positive correlation between socio-economic and Performance, $r = .16, n = 165, p = .035$.

A separate Pearson $r$ statistic was computed to explore statistically significant relationships between Muilenburg and Berge (2005) barrier factors scores and Performance. There was a statistically significant negative correlation representing a small effect (Cohen in Field, 2009) between academic skills and Performance, $r = -.17, n = 165, p = .027$. There was a statistically significant negative correlation representing a small effect between learner motivation and Performance, $r = -.16, n = 165, p = .038$. There was a statistically significant negative correlation representing a small effect between time and support for studies and Performance, $r = -.25, n = 165, p = .002$. There was a statistically significant negative
correlation representing a small effect between cost and access to the Internet and Performance, $r = -.20$, $n = 165$, $p = .008$.  

Learner Satisfaction  

A Pearson $r$ statistic was computed to explore statistically significant relationships between Muilenburg and Berge (2005) demographics and Satisfaction. There was a statistically significant negative correlation representing a small effect (Cohen in Field, 2009) between likelihood of taking a future online course and Satisfaction, $r = -.16$, $n = 165$, $p = .037$. There was a statistically significant negative correlation representing a small effect between highest level high school completed and Satisfaction, $r = -.18$, $n = 165$, $p = .023$. There was a statistically significant negative correlation representing a small effect between high school GPA and Satisfaction, $r = -.18$, $n = 165$, $p = .019$. There was a statistically significant negative correlation representing a small effect between marital status and Satisfaction, $r = -.29$, $n = 165$, $p < .001$.  

A Pearson $r$ statistic was computed to explore statistically significant relationships between Muilenburg and Berge (2005) barrier factors scores and Satisfaction. There were no statistically significant correlations observed between Muilenburg and Berge barrier factors scores and Satisfaction. Because factors scores were not significant, individual Muilenburg and Berge barrier items were considered. There was a statistically significant positive correlation representing a small effect (Cohen in Field, 2009) between concern for online course quality and Satisfaction, $r = .18$, $n = 165$, $p = .022$. There was a statistically significant positive correlation representing a small effect between concern for online instructor quality and Satisfaction, $r = .20$, $n = 165$, $p = .012$. There was a statistically significant negative correlation representing a small effect between concern family will be disruptive and Satisfaction, $r = -.17$, $n = 165$, $p = .027$.  

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There was a statistically significant positive correlation representing a small effect between marital status and Satisfaction, $r = .16$, $n = 165$, $p = .041$. 
CHAPTER V
DISCUSSION, IMPLICATIONS, AND CONCLUSIONS

Introduction

Experts struggled to find consensus defining learning efficacy constructs, but generally agreed that understanding learners will benefit instructional design (Genovese, 2004). Universities are examining retention and attrition more closely (Smith, 2014) and both have been linked to student satisfaction (Chang & Smith, 2008). Limited availability of tax dollars has motivated state and federal governments to fund the most effective programs, and therefore, to find a way to measure effectiveness (WBEC, 2000). Technology advanced quickly and changed the way people interact with content (Jones & Knezek, 1994; Alexander, Schallert, & Reynolds, 2009; McLuhan, 1966). These changes have complicated creating learning constructs and measuring effective programs because to some degree learning is a subjective experience (Zabkar et al., 2015). Online content delivery methods are the course and the instructor in a real sense (McCombs, 2015), therefore we need to understand their impact on the learning process to avoid bias and help students meet their goals.

The study was performed to aid the knowledge base of online course design by synthesizing multiple learning theories to link learner modal preference (Preference) and content delivery method content delivery method supplemented with visual content (Content) to learner performance and learner satisfaction using web-based online content. The causal-comparative and quasi-experimental mixed method longitudinal analysis examined whether or not the participant’s Preference, Content, or the interaction of Preference and Content, influenced learner performance and/or learner self-reported satisfaction over the semester. The six research
questions are discussed below, and the implications, recommendations, future research, and conclusions follow the initial discussion.

Discussion

The VARK model was a popular tool used in the study to measure the independent grouping variable learner modal preference (Preference). The content modules were offered in an online course environment that was setup to operate as a cohesive learning management system. Dowaliby and Schumer (1972) suggested that because of the impact of technology on learning, the only way to investigate different content delivery methods in distance-learning might be to intentionally incorporate treatment into the research design (p. 126); therefore, the second independent grouping variable used the VARK taxonomies as a guide to create modal focused content (Content). The online environment manipulated the content delivery method and presented each group of participants a specific modal focused content module—one a week for eight weeks over the semester. Because Manochehri and Young (2006) found a statistically significant relationship between teaching methodology and learner satisfaction, and Jan (2015) found a statistically significant relationship between self-efficacy and learner satisfaction, learner performance (second dependent variable) was measured after learner satisfaction (first dependent variable) to mitigate the possible impact of the learner’s perceived performance on the learner’s satisfaction measures.

Quasi-Experimental

Learner Performance

The first three questions concerned learner performance. Learner performance was observed to be statistically significantly different across content module measures. Although each module was built on prior content, the statistical difference could be attributed to the way
each content module and learner performance measure was created separately to measures different content knowledge; therefore, the learner performance measure on each module would be expected to be different across measures.

Each learner performance content measure was built using a question template, but question operation did not vary directly with question template type and learner performance was normally distributed. This suggests that question types were not biased against learners. This leads us to consider other possible causes of differences over time.

*Discussion for Research Question 1*

What is the effect of learner modal preference on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

This researcher hypothesized that there is a statistically significant difference between performance of learners reporting similar modal preferences across all content delivery methods supplemented with the visual content delivery method among online computer-based learners. Question one investigated the effect of learner modal preference (Preference) on learner performance (Performance) given web-based modules (Time) and aural, read/write, kinesthetic VARK-based modal focused content supplemented with the visual content delivery method (Content) among online computer-based learners. No statistically significant differences were observed for participants on Performance across the content modules (Time) given Preference—interaction of Time and Preference. Similarly, no statistically significant differences were observed on Performance of participant groups based on Preference. The study failed to reject the null hypothesis.
The study findings suggested that there was no meaningful difference in Performance across repeated measures (Time) given their Preference, and there was no meaningful difference in Performance given Preference for any one Preference group compared to any other Preference group. This is consistent with Urval et al. (2014) using the VARK and Lu et al. (2003) using the Group Embedded Figures Test (GEFT) learning style, where no relationship was found between Performance and Preference. This finding is inconsistent with Leung et al. (2014) findings. Leung et al. compared two different courses that were both in traditional classroom setting where the material and the measures were different. Because the Leung et al. study focused on different content and measures, it may support Alexander, Schallert, and Reynolds’ (2009) finding on contextual influences on Performance in varied informational paradigms.

The lack of meaningful differences is important because it suggests that given the same Content types, Preference does not influence Performance. While the result may appear to support Greenfield’s (2007) concern that learning styles do not matter, it more correctly suggests that given the same Content types, Preference measured by the VARK does not meaningfully predict learner performance. However, different from Leung et al. (2014), the study question does not address when content varies.

Discussion for Research Question 2

What is the effect of content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

This researcher hypothesized that there is a statistically significant difference between performance of learners using similar content delivery methods supplemented with the visual content delivery method across all content delivery methods supplemented with the visual
content delivery method among online computer-based learners. Question two investigated the effect of modal focused content supplemented with the visual content delivery method (Content) on learner performance (Performance) given web-based modules (Time) and aural, read/write, kinesthetic VARK-based modal focused content supplemented with the visual content delivery method (Content) among online computer-based learners. No statistically significant differences were observed for participants on Performance across the content modules (Time) given the Content (interaction of Time and Content). However, statistically significant differences were observed on Performance of participant groups for the VARK-based read/write modal focused content supplemented with visual content (Content) compared to other methods. The study rejected the null hypothesis, a difference was observed.

The study findings suggested that there was no meaningful difference in Performance across repeated measures (Time) given Content, but that there was a meaningful difference in Performance given VARK-based read/write modal focused Content based on the VARK model compared to other Preference groups. It is important to note that although the participants that received VARK-based read/write content did not out-perform any other group on the pretest, the participants that received the VARK-based read/write content consistently out-performed all other learners across all learner performance measures including the posttest. This means that content delivery method supplemented with visual content did differentiate learners on performance when comparing the VARK-based read/write modality to every other VARK-based content deliver method supplemented with visual content.

The finding is consistent with Manochehri and Young’s (2006) finding for student-based learners using Kolb’s Learning Style Inventory (K-LSI) that contains a measure of learner profile when comparing traditional and online methods. Interestingly the finding is inconsistent with
Kozub (2010) using Kolb’s Learning Style Inventory, Lu et al. (2003) using the Group Embedded Figures Test (GEFT) to determine learning style, and Manochehri and Young’s (2006) finding for instructor-based learners. It is important to note than none of these study’s used modal focused content—the content was generally described as either online courses or online and traditional courses. This may suggest that some learning style measures had a masking effect because they are multidimensional and the VARK looks at only one dimension of learning; therefore, it may be more useful (Fleming, Appendix B).

The finding is import for two reasons. First, it may suggest that Content choice can impact Performance and artificially raise or lower scores. Second, this finding is important because it may suggest a weakness in the Leung et al. (2014) study. The Leung et al. study compared two courses that by nature have different but related content messages. Consistent with the Alexander, Schallert, and Reynolds (2009) finding on contextual influences, Leung et al. noted the two courses “tend to require differences in information processing” (p. 113).

Discussion for Research Question 3

What is the interaction effect of learner modal preference and content delivery method supplemented with the visual content delivery method on learner performance across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

This researcher hypothesized that there is a statistically significant difference between performance of learners when modal preferences and content delivery methods supplemented with the visual content delivery method interact across all content delivery methods supplemented with the visual content delivery method among online computer-based learners. Question three investigated the interaction effect of learner modal preference (Preference) and
modal focused content supplemented with the visual content delivery method (Content) on learner performance (Performance) given web-based modules (Time) and aural, read/write, kinesthetic VARK-based modal focused content supplemented with the visual content delivery method (Content) among online computer-based learners. No statistically significant differences were observed for participants on Performance across the content modules (Time) given the Content and Preference—interaction of Time, Content, and Preference. Similarly, no statistically significant differences were observed on Performance of participant groups based on Content and Preference—interaction of Content and Preference. The study failed to reject the null hypothesis.

The study findings suggested that there was no meaningful difference in Performance across repeated measures (Time) given the interaction of their Preference and Content, and there was no meaningful difference in Performance given the interaction of Preference and Content for any one interaction group compared to any other interaction group. In addition to Fleming’s (2006) difficulty with statistical validity, this is consistent with Greenfield’s (2007) warning that Preference may simply not exist—if Preference does not exist as a valid construct then it would be hard pressed to cause an interaction effect. This finding is consistent with Kozub (2010) using Preference with web-based materials and Manochehri and Young (2006) investigating at the interaction effect of Content (teaching methodology) and Preference between online and traditional classroom settings for teacher-based learners.

The study finding is important because it addressed an absence of meaningful focused research identified by Kozub (2010). The lack of meaningful differences is also important because it identified a hidden bias, using the same content that suggested a meaningful difference exists for the VARK-based read/write content delivery method and adding learner modal
preference masks the influence of content delivery method on learner performance. Consistent with Pike and Phillippi (1989), the finding highlights the importance of using factorial research methods to investigate more than one aspect.

*Learner Satisfaction*

The final three questions concerned learner self-reported satisfaction measures. Although learner content satisfaction measures were similar across time, a meaningfully different between Module 3 and previous self-reported satisfaction measures, and Module 5 and previous self-reported satisfaction measures was observed. Reviewing the reported measures showed that the differences were positive increases compared to prior measures.

The first learner self-reported satisfaction measure between Module 1 and Module 2 was small and not meaningful; however, the second learner self-reported satisfaction measure between Module 3 and previous modules was larger and meaningful. This change was maintained over time. A second meaningful increase was measured between Module 5 and previous modules. This could be attributed to the way each content module was created separately and learners could simply be enjoying the content more than previously. This change was not maintained over time and simply reflects a fluctuation. The sustained learner self-reported satisfaction measure following Module 2 suggests that some change occurred.

*Discussion for Research Question 4*

What is the effect of learner modal preference on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

This researcher hypothesized that there is a statistically significant difference between self-reported satisfaction of learners reporting similar modal preferences across all content
delivery methods supplemented with the visual content delivery method among online computer-based learners. Question four investigated the effect of learner modal preference (Preference) on learner self-reported satisfaction (Satisfaction) given web-based modules (Time) and aural, read/write, kinesthetic VARK-based modal focused content supplemented with the visual content delivery method (Content) among online computer-based learners. No statistically significant differences were observed for participants on Satisfaction across the content modules (Time) given Preference—interaction of Time and Preference. Similarly, no statistically significant differences were observed on Satisfaction of participant groups based on Preference. The study failed to reject the null hypothesis.

The study findings suggested that there was no meaningful difference in Satisfaction across repeated measures (Time) given their Preference, and there was no meaningful difference in Satisfaction given Preference for any one Preference group compared to any other Preference group. This finding is consistent with Sinclaire (2012) using Preference and Manochehri and Young’s (2006) finding using Kolb’s Learning Style Inventory (K-LSI) that contains a measure of learner profile. This leads us to consider whether learner expectations changed over time, Content improved, or the interaction of a flexible Preference and Content were possible causes of differences over time.

The lack of meaningful differences is important because it suggests that given the same Content types, Preference does not meaningfully influence learner satisfaction. While the result may appear to support Greenfield’s (2007) concern that learning styles do not matter, it more correctly suggests that given the same Content types, Preference measured by the VARK does not meaningfully predict learner satisfaction. It is important to remember that the study used modal focused content, so Alexander, Schallert, and Reynolds’ (2009) finding on contextual
influences may indicate learner satisfaction might change if the informational paradigms change. Also, Preference alone cannot account for the meaningful difference between Module 3 and previous self-reported satisfaction measures, and Module 5 and previous self-reported satisfaction measures.

Discussion for Research Question 5

What is the effect of content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

This researcher hypothesized that there is a statistically significant difference between self-reported satisfaction of learners using similar content delivery methods supplemented with the visual content delivery method across all content delivery methods supplemented with the visual content delivery method among online computer-based learners. Question five investigated the effect of content delivery method supplemented with the visual content delivery method (Content) on learner self-reported satisfaction (Satisfaction) given web-based modules (Time) and aural, read/write, kinesthetic VARK-based modal focused content supplemented with the visual content delivery method (Content) among online computer-based learners. No statistically significant differences were observed for participants on Satisfaction across the content modules (Time) given Content—interaction of Time and Content. Similarly, no statistically significant differences were observed on Satisfaction of participant groups based on Content. The study failed to reject the null hypothesis.

The study findings suggested that there was no meaningful difference in Satisfaction across repeated measures (Time) given Content, and there was no meaningful difference in Satisfaction given Content for any one Preference group compared to any other Preference
This finding is consistent with Kozub’s (2010) considering online content and contrary to Manochehri and Young’s (2006) finding considering online versus traditional classroom instruction for student-based learners. This finding being contrary to Manochehri and Young’s may imply that intentionally integrating Content into the research design, as Dowaliby and Schumer (1972) suggested, was an effective idea.

The lack of meaningful differences is important because it suggests that given the same Content types, Content does not meaningfully influence learner satisfaction. This implies that Content type was not a barrier the learners were aware of at the time of the measure. Therefore, Content type alone cannot account for the meaningful difference between Module 3 and previous self-reported satisfaction measures, and Module 5 and previous self-reported satisfaction measures.

*Discussion for Research Question 6*

What is the interaction effect of learner modal preference and content delivery method supplemented with the visual content delivery method on learner self-reported satisfaction across all content delivery methods supplemented with the visual content delivery method among online computer-based learners?

This researcher hypothesized that there is a statistically significant difference between self-reported satisfaction of learners when modal preferences and content delivery methods supplemented with the visual content delivery method interact across all content delivery methods supplemented with the visual content delivery method among online computer-based learners. Question six investigated the interaction effect of learner modal preference (Preference) and modal focused content supplemented with the visual content delivery method (Content) on learner self-reported satisfaction (Satisfaction) given web-based modules (Time)
and aural, read/write, kinesthetic VARK-based modal focused content supplemented with the visual content delivery method (Content) among online computer-based learners. No statistically significant differences were observed for participants on Satisfaction across the content modules (Time) given the Content and Preference—interaction of Time, Content, and Preference. Similarly, no statistically significant differences were observed on Satisfaction of participant groups based on Content and Preference—interaction of Content and Preference. The study failed to reject the null hypothesis.

The study findings suggested that there was no meaningful difference in Satisfaction across repeated measures (Time) given the interaction of their Preference and Content, and there was no meaningful difference in Satisfaction given the interaction of Preference and Content for any one interaction group compared to any other interaction group. This finding is consisted with Kozub (2010). Interestingly, Manochehri and Young (2006) do not specifically discuss the interaction effect of Content (teaching methodology) and Preference as they did with learner performance.

The lack of meaningful differences is important because it suggests that the interaction of Preference and Content does not meaningfully influence learner satisfaction. This implies that the interaction effect of Preference and Content was not a barrier the learners were aware of at the time of the measure. Therefore, the interaction of Preference and Content cannot account for the observed meaningful difference between Module 3 and previous self-reported satisfaction measures, and Module 5 and previous self-reported satisfaction measures.
Causal-Comparative

Learner Performance

Performance was weakly related to demographic questions on marital status and socio-economic status, (see Appendix E). Contrary to Welsh (2007), those with more marital experience and higher income have higher performance scores compared to others of this sample. Consistent with McNeil, Long, and Ohland (2014), this suggests older more established participants generally performed slightly better. Performance scores were withheld from participants and consistent with Alder and Ambrose (2005), Woo and Frank (2000) and Dunn, Cavanaugh, Eberle, and Zenhausern (1982), the lack of feedback could have influenced performance scores.

Performance was weakly but negatively related to Muilenburg and Berge (2005) barriers academic skills, learner motivation, time and support for studies, and cost and access to the Internet. It is logically consistent that student’s that did not perceived time and costs as barriers achieved higher performance scores. Consistent with Parks, Evans, and Getch (2013) and Chang et al. (2014), participants that did not perceive self-efficacy and motivation barriers performed better.

Learner Satisfaction

Participant satisfaction was weakly but negatively related to demographic questions likelihood of taking a future online course, highest level high school completed, high school GPA, and marital status, (see Appendix E). The structured system is more rigid than other learning management systems (LMS) and logically might provide some hesitation to participants familiar with other more flexible systems; therefore, similar to Shazia (2015) not finding a significant positive relationship between computer self-efficacy and satisfaction, it is consistent
that participants reporting they are more likely to take online classes could have a negative relationship with satisfaction. As before, performance scores were withheld from participants and consistent with Alder and Ambrose (2005), Woo and Frank (2000) and Dunn, Cavanaugh, Eberle, and Zenhausern (1982), the lack of feedback could have influenced satisfaction scores.

The highest level of high school completed scale shown in Appendix E, extends from Eighth-Grade to General Equivalence, Which I did study to pass. According to Bowen and Nantz (2014), the highest three options are consistent with higher self-esteem and self-efficacy. The marital status scale ranged from Single, never married to Divorced with one or more children. According to McNeil et al. (2014), older more established individual perform better, and according to Bowen and Nantz those that perform better have higher self-efficacy; therefore, highest level high school completed, high school GPA, and marital status all relate to individual self-efficacy. Similar to participants reporting more likely to take online classes, those reporting higher self-efficacy also reported lower satisfaction with the structured system and content.

Participant satisfaction was not found to be meaningfully related to Muilenburg and Berge (2005) barrier factors scores, so individual items were investigated. Participant satisfaction was weakly related to concern for online course quality, concern for online instructor quality, marital status, but negatively related to barrier concern family will be disruptive. It is logically consistent that participants reported higher satisfaction scores when there was less concern for family being disruptive. Consistent with Paechter, Maier, and Macher (2010), students that seek knowledge have higher expectations; therefore, it is logical that participants that were more concerned with course and instructor quality also reported more marital experience, because older students returning to higher education have a vested interest in learning achievement. Consistent with Butler’s (2008) work on field-independent knowledge
seekers, participants that were more concerned with course and instructor quality, and reported more marital experience, also reported higher satisfaction scores.

Overall

When considering learner modal preference (Preference), content delivery method supplemented with the visual content delivery method (Content) and the interaction effect of Preference and Content on learner performance among online computer-based learners, only the VARK-based read/write Content stood out as statistically significantly different from the other measure. All Content types performed consistently for all Preference types; however, Content variations between comparative cohorts could result in one group being disadvantaged.

When considering learner modal preference (Preference), content delivery method supplemented with the visual content delivery method (Content) and the interaction effect of Preference and Content on learner satisfaction factor scores among online computer-based learners, no statistically significantly differences were observed. Because Preference, Content, and the interaction of Preference and Content on satisfaction factor scores were not statistically significant, it is possible that the observed sustained change over time of satisfaction may simply have been participants becoming more comfortable with the Content or content delivery system.

Implications

Learner Performance

While defining learning has proven a pluralistic task, it is accepted that better understanding learners will improve instructional design (Genovese, 2004). Higher education is funded at both the state and federal level and has a legal responsibility to fairly measures educational effectiveness (WBEC, 2000). The study results found that not all web-based content delivery methods supplemented with the visual content delivery method (Content) can be
directly compared. The study suggested that programs that utilize a read/write modality based on the VARK model and hold the verbal message of the content static may consistently and statistically significantly yield slightly better learner performance (Performance) outcomes.

The study finding does not mean that a kinesthetic or aural VARK-based Content cannot outperform the VARK-based read/write modality, but it does offer interesting insight into what to consider when comparing the effectiveness of two programs. First, because online Content is the course and the instructor (McCombs, 2015), online systems need to be able to motivate students beyond grades (Ford-Conners et al., 2015). Second, when comparing instructional program efficacy it may be important to review the message in the Content and the message of the Content, in addition to the quality of Performance measures to be sure the comparison is fair.

Learner Satisfaction

Although learners do not expect student-based grading, they do expect grades to be fair (Mourad, Ennew, & Kortam, 2010; Eagle & Brennan, 2007). Learner performance (Performance) has been tied to learner efficacy, and learner satisfaction (Satisfaction) has been tied to both efficacy and motivation. While the study showed learners can become more comfortable over time and learners may not particularly prefer one online Content over another, research suggested the Content matters because Satisfaction matters to students and students make decisions based on what is most satisfying (Glasser, 1997).

Student satisfaction impacts choice, and choice matters because it impacts retention and attrition which matter to educational institutions (Smith, 2014). Cohorts may make decisions based on similar published or perceived satisfaction measures and end up with different outcomes due to the personal differences of those being surveyed. At a minimum this means that
education institutions should be cautious about only posting or using student satisfaction measures.

Future Research

Future technology changes may also change the way people interact with content as it has in the past (Alexander, Schallert, & Reynolds, 2009; McLuhan, 1966); however, unless learning style models are incomplete, content delivery method will remain the lowest level interaction the instructional designer can influence between the instructor and the learner (Dunn & Dunn, 1987). This highlights the importance of a statistically valid learner modal preference measure.

Further research on Preference should respect the current research and not yield to popular media definitions of content delivery methods. Additional research should consider whether language is a higher order construct above and beyond the visual, aural, read/write, and kinesthetic, or if Read/Write, Verbal, and Tactile Braille languages all deserve equal taxonomy in a new learner modal preference model within a learning style inventory.

A learning style inventory is a method of considering multiple inputs and yielding a single classification for the learner type. While this may be useful for a classroom discussion, learning style taxonomies may have a masking effect in statistical research. Future research should include research-based content delivery method taxonomies, research-based statistically valid learner modal preference constructs, and utilize factorial designs that include the components of a learning style inventory rather than a higher order classification.

Recommendations

The study should be repeated with a larger sample size and the design should be extended to consider the interaction of the cohesive group of characteristics that include a participant’s learning style and processes due to the qualitative nature of the learner experience. Focused
research in the absence of other theories might yield significant results that are meaningless when the totality of the learner experiences or learner differences is considered. Therefore, the study should include multiple theories that form a more complete construct that describes the learning processes and utilize factorial research methods that do not focus on a single concept.
Conclusions

Institutional measures of student retention and persistence are important, but the inherent nature of institutions striving to serve students creates intentional qualitative differences. Institutions are being asked to create their own scales because no universally accepted measures exist. Tying educational funding to performance ignores the value of those qualitative institutional experiences.

Educational institutions are competing for limited state and federal funds and utilizing technology to reduce costs. Higher learning institutions will continue to expand their online footprint for the foreseeable future to help reduce costs. Educational institutions will need to utilize every tool at their disposal to fight for funding, or they risk having to cut-programs in the face of another institution that is statistically more effective.

Institutions that receive state and federal funding needs to better understand what online educational programs will disadvantage some student and what instructional designs can yield better results for all students. While learner satisfaction (Satisfaction) is not impacted by fair content and perceived fair measures, learner performance (Performance) can be meaningfully impacted by content delivery methods (Content) for the study sample; however, learner personal learning profile (Preference) does not appear to impact Performance or Satisfaction. While the effect found by the study was small and is not generalizable, little more than one-half of one percentage point for the study sample, the difference could be extremely important when viewed in state and federal monetary support when the limitations of comparative metrics are not fully understood.
APPENDIX A

VARK: QUESTIONNAIRE ORIGINAL

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The VARK Questionnaire (Version 7.8)

How Do I Learn Best?

Choose the answer which best explains your preference and circle the letter(s) next to it. Please circle more than one if a single answer does not match your perception. Leave blank any question that does not apply.

1. You are helping someone who wants to go to your airport, the center of town or railway station. You would:
   a. go with her.
   b. tell her the directions.
   c. write down the directions.
   d. draw or show her a map or give her a map.

2. A website has a video showing how to make a special graph. There is a person speaking, some lists and words describing what to do and some diagrams. You would learn most from:
   a. seeing the diagrams.
   b. listening.
   c. reading the words.
   d. watching the actions.

3. You are planning a vacation for a group. You want some feedback from them about the plan. You would:
   a. describe some of the highlights they will experience.
   b. use a map to show them the places.
   c. give them a copy of the printed itinerary.
   d. phone, text or email them.

4. You are going to cook something as a special treat. You would:
   a. cook something you know without the need for instructions.
   b. ask friends for suggestions.
   c. look on the Internet or in some cookbooks for ideas from the pictures.
   d. use a good recipe.

5. A group of tourists want to learn about the parks or wildlife reserves in your area. You would:
   a. talk about, or arrange a talk for them about parks or wildlife reserves.
   b. show them maps and Internet pictures.
   c. take them to a park or wildlife reserve and walk with them.
   d. give them a book or pamphlets about the parks or wildlife reserves.

6. You are about to purchase a digital camera or mobile phone. Other than price, what would most influence your decision?
   a. Trying or testing it.
   b. Reading the details or checking its features online.
   c. It is a modern design and looks good.
   d. The salesperson telling me about its features.

7. Remember a time when you learned how to do something new. Avoid choosing a physical skill, e.g., riding a bike. You learned best by:
   a. watching a demonstration.
   b. listening to somebody explaining it and asking questions.
   c. diagrams, maps, and charts - visual clues.
   d. written instructions - e.g., a manual or book.
8. You have a problem with your heart. You would prefer that the doctor:
   a. gave you something to read to explain what was wrong.
   b. used a plastic model to show what was wrong.
   c. described what was wrong.
   d. showed you a diagram of what was wrong.

9. You want to learn a new program, skill or game on a computer. You would:
   a. read the written instructions that came with the program.
   b. talk with people who know about the program.
   c. use the controls or keyboard.
   d. follow the diagrams in the book that came with it.

10. I like websites that have:
    a. things I can click on, shift or try.
    b. interesting design and visual features.
    c. interesting written descriptions, lists and explanations.
    d. audio channels where I can hear music, radio programs or interviews.

11. Other than price, what would most influence your decision to buy a new non-fiction book?
    a. The way it looks is appealing.
    b. Quickly reading parts of it.
    c. A friend talks about it and recommends it.
    d. It has real-life stories, experiences and examples.

12. You are using a book, CD or website to learn how to take photos with your new digital camera. You would like to have:
    a. a chance to ask questions and talk about the camera and its features.
    b. clear written instructions with lists and bullet points about what to do.
    c. diagrams showing the camera and what each part does.
    d. many examples of good and poor photos and how to improve them.

13. Do you prefer a teacher or a presenter who uses:
    a. demonstrations, models or practical sessions.
    b. question and answer, talk, group discussion, or guest speakers.
    c. handouts, books, or readings.
    d. diagrams, charts or graphs.

14. You have finished a competition or test and would like some feedback. You would like to have feedback:
    a. using examples from what you have done.
    b. using a written description of your results.
    c. from somebody who talks it through with you.
    d. using graphs showing what you had achieved.

15. You are going to choose food at a restaurant or cafe. You would:
    a. choose something that you have had there before.
    b. listen to the waiter or ask friends to recommend choices.
    c. choose from the descriptions in the menu.
    d. look at what others are eating or look at pictures of each dish.

16. You have to make an important speech at a conference or special occasion. You would:
    a. make diagrams or get graphs to help explain things.
    b. write a few key words and practice saying your speech over and over.
    c. write out your speech and learn from reading it over several times.
    d. gather many examples and stories to make the talk real and practical.
The VARK Questionnaire Scoring Chart

Use the following scoring chart to find the VARK category that each of your answers corresponds to. Circle the letters that correspond to your answers.

E.g. If you answered b and c for question 3, circle V and R in the question 3 row.

<table>
<thead>
<tr>
<th>Question</th>
<th>a category</th>
<th>b category</th>
<th>c category</th>
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<td>16</td>
<td>V</td>
<td>A</td>
<td>R</td>
<td>K</td>
</tr>
</tbody>
</table>

Calculating your scores

Count the number of each of the VARK letters you have circled to get your score for each VARK category.

Total number of V's circled = 
Total number of A's circled = 
Total number of R's circled = 
Total number of K's circled = 
APPENDIX B

VARK: AUTHOR EMAILS
Email 1

From: neil.fleming@vark-learn.com

Dear Blair

I read part of your colleagues thesis and have copied this from it:

VARK is not a complete learning style. It does not measure motivation, social, physical, or environmental elements to learning. VARK deals with only one dimension of learning. It focuses on a general learning style that is broken into visual, auditory, reading, kinesthetic, and multimodal learning.

His terminology is confusing as it first states that VARK is not a complete learning style which is true and then states that it is a "general learning style." Maybe there is a different perception of terms but this is contradictory.

As you will read in the book and on the website, VARK is not a learning style where such a thing is defined as all the attributes and preferences that determine the ways in which a learner learns. I doubt that there is any inventory or instrument that would claim to be a learning style on that definition. As Wesley correctly points out, VARK says nothing about a number of key elements to a learning style. But it is not helpful to state that VARK is "a general learning style" unless that is defined as being something separate form "a learning style". Maybe I have missed some definitions that are elsewhere in his thesis.

I used Dunn and Dunn's model of a learning style which has elements grouped into four categories. VARK focuses on only one element in one group - perceptual preferences or perceptual modalities. These are the preferences that individuals have for "taking in" information and "putting out" information and are similar to communication preferences.

As VARK uses only one of Dunn and Dunns elements it cannot claim (and does not claim) to be a learning style. To describe a person as a visual learner misses so many other dimensions - motivation, persistence, choice of learning in groups or alone, time of day, light and temperature levels etc etc. On that basis I would hesitate to use term "general" to describe VARK.

Any research study that tries to identify the effect of a student's learning style (and uses VARK) needs to be very careful for another reason other than the above. VARK categories (Visual, Read/write etc..) are a construction from the original data. They are a mathematical abstraction from the original four scores from the questionnaire and a researcher would be better to use the multi-modality of individuals in a research design. In several places I make the statement that all individuals are multimodal and that life is also predominately multimodal. In our huge database I doubt that we have anybody who has scored all sixteen questions for one mode and zero for all the other modes. As individuals we have four VARK scores and even our zero score (if we have one) is an influence on how we learn. For example a student who has scores of 0 4 5 13 may appear to be a kinesthetic learner.
(a phrase I try to avoid). That is a useful shorthand for recognizing that he/she uses kinesthetic modes for many of his/her learning decisions (both input and output). But notice that he/she has three other scores. They exert an influence and are not to be ignored in any summation of how he/she learns best. Auditory and Read/write methods will be useful alone and in support of kinesthetic opportunities. There may be occasions when the learning has to be Auditory and the learner will need to access and use that mode. In addition, students are adept at transforming input from one mode to another e.g. taking notes in a kinesthetic manner from a lecture.

An aside: One researcher tried to teach some children to swim using only mode exclusively e.g. Visual, then Auditory, then Read/write then Kinesthetic modes. You can imagine what happened. Very few things in life are unimodal. The internet is, interestingly, mainly Read/write and not Visual (as defined by VARK).

To return to a major research question- "Does perceptual modality affect how students learn?". Of course it does. By how much, we may not know; but to conclude that "how we prefer to take in information and put it out does not affect our learning outcomes" seems rather weird.

The next question is- "Does VARK measure perceptual preferences?" and I would say that it does that very well.

The next question is – “Does knowledge of your perceptual preferences influence your learning?". That is not known.

The next question is "Does using knowledge of perceptual preferences affect a student's learning?" My experience would indicate that a student who knows his/her preferences and who use that knowledge to concentrate on their highest preferences will do much better than somebody who chooses to ignore that information.

Many of these questions are difficult to place into a research design because learning is multi-faceted. When a learner learns something it is difficult for the learner to accurately attribute that learning to any cause(s).

That raises the last question "Why did I choose modality preferences as the subject for my questionnaire?" Because it was the element in a learning style that was most clearly within a teacher's ability to change. Time of day and food intake and motivation and group size etc are largely outside the range of teacher choice BUT the teacher can change the modes he/she uses to improve the students' learning.

cheers
neil
Neil D Fleming
Designer of the VARK questionnaire
50 Idris Road, Christchurch 8052
Email 2

From: neil.fleming@vark-learn.com

Dear Blair

Thank you for seeking permission to use VARK. We rely on the honesty of people to act in a professional way when using our materials. Many don't know that businesses, government agencies and professional sports groups must obtain permission or be licensed to use the VARK copyright materials. You may not place VARK copyright materials on an open-access website, or place the VARK questionnaire on your intranet without contacting us. If you want to use VARK on a site you need special permission. You are welcome to use the VARK materials by linking to our online website, or in paper format, for your studies, providing suitable acknowledgement is made.

This is the acknowledgement I prefer:

You may be interested in our new VARK Subscription service which does not need any installation on your system. You can capture the VARK scores for your class or classes, work team or colleagues and the results are available to you using your own password. The Subscription Service is demonstrated on our website in a working example. There is also sophisticated and specialised VARK software that allows you to capture and use the data from your own students on your own intranet.
To comply with copyright laws, trainers should consider purchasing an inexpensive VARK Licence with a once-only lifetime or annual fee. We also have a VARK PowerPoint presentation, a Resource Kit and a VARK Score sheet for large numbers of respondents.

You may find the two VARK books helpful for your work. There is also a book that teachers use for widening their repertoire of strategies. It is titled "55 Strategies for Teaching" and has 55 practical ideas.
VARK principles are being applied to coaching athletes and sports players and a new book titled "Sports Coaching and Learning" is now available.
To purchase any of these resources (above) you can use a personal check/cheque, an institutional Purchase Order or buy from our secure website with your credit card.

Best wishes for your work.
Neil
Neil Fleming
Designer of the VARK Questionnaire
50 Idris Road, Christchurch 8052
New Zealand
www.vark-learn.com
phone:  (64) 3 3517798
fax:     (64) 3 3519939
Email 3

From: neil.fleming@vark-learn.com
Subject: Using the VARK Questionnaire
Date: Wed, 30 Mar 2016 08:04:12 +1300

Dear Blair

You may include the text of your VARK version in your dissertation appendix.

cheers

neil

Neil D Fleming
Designer of the VARK Questionnaire
Director: VARK LEARN Limited
50 Idris Road, Christchurch 8052
New Zealand
www.vark-learn.com
phone: (64) 3 3517798

To: neil.fleming@vark-learn.com
Subject: RE: VARK Questionnaire
Date: Mon, 28 Mar 2016 22:35:45 -0500

Hello sir!

I apologize for the extremely late reply, but I guess that is the nature of dissertations. I have been working constantly since before January of 2015, so I am glad to be where I am now.

I am just now finishing up all the writing and trying to get my dissertation approved, and would still like to send you the bulk data to be multi-coded if you have time this year. There is no rush on that.

I have to ask a question though.

I want others to be able to know the text of the VARK as it was used in this study, that way if someone tries to duplicate my study, they will be able to tell how different the current version is from the one I used. Obviously that requires your permission.

Even through the questions are available on your website, I am guessing this is a delicate question because of the copyright so I wanted to know if I should just reference the instrument or if I could include the 3 pages of the PDF in the Appendix of my dissertation.
I have a whole new appreciation for researchers after this experience...

Most Sincerely,

Blair Copeland

From: neil.fleming@vark-learn.com
Subject: VARK Questionnaire
Date: Thu, 22 Jan 2015 08:40:13 +1300

Attached is the VARK Questionnaire you should use (Unaltered) as the students will not have to use codes to get the totals for V, A R and K.

neil

Neil D Fleming
Designer of the VARK Questionnaire
Director: VARK LEARN Limited
50 Idris Road, Christchurch 8052
New Zealand
www.vark-learn.com
phone: (64) 3 3517798
Email 4

From: Neil Donald Fleming <neil.fleming@vark-learn.com>
Date: 05/19/2016 3:37 PM (GMT-06:00)
Subject: Using VARK for Research

Dear Blair

You may use your first option (1)

cheers

neil

Neil D Fleming
Designer of the VARK Questionnaire
Director: VARK LEARN Limited
50 Idris Road, Christchurch 8052
New Zealand
www.vark-learn.com
phone: (64) 3 3517798

To: neil.fleming@vark-learn.com
Subject: RE: VARK Questionnaire
Date: Thu, 19 May 2016 12:19:26 -0500

In response to this approval, the graduate School copyright reviewer focused on the words, "your VARK version".

So I need clarification for our graduate school. In order that others will know what I used should they try to repeat my study, in the appendix may I include

1) the VARK PDF used in the study exactly (with a copyright notice/warning and link to the VARK website),

2) the text from the PDF used in the research (with a copyright notice/warning and link to the VARK website),

3) or simply a version number (with a copyright notice/warning and link to the VARK website)?

I apologize for this inconvenience.

Most Sincerely,

Blair Copeland
APPENDIX C

VARK: RECORDING INSTRUMENT

Reproduced with permission from Neil D Fleming.
Research Study

VARK

University of North Texas

Please navigate to the following site:

Note: This link should LAUNCH a new tab, it will not advance this window. Since the VARK site does not provide a method to return here, we wanted to make this tangent more convenient. If your computer does not open a new window, please copy and paste this link into another browser window.


You can use a scratch piece of paper to keep a tally, or print it out. Once you have your score, please record it here.

There are further instruction on the page.

Visual

Aural

Read/Write

Kinesthetic

Ready to Continue? Record VARK Scores First

Continue  Help  Comment  Profile  Logout
APPENDIX D

BERGE AND MUILENBURG: ORIGINAL

Reproduced with permission from Zane L. Berge.
Survey of Student Barriers to eLearning

Zane L. Berge, Ph.D.
Lin Muilenburg

Version July, 2003

Your first and last name (ex., John Smith):
Your email address:

Note: Your name and email address will not be given to anyone outside of this research and your identification will be kept confidential. Your email address will only be used to email you the results of this survey when available or follow-up from the researchers.

Instructions
For the purposes of this survey, the terms "eLearning" and "online learning" are used synonymously. An elearning course, or an online course, involves: a) a formal training or educational event/course in which the students are not face-to-face with each other, or they are not face-to-face with the instructor, b) more than 75% of the graded assignments for the course are completed at a distance, and c) the delivery of the course is via the web, internet, intranet, computer conferencing systems, or a learning-/course-management system such as Blackboard, WebCT, Prometheus, FirstClass or Learning Space. Courses delivered through video conferencing, audio or video tape, CD or DVD, EPSS, radio, ITV, or print-based systems are not part of this research.

Please check one response for each of the questions 1-11.

1. My gender is:
   Male
   Female

2. My age is:
   under 18 years of age
   18-24
   25-31
   32-38
   39-45
   45-51
   52-57
   58 or above

3. Do you consider yourself:
   American Indian/Alaska Native
   Asian/Pacific Islander
   Black, non-Hispanic
   Hispanic
White, non-Hispanic
Other

4. For purposes of this survey, I am primarily a student in:
   A high school.
   A community college.
   An undergraduate student in higher education other than a community college.
   A graduate student in higher education other than a community college.
   A business/corporate/non-profit organization.
   A government/military organization.

5. I would characterize myself regarding online learning most closely as:
   I do not use online learning technology (such as email and the internet) very much.
   I use online learning technologies such as email and the internet for my own personal
   productivity but not so much for education or training purposes.
   I am learning online, but I am unsure of my skills when doing so.
   I have learned, or I am learning online and feel comfortable and confident when I do so.

6. The statement that best describes how I view my learning effectiveness in online learning is:
   I cannot learn as well online as I can in the classroom with other learners and the instructor.
   I really don't see much difference in my learning in a online learning environment compared
   to being in the classroom with other learners and the instructors.
   I learn better through online learning compared to being in the same room as other learners
   and the instructor.
   While I have never completed an online class, I predict I would not learn as well online as I
   would in the classroom with other learners and the instructor.
   While I have never completed an online class, I predict I would not see much difference in
   my learning in an online learning environment compared to being in the classroom with other
   learners and the instructor.
   While I have never completed an online class, I predict I would learn better online compared
   to being in the classroom with other learners and the instructor.
7. The statement that best describes how I view my enjoyment of online learning compared to being in the same room as the instructor and other learners is:
I enjoy the online learning experience significantly less.
I really don’t see much different in my enjoyment between learning online and in the classroom with other learners and the instructor.
I enjoy the online learning experience significantly more.
While I have never completed an online class, I predict I would enjoy the learning experience significantly less online compared to being in the classroom with other learners and the instructor.
While I have never completed an online class, I predict I would not see much difference in my enjoyment of the online learning environment compared to being in the classroom with other learners and the instructor.
While I have never completed an online class, I predict I would enjoy the learning experience significantly more online than being in the classroom with other learners and the instructor.

8. I have completed the following number of online education courses. A course is any training or education that is so designated by your school or organization (Note: If you are taking a course now but have not completed it, do not count it in this answer):
0
1
2
3
4
5 - 7
8 - 10
10 - 13
14 or more

9. I have dropped the following number of distance education courses, even if I later completed one or more of these courses:
0
1
2
3
4
5 - 7
8 - 10
10 - 13
14 or more
10. The likelihood that I will take an online course in the future if I am not required to do so is:
   - definitely not
   - probably not
   - probably yes
   - definitely yes

11. My cultural background, physical or other disability, or some prejudice of instructors or peers concerning a personal characteristic of mine significantly affects my learning in face-to-face classroom instruction.
   - Yes
   - No

Instructions for Questions Regarding Barriers Below

Think about your most recent experience as an online student, or your desire to study online. Rate each of the barriers/obstacles below according to how strong you perceive that barrier to be to your most recent online student experience, or your desire to study online. Marking an item as a "very strong barrier," indicates that you feel that item is a very difficult obstacle to overcome. Marking the intermediate responses of "weak," "moderate," or "strong," would indicate the relative weight you give that item as a barrier. Marking "no barrier" means you do not perceive that item as an obstacle to your study, or desire to study online.

We want to know YOUR PERSONAL PERCEPTIONS of online learning. Do not answer based on how you think online learning might affect others. Answer only how you personally feel about the issues below.

Note well that answering "no barrier" could mean several different things: that you believe "it does not apply to me", or that you "have the skills to deal with this barrier," or that you "have never experienced this barrier," or if you have never taken an online course, that "you would not experience this barrier" should you take an online class in the future. At this point, we are not trying to determine why it is not a problem for you, only whether it is or is not an obstacle for you personally and to what degree if it is.

The survey is in six parts: technical, infrastructure/support services, social, prerequisite skills, motivation, and time/interruptions. A brief description is given at the beginning of each section. The pilot testing showed that it usually took between 11 and 13 minutes to complete.

Technical. Participants must be comfortable with the online system and the software that is being using in elearning. The ultimate technical goal would be to make the technology transparent. When this is done, the learner may concentrate on the academic task at hand.
1. The needed technology (hardware or software) is not accessible to me.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

2. I am afraid of losing privacy, confidentiality, or intellectual property in the online environment.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

3. I am unfamiliar with the technical tools needed in elearning.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

4. I lack a reliable internet connection, high speed connectivity, or an internet service provider.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

5. The hardware, software, repairs, or a service provider costs too much.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

6. I lack the skills necessary to navigate successfully through the delivery system in the online course.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

7. I am afraid of computers and related technologies.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

8. I am concerned about, or have found a lack of consistency in platforms, hardware, browsers, and software for online courses.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

9. I lack the necessary skills in using the software for online courses.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

10. I am concerned about, or have found a lack of technical assistance.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

11. I am uncomfortable with, or fear, learning how to use new tools to access online courses.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

12. I am uncomfortable with, or fear, learning with different methods used in online courses.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

13. I am concerned, or have found that a lack of compatibility of hardware and software creates technical problems.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

Infrastructure/Support Services From the students’ perspective, these are issues that the instructor or organization control.
14. I am concerned about, or have found a lack of access to the instructor, or knowledgeable experts
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

15. I am concerned about, or have found a lack of timely feedback or response from the instructor.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

16. I have found or am concerned that the quality of the learning materials and instruction is lower in online courses.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

17. I have found or am concerned that instructors don't know what they are doing when they teach online.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

18. I am concerned about, or have found a lack of clear expectations or instructions from the online instructor.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

19. I am concerned about, or have found a lack of sufficient academic advisors for online learning.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

20. There is insufficient training given in the use of the delivery system.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

21. I am concerned about, or have found a lack of support and services such as tutors.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

22. I am concerned about, or have found that course materials are not always delivered on time.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

23. I have difficulty contacting academic and administrative staff for online courses.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

24. I am concerned that the class size is not right for learning in online courses (too small or too large).
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

Social. The learning environment that is created for learning online should be friendly and social, and one in which learning is promoted. This suggests promoting human relationships, developing group cohesiveness, maintaining the group as a unit, and in other ways helping participants to work together for a mutual cause.
25. Online learning is, or seems like it would be impersonal to me.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

26. I prefer to learn through face-to-face interaction with other students and instructor.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

27. I do, or am afraid of feeling isolated from the other students in an online course.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

28. I am concerned about, or have found a lack of interaction and communication among students in online courses.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

29. I am concerned about, or have found a lack of social context cues (e.g., body language) in the online environment.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

30. I am concerned about, or have found a lack of collaboration with other students online.
No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier
Prerequisite Skills are areas that most students believe they need to have mastered to a certain degree before entering the online classroom.

31. I lack the writing skills needed in online courses.
   **No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier**

32. I lack the typing skills needed in online courses.
   **No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier**

33. I lack the reading skills needed in online courses.
   **No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier**

34. I am shy or lack academic confidence for online courses.
   **No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier**

35. I lack the necessary, communication skills for elearning.
   **No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier**

36. I lack the language skills needed in online courses.
   **No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier**

Motivation has to do with the psychological processes that cause students to persist in meeting their learning goals.

37. I have to take on more of the responsibility for my own learning in an online course.
   **No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier**

38. I lack the motivation to learn online.
   **No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier**

39. I procrastinate, or feel I cannot seem to "get started to learn" online.
   **No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier**

40. I choose to learn the easier aspects of the assignments rather than the more demanding ones.
   **No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier**

41. I have found or am concerned that the elearning environment is not inherently motivating.
   **No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier**
Time/Interruptions is a factor that has to do with the perceived barriers to your time in learning online and the interruptions that may disrupt your learning.

42. I am concerned about, or have found there is not sufficient time to learn during elearning courses.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

43. There are significant interruptions at work, home or wherever I study.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

44. I am concerned about, or have found a lack of support from family, friends, employers, or significant others.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

45. I am afraid my family life will be disrupted
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

46. Elearning would or does cut in to my personal time.
   No Barrier Weak Barrier Moderate Barrier Strong Barrier Very Strong Barrier

COMMENTS: Please add any comments you may have, either about barriers you face regarding online learning or about the survey.

__________________________________________________________________________

Thank you for your time!
APPENDIX E

BERGE AND MUILENBURG: ENHANCEMENT

Reproduced with permission from Zane L. Berge.
Question 11 from the Muilenburg and Berge (2005) instrument was rescaled to increase granularity. The new scale more closely matches the other question scales in the instrument. Question 11 can be rescaled to its original binary form for the further analysis of the Muilenburg and Berge (2005) if required.

11) My cultural background, physical or other disability, or some prejudice of instructors or peers concerning a personal characteristic of mine significantly affects my learning in face-to-face classroom instruction.
   ○ Not at all
   ○ Mild
   ○ Less than average
   ○ Average
   ○ More than Average
   ○ Greatly
   ○ Constantly

12) When I study for courses, I most often use:
   ○ Nothing
   ○ I repeat things to myself silently
   ○ I repeat things to myself aloud
   ○ I read silently
   ○ I read aloud
   ○ I write things down
   ○ I use a combination of these often

13) Regardless of my current course, my highest level of high school education completed:
   ○ Eighth-Grade
   ○ Ninth-Grade
   ○ Tenth-Grade
   ○ Eleventh-Grade
   ○ Twelfth-Grade
   ○ General Equivalence, Which I did not study to pass
   ○ General Equivalence, Which I did study to pass

14) High school GPA:
   ○ Do Not Recall
   ○ 0.0 up to but not including 1.0
   ○ 1.0 up to but not including 2.0
   ○ 2.0 up to but not including 2.5
   ○ 2.5 up to but not including 3.0
   ○ 3.0 up to but not including 3.5
   ○ 3.5 up to but not including 4.0
   ○ 4.0 or higher

15) Regardless of my current course, my highest level of higher education completed:
   ○ Some coursework but no degree
- Technical School, Junior College or Community College
- Bachelor's Degree
- Master's Degree
- Doctoral Degree
- General Equivalence, Which I did not study to pass
- General Equivalence, Which I did study to pass

16) Higher Education GPA on current degree plan?
   - Do Not Recall
   - 0.0 up to but not including 1.0
   - 1.0 up to but not including 2.0
   - 2.0 up to but not including 2.5
   - 2.5 up to but not including 3.0
   - 3.0 up to but not including 3.5
   - 3.5 up to but not including 4.0
   - 4.0 or higher

17) Number of bathrooms in childhood home including partial baths:
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7 or more

18) Number of childhood pets, insects should be grouped to type count (i.e.: 2 ant colony, not 200 ants in two colonies):
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7 or more
19) Marital status:
   o Single, never married
   o Married
   o Married, with one child
   o Married, with more than one child
   o Married and Divorced
   o Married and Divorced, with one child
   o Married and Divorced, with more than one child
   o Divorced
   o Divorced with one child
   o Divorced with more than one child
   o Prefer not to answer.

20) Educational funding method:
   o Self-funded
   o Relative(s)
   o Self-funded and Relative(s)
   o Grant, Loan and/or Scholarship
   o Self-funded, Grant, Loan and/or Scholarship
   o Relative(s), Grant, Loan and/or Scholarship
   o Self-funded, Relative(s), Grant, Loan and/or Scholarship

21) Number of dependents:
   o 1
   o 2
   o 3
   o 4
   o 5
   o 6
   o 7 or more

22) Age of first computer use:
   o 5 up to but not including 8
   o 8 up to but not including 12
   o 12 up to but not including 16
   o 16 up to but not including 20
   o 20 up to but not including 25
   o 25 up to but not including 30
   o 30 or later...
23) Age of first computer ownership including mobile Internet device:
   o 5 up to but not including 8
   o 8 up to but not including 12
   o 12 up to but not including 16
   o 16 up to but not including 20
   o 20 up to but not including 25
   o 25 up to but not including 30
   o 30 or later...

24) I would categorize my current socio-economic status as:
   o Prefer not to say...
   o $0 - Not Known
   o up to but not including $25,600 - Low
   o up to but not including $40,960 - Moderate
   o up to but not including $61,400 - Middle
   o up to but not including $125,000 - Upper
   o $125,000 or greater - Upper
APPENDIX F

BERGE AND MUILENBURG: AUTHOR EMAIL
Email 1

From: Zane Berge [mailto:berge@umbc.edu]

Dear Blair Copeland,

You have permission to use the student barriers survey in your research (please see attached). Good luck with your research. Please keep us informed regarding your results.

Regards,

Zane L. Berge, Ph.D.
Professor of Education
berge@umbc.edu

On 2/10/2013 12:07 AM, Copeland, Blair wrote:
I am working on my dissertation and would like to use your Student Barrier survey.

I have not been able to get the published link to work:

http://www.umbc.edu/oit/phonetree/student_barrier/survey.html

Possibly it has moved in the last 7 years?

With your approval, I would appreciate your assistance in obtaining a copy.

Sincerely,

Blair Copeland
Doctoral Student
Higher Education Program
University of North Texas
blair.copeland@untsystem.edu
Email 2

From: Zane Berge [mailto:berge@umbc.edu]
Sent: Monday, May 23, 2016 7:01 PM
To: Copeland, Blair; Lin Muilenburg <lymuilenburg@smcm.edu>
Subject: Re: Student Barriers

Dear Blair,

I'm glad you are wrapping up your dissertation work. You have permission to execute option 1 below. Please let me see the final version of your dissertation when it is available.

Regards,

--
Zane L. Berge, Ph.D.
Professor of Education
berge@umbc.edu
twitter: @ZaneBerge

On 5/23/2016 7:16 PM, Copeland, Blair wrote:
Back in 2013 you gave me permission to use the Student Barrier’s Instrument for my dissertation study, that message is attached below.

I wanted to include the version of your instrument I used in my study in the appendix, so that if anyone else wanted to repeat my study they would know what materials I used.

I am seeking permission to either include
1) the text of your “Student Barrier’s Instrument” as used in the study exactly (with a copyright notice/warning and link to a website),

2) or a date or version number you provide (with a copyright notice/warning and link to a website)?

If one of these options is acceptable to you, or if you prefer something else, please let me know what would be acceptable so I may properly credit and identify your existing work.

I apologize if I have not asked or requested permission in a way that would be acceptable.

Most Sincerely,

Blair Copeland
University of North Texas
APPENDIX G

BERGE AND MUILENBURG: INSTRUMENT

Reproduced with permission from Zane L. Berge.
Research Survey

Survey of Student Barriers to eLearning

Instructions:

For the purposes of this survey, the terms "eLearning" and "online learning" are used synonymously.

An elearning course, or an online course, involves:
 a) a formal training or educational event/course in which the students are not face-to-face with each other, or they are not face-to-face with the instructor,
 b) more than 75% of the graded assignments for the course are completed at a distance, and
 c) the delivery of the course is via the web, internet, intranet, computer conferencing systems, or a learning-/course-management system such as Blackboard, WebCT, Prometheus, FirstClass or Learning Space.

Courses delivered through video conferencing, audio or video tape, CD or DVD, EPSS, radio, ITV, or print-based systems are not part of this research.

Please check one response for each of the questions 1 - 24.

1. My gender is:
   a. ☐ Male
   b. ☐ Female

2. My age is:
   a. ☐ under 18 years of age may not participate in this study.
   b. ☐ 18 - 24
   c. ☐ 25 - 31
   d. ☐ 32 - 38
   e. ☐ 39 - 44
   f. ☐ 45 - 51
   g. ☐ 52 - 57
   h. ☐ 58 or above
3. Do you consider yourself:
   a. American Indian/Alaska Native
   b. Asian/Pacific Islander
   c. Black, non-Hispanic
   d. Hispanic
   e. White, non-Hispanic
   f. Other

4. For purposes of this survey, I am primarily a student in:
   a. A high school.
   b. A community college.
   c. An undergraduate student in higher education other than a community college.
   d. A graduate student in higher education other than a community college.
   e. A business/corporate/non-profit organization.
   f. A government/military organization.

5. I would characterize myself regarding online learning most closely as:
   a. I do not use online learning technology (such as email and the internet) very much.
   b. I use online learning technologies such as email and the internet for my own personal productivity but not so much for education or training purposes.
   c. I am learning online, but I am unsure of my skills when doing so.
   d. I have learned, or I am learning online and feel comfortable and confident when I do so.
6. The statement that best describes how I view my learning effectiveness in online learning is:

a.  ○ I cannot learn as well online as I can in the classroom with other learners and the instructor.
b. ○ I really don't see much difference in my learning in a online learning environment compared to being in the classroom with other learners and the instructor.
c. ○ I learn better through online learning compared to being in the same room as other learners and the instructor.
d. ○ While I have never completed an online class, I predict I would not learn as well online as I would in the classroom with other learners and the instructor.
e. ○ While I have never completed an online class, I predict I would not see much difference in my learning in an online learning environment compared to being in the classroom with other learners and the instructor.
f. ○ While I have never completed an online class, I predict I would learn better online compared to being in the classroom with other learners and the instructor.

7. The statement that best describes how I view my enjoyment of online learning compared to being in the same room as the instructor and other learners is:

a. ○ I enjoy the online learning experience significantly less.
b. ○ I really don't see much different in my enjoyment between learning online and in the classroom with other learners and the instructor.
c. ○ I enjoy the online learning experience significantly more.
d. ○ While I have never completed an online class, I predict I would enjoy the learning experience significantly less online compared to being in the classroom with other learners and the instructor.
e. ○ While I have never completed an online class, I predict I would not see much difference in my enjoyment of the online learning environment compared to being in the classroom with other learners and the instructor.
f. ○ While I have never completed an online class, I predict I would enjoy the learning experience significantly more online than being in the classroom with other learners and the instructor.
8. I have completed the following number of online education courses. A course is any training or education that is so designated by your school or organization (Note: If you are taking a course now but have not completed it, do not count it in this answer):

   a. 0
   b. 1
   c. 2
   d. 3
   e. 4
   f. 5 - 7
   g. 8 - 10
   h. 11 - 13
   i. 14 or more

9. I have dropped the following number of distance education courses, even if I later completed one or more of these courses:

   a. 0
   b. 1
   c. 2
   d. 3
   e. 4
   f. 5 - 7
   g. 8 - 10
   h. 11 - 13
   i. 14 or more
10. The likelihood that I will take an online course in the future if I am not required to do so is:
   
   a. ☐ definitely not  
   b. ☐ probably not  
   c. ☐ probably yes  
   d. ☐ definitely yes  

11. My cultural background, physical or other disability, or some prejudice of instructors or peers concerning a personal characteristic of mine significantly affects my learning in face-to-face classroom instruction.

   a. ☐ Not at all  
   b. ☐ Somewhat  
   c. ☐ Less than average  
   d. ☐ Average  
   e. ☐ More than average  
   f. ☐ Mostly  
   g. ☐ Constantly  

12. When I study for courses, I most often use:

   a. ☐ Nothing  
   b. ☐ I repeat things to myself silently  
   c. ☐ I repeat things to myself aloud  
   d. ☐ I read silently  
   e. ☐ I read aloud  
   f. ☐ I write things down  
   g. ☐ I use a combination of these often
13. Regardless of my current course, my highest level of high school education completed:
   a. ☐ Eighth-Grade
   b. ☐ Ninth-Grade
   c. ☐ Tenth-Grade
   d. ☐ Eleventh-Grade
   e. ☐ Twelfth-Grade
   f. ☐ General Equivalence, Which I did not study to pass
   g. ☐ General Equivalence, Which I did study to pass

14. High school GPA:
   a. ☐ 0.0 up to but not including 1.0
   b. ☐ 1.0 up to but not including 2.0
   c. ☐ 2.0 up to but not including 2.5
   d. ☐ 2.5 up to but not including 3.0
   e. ☐ 3.0 up to but not including 3.5
   f. ☐ 3.5 up to but not including 4.0
   g. ☐ 4.0 or higher

15. Regardless of my current course, my highest level of higher education completed:
   a. ☐ Some coursework but no degree
   b. ☐ Technical School, Junior College or Community College
   c. ☐ Bachelor's Degree
   d. ☐ Master's Degree
   e. ☐ Doctoral Examinations, Which I did not study to pass
   f. ☐ Doctoral Examinations, Which I did study to pass
   g. ☐ Doctoral Degree
16. Higher Education GPA on current degree plan:
   a. 0.0 up to but not including 1.0
   b. 1.0 up to but not including 2.0
   c. 2.0 up to but not including 2.5
   d. 2.5 up to but not including 3.0
   e. 3.0 up to but not including 3.5
   f. 3.5 up to but not including 4.0
   g. 4.0 or higher

17. Number of bathrooms in childhood home including partial baths:
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
   f. 6
   g. 7 or more

18. Number of childhood pets, insects should be grouped to type count (i.e.: 2 ant colony, not 200 ants in two colonies):
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
   f. 6
   g. 7 or more
   h. None
19. Marital status:
   a. ○ Single, never married
   b. ○ Married
   c. ○ Married, with one or more children
   d. ○ Married and Divorced
   e. ○ Married and Divorced, with one or more children
   f. ○ Divorced
   g. ○ Divorced with one or more children

20. Primary educational funding method:
   a. ○ Self-funded
   b. ○ Relative(s)
   c. ○ Grant(s)
   d. ○ Scholarship(s)
   e. ○ Loan(s)
   f. ○ Self-funded, Relative(s), Grant, Loan and/or Scholarship
   g. ○ Other

21. Number of dependents (including you):

   a. ○ 1
   b. ○ 2
   c. ○ 3
   d. ○ 4
   e. ○ 5
   f. ○ 6
   g. ○ 7 or more
22. Age of first computer use:
   a. ☐ 3 up to but not including 8
   b. ☐ 8 up to but not including 12
   c. ☐ 12 up to but not including 16
   d. ☐ 16 up to but not including 20
   e. ☐ 20 up to but not including 25
   f. ☐ 25 up to but not including 30
   g. ☐ 30 or later...

23. Age of first computer ownership including mobile Internet device:
   a. ☐ 5 up to but not including 8
   b. ☐ 8 up to but not including 12
   c. ☐ 12 up to but not including 16
   d. ☐ 16 up to but not including 20
   e. ☐ 20 up to but not including 25
   f. ☐ 25 up to but not including 30
   g. ☐ 30 or later...

24. I would categorize my current socio-economic status as:
   a. ☐ Prefer not to say...
   b. ☐ $0 - Not Known
   c. ☐ up to but not including $25,600 - Low
   d. ☐ up to but not including $40,960 - Moderately Low
   e. ☐ up to but not including $61,400 - Middle
   f. ☐ up to but not including $125,000 - Upper Middle
   g. ☐ $125,000 or greater - Upper

(* Please Note: All answers are just coded as a letter in a file, and stored separately from your name. *)
Research Survey

Survey of Student Barriers to eLearning

Barriers

Instructions for Questions Regarding Barriers

Below Think about your most recent experience as an online student, or your desire to study online. Rate each of the barriers/obstacles below according to how strong you perceive that barrier to be to your most recent online student experience, or your desire to study online. Marking an item as a "very strong barrier," indicates that you feel that item is a very difficult obstacle to overcome. Marking the intermediate responses of "weak," "moderate," or "strong," would indicate the relative weight you give that item as a barrier. Marking "no barrier" means you do not perceive that item as an obstacle to your study, or desire to study online.

We want to know YOUR PERSONAL PERCEPTIONS of online learning. Do not answer based on how you think online learning might affect others. Answer only how you personally feel about the issues below.

Note well that answering "no barrier" could mean several different things: that you believe "it does not apply to me", or that you "have the skills to deal with this barrier," or that you "have never experienced this barrier," or if you have never taken an online course, that "you would not experience this barrier" should you take an online class in the future. At this point, we are not trying to determine why it is not a problem for you, only whether it is or is not an obstacle for you personally and to what degree if it is.

The survey is in six parts: technical, infrastructure/support services, social, prerequisite skills, motivation, and time/interruptions. A brief description is given at the beginning of each section. The pilot testing showed that it usually took between 11 and 13 minutes to complete.

Technical. Participants must be comfortable with the online system and the software that is being using in elearning. The ultimate technical goal would be to make the technology transparent. When this is done, the learner may concentrate on the academic task at hand.
1. The needed technology (hardware or software) is not accessible to me.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier

2. I am afraid of losing privacy, confidentiality, or intellectual property in the online environment.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier

3. I am unfamiliar with the technical tools needed in elearning.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier

4. I lack a reliable internet connection, high speed connectivity, or an internet service provider.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier
5. The hardware, software, repairs, or a service provider costs too much.
   a. No Barrier
   b. Weak Barrier
   c. Moderate Barrier
   d. Strong Barrier
   e. Very Strong Barrier

6. I lack the skills necessary to navigate successfully through the delivery system in the online course.
   a. No Barrier
   b. Weak Barrier
   c. Moderate Barrier
   d. Strong Barrier
   e. Very Strong Barrier

7. I am afraid of computers and related technologies.
   a. No Barrier
   b. Weak Barrier
   c. Moderate Barrier
   d. Strong Barrier
   e. Very Strong Barrier

8. I am concerned about, or have found a lack of consistency in platforms, hardware, browsers, and software for online courses.
   a. No Barrier
   b. Weak Barrier
   c. Moderate Barrier
   d. Strong Barrier
   e. Very Strong Barrier
9. I lack the necessary skills in using the software for online courses.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

10. I am concerned about, or have found a lack of technical assistance
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

11. I am uncomfortable with, or fear, learning how to use new tools to access online courses.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

12. I am uncomfortable with, or fear, learning with different methods used in online courses.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier
13. I am concerned, or have found that a lack of compatibility of hardware and software creates technical problems.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

14. I am concerned about, or have found a lack of access to the instructor, or knowledgeable experts.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

15. I am concerned about, or have found a lack of timely feedback or response from the instructor.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

16. I have found or am concerned that the quality of the learning materials and instruction is lower in online courses.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier
17. I have found or am concerned that instructors don't know what they are doing when they teach online.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier

18. I am concerned about, or have found a lack of clear expectations or instructions from the online instructor.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier

19. I am concerned about, or have found a lack of sufficient academic advisors for online learning.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier

20. There is insufficient training given in the use of the delivery system.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier
21. I am concerned about, or have found a lack of support and services such as tutors.

   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

22. I am concerned about, or have found that course materials are not always delivered on time.

   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

23. I have difficulty contacting academic and administrative staff for online courses.

   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

24. I am concerned that the class size is not right for learning in online courses (too small or too large).

   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier
Social. The learning environment that is created for learning online should be friendly and social, and one in which learning is promoted. This suggests promoting human relationships, developing group cohesiveness, maintaining the group as a unit, and in other ways helping participants to work together for a mutual cause.

25. Online learning is, or seems like it would be impersonal to me.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier

26. I prefer to learn through face-to-face interaction with other students and instructor.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier

27. I do, or am afraid of feeling isolated from the other students in an online course.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier
28. I am concerned about, or have found a lack of interaction and communication among students in online courses.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

29. I am concerned about, or have found a lack of social context cues (e.g., body language) in the online environment.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

30. I am concerned about, or have found a lack of collaboration with other students online.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier
Prerequisite Skills are areas that most students believe they need to have masters to a certain degree before entering the online classroom.

31. I lack the writing skills needed in online courses.

   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

32. I lack the typing skills needed in online courses.

   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

33. I lack the reading skills needed in online courses.

   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier
34. I am shy or lack academic confidence for online courses.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

35. I lack the necessary, communication skills for elearning.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

36. I lack the language skills needed in online courses.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier
Motivation has to do with the psychological processes that cause students to persist in meeting their learning goals.

37. I have to take on more of the responsibility for my own learning in an online course.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

38. I lack the motivation to learn online.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

39. I procrastinate, or feel I cannot seem to "get started to learn" online.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier
40. I choose to learn the easier aspects of the assignments rather than the more demanding ones.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier

41. I have found or am concerned that the elearning environment is not inherently motivating.
   a. ☐ No Barrier
   b. ☐ Weak Barrier
   c. ☐ Moderate Barrier
   d. ☐ Strong Barrier
   e. ☐ Very Strong Barrier
Time/Interruptions is a factor that has to do with the perceived barriers to your time in learning online and the interruptions that may disrupt your learning.

42. I am concerned about, or have found there is not sufficient time to learn during elearning courses.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

43. There are significant interruptions at work, home or wherever I study.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier

44. I am concerned about, or have found a lack of support from family, friends, employers, or significant others.
   a. ○ No Barrier
   b. ○ Weak Barrier
   c. ○ Moderate Barrier
   d. ○ Strong Barrier
   e. ○ Very Strong Barrier
45. I am afraid my family life will be disrupted.
   a.  ○  No Barrier
   b.  ○  Weak Barrier
   c.  ○  Moderate Barrier
   d.  ○  Strong Barrier
   e.  ○  Very Strong Barrier

46. E-learning would or does cut in to my personal time.
   a.  ○  No Barrier
   b.  ○  Weak Barrier
   c.  ○  Moderate Barrier
   d.  ○  Strong Barrier
   e.  ○  Very Strong Barrier
APPENDIX H

BERGE AND MUILENBURG: FACTOR LOADINGS
<table>
<thead>
<tr>
<th>Factors</th>
<th>Original Loadings</th>
<th>Confirmatory Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L. Y. Muilenburg and Z. L. Berge</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Factors</strong></td>
<td><strong>Factor 1</strong></td>
<td><strong>Factor 1</strong></td>
</tr>
<tr>
<td><strong>(1) Administrative/instructor issues.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Lack of sufficient academic advisors online</td>
<td>.750</td>
<td>.664</td>
</tr>
<tr>
<td>22. Course materials not always delivered on time</td>
<td>.747</td>
<td>.634</td>
</tr>
<tr>
<td>17. Instructors do not know how to teach online</td>
<td>.743</td>
<td>.730</td>
</tr>
<tr>
<td>18. Lack of clear expectations/instructions</td>
<td>.729</td>
<td>.671</td>
</tr>
<tr>
<td>23. Difficulty contacting academic or administrative staff</td>
<td>.726</td>
<td>.570</td>
</tr>
<tr>
<td>15. Lack of timely feedback from instructor</td>
<td>.726</td>
<td>.679</td>
</tr>
<tr>
<td>14. Lack of access to instructor/expert</td>
<td>.690</td>
<td>.652</td>
</tr>
<tr>
<td>21. Lack of support services such as tutors</td>
<td>.657</td>
<td>.688</td>
</tr>
<tr>
<td>16. Lower quality materials/instruction online</td>
<td>.609</td>
<td>.563</td>
</tr>
<tr>
<td>20. Insufficient training to use the delivery system</td>
<td>.543</td>
<td>.664</td>
</tr>
<tr>
<td>24. Class size is not right for online learning</td>
<td>.510</td>
<td></td>
</tr>
<tr>
<td>Cronbach $\alpha$ (Both based on the study.)</td>
<td>.901</td>
<td>.905</td>
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<tr>
<td><strong>(2) Social interactions.</strong></td>
<td><strong>Factor 2</strong></td>
<td><strong>Factor 6</strong></td>
</tr>
<tr>
<td>28. Lack of interaction/communication among students</td>
<td>.828</td>
<td>.766</td>
</tr>
<tr>
<td>25. Online learning seems impersonal</td>
<td>.809</td>
<td></td>
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<tr>
<td>27. Afraid of feeling isolated</td>
<td>.803</td>
<td>.720</td>
</tr>
<tr>
<td>29. Lack of social context cues</td>
<td>.770</td>
<td>.686</td>
</tr>
<tr>
<td>30. Lack of student collaboration</td>
<td>.757</td>
<td>.740</td>
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<tr>
<td>26. Prefer to learn in person</td>
<td>.717</td>
<td></td>
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<tr>
<td>Cronbach $\alpha$ (Both based on the study.)</td>
<td>.837</td>
<td>.865</td>
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<td>(3) Academic skills.</td>
<td>Factor 3</td>
<td>Factor 2</td>
</tr>
<tr>
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</tr>
<tr>
<td>36. Lack language skills for online learning</td>
<td>.816</td>
<td>.764</td>
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<tr>
<td>31. Lack writing skills for online learning</td>
<td>.807</td>
<td>.799</td>
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<td>33. Lack reading skills for online learning</td>
<td>.787</td>
<td>.816</td>
</tr>
<tr>
<td>35. Lack communication skills for online learning</td>
<td>.770</td>
<td>.765</td>
</tr>
<tr>
<td>32. Lack typing skills for online learning</td>
<td>.702</td>
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</tr>
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<td>34. Shy or lack confidence for online learning</td>
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<tr>
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<td>.912</td>
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<table>
<thead>
<tr>
<th>(4) Technical skills.</th>
<th>Factor 4</th>
<th>Factor 3</th>
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<tbody>
<tr>
<td>11. Fear new tools for online learning</td>
<td>.778</td>
<td>.638</td>
</tr>
<tr>
<td>7. Fear computers and technology</td>
<td>.725</td>
<td></td>
</tr>
<tr>
<td>9. Lack online learning software skills</td>
<td>.706</td>
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</tr>
<tr>
<td>6. Lack skills for using the delivery system</td>
<td>.689</td>
<td></td>
</tr>
<tr>
<td>3. Unfamiliar with online learning technical tools</td>
<td>.648</td>
<td></td>
</tr>
<tr>
<td>12. Fear different learning methods used for online learning</td>
<td>.598</td>
<td>.718</td>
</tr>
<tr>
<td>8. Lack of consistent platforms, browsers, software</td>
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<td>Cronbach $\alpha$ (Both based on the study.)</td>
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<td>.794</td>
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<table>
<thead>
<tr>
<th>(5) Learner motivation.</th>
<th>Factor 5</th>
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</tr>
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<tbody>
<tr>
<td>39. Procrastinate, cannot get started</td>
<td>.812</td>
<td>.845</td>
</tr>
<tr>
<td>38. Lack personal motivation for online learning</td>
<td>.796</td>
<td>.834</td>
</tr>
<tr>
<td>37. Must take on more responsibility for learning</td>
<td>.762</td>
<td>.699</td>
</tr>
<tr>
<td>40. Choose easier, less demanding aspects of assignments</td>
<td>.678</td>
<td>.661</td>
</tr>
<tr>
<td>41. Online learning environment is not inherently motivating</td>
<td>.625</td>
<td>.697</td>
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<tr>
<td>Cronbach $\alpha$ (Both based on the study.)</td>
<td></td>
<td>.870</td>
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</table>
### (6) Time and support for studies.

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 6</th>
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</tr>
</thead>
<tbody>
<tr>
<td>45. Fear family life will be disrupted</td>
<td>.768</td>
<td>.758</td>
</tr>
<tr>
<td>46. Online learning cuts into my personal time</td>
<td>.759</td>
<td>.524</td>
</tr>
<tr>
<td>44. Lack support from family, friends, employer</td>
<td>.671</td>
<td>.590</td>
</tr>
<tr>
<td>43. Significant interruptions during study at home/work</td>
<td>.638</td>
<td></td>
</tr>
<tr>
<td>42. Insufficient time to learn during online courses</td>
<td>.531</td>
<td></td>
</tr>
<tr>
<td>24. Class size is not right for online learning</td>
<td></td>
<td>.610</td>
</tr>
</tbody>
</table>

**Cronbach α (Both based on the study.)**

<table>
<thead>
<tr>
<th>Cronbach α</th>
<th>Factor 6</th>
<th>Factor 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>.785</td>
<td></td>
<td>.699</td>
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</table>

### (7) Cost and access to the Internet.

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 7</th>
<th>Factor 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Lack adequate Internet access</td>
<td>.732</td>
<td>.642</td>
</tr>
<tr>
<td>5. Online learning technology costs too much</td>
<td>.727</td>
<td>.647</td>
</tr>
<tr>
<td>1. Needed technology is not available</td>
<td>.656</td>
<td>.807</td>
</tr>
<tr>
<td>2. Afraid of losing privacy, confidentiality, or intellectual property</td>
<td></td>
<td>.621</td>
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</tbody>
</table>

**Cronbach α (Both based on the study.)**

<table>
<thead>
<tr>
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<th>Factor 7</th>
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</thead>
<tbody>
<tr>
<td>.711</td>
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<td>.746</td>
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### (8) Technical problems.

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 8</th>
<th>Factor 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Lack of consistent platforms, browsers, software</td>
<td>.688</td>
<td></td>
</tr>
<tr>
<td>13. Incompatibility creates technical problems</td>
<td>.673</td>
<td></td>
</tr>
<tr>
<td>10. Lack technical assistance</td>
<td>.623</td>
<td></td>
</tr>
<tr>
<td>7. Fear computers and technology</td>
<td></td>
<td>.732</td>
</tr>
<tr>
<td>6. Lack skills for using the delivery system</td>
<td></td>
<td>.528</td>
</tr>
<tr>
<td>3. Unfamiliar with online learning technical tools</td>
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<td>.559</td>
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</tbody>
</table>

**Cronbach α (Both based on the study.)**

<table>
<thead>
<tr>
<th>Cronbach α</th>
<th>Factor 8</th>
<th>Factor 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>.755</td>
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<td>.693</td>
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**Note.** Extraction method: principal component analysis. Rotation method: Varimax with Kaiser normalization. Cutoff = 0.50.
APPENDIX I

BERGE AND MUILENBURG: RESPONSE RATE
<table>
<thead>
<tr>
<th>Factors</th>
<th>Barriers</th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>(1) Administrative/instructor issues.</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>19. Lack of sufficient academic advisors online</td>
<td>43.0</td>
<td>25.5</td>
<td>20.6</td>
<td>7.9</td>
<td>3.0</td>
</tr>
<tr>
<td>22. Course materials not always delivered on time</td>
<td>46.1</td>
<td>31.5</td>
<td>13.3</td>
<td>6.1</td>
<td>3.0</td>
</tr>
<tr>
<td>17. Instructors do not know how to teach online</td>
<td>42.4</td>
<td>32.1</td>
<td>17.6</td>
<td>4.2</td>
<td>3.6</td>
</tr>
<tr>
<td>18. Lack of clear expectations/instructions</td>
<td>30.3</td>
<td>27.3</td>
<td>26.7</td>
<td>12.7</td>
<td>3.0</td>
</tr>
<tr>
<td>23. Difficulty contacting academic or administrative staff</td>
<td>47.9</td>
<td>32.7</td>
<td>14.5</td>
<td>3.6</td>
<td>1.2</td>
</tr>
<tr>
<td>15. Lack of timely feedback from instructor</td>
<td>32.1</td>
<td>30.9</td>
<td>26.1</td>
<td>7.9</td>
<td>3.0</td>
</tr>
<tr>
<td>14. Lack of access to instructor/expert</td>
<td>40.6</td>
<td>31.5</td>
<td>17.6</td>
<td>7.9</td>
<td>2.4</td>
</tr>
<tr>
<td>21. Lack of support services such as tutors</td>
<td>47.3</td>
<td>21.2</td>
<td>22.4</td>
<td>8.5</td>
<td>0.6</td>
</tr>
<tr>
<td>16. Lower quality materials/instruction online</td>
<td>33.9</td>
<td>26.1</td>
<td>23.0</td>
<td>12.1</td>
<td>4.8</td>
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<tr>
<td>20. Insufficient training to use the delivery system</td>
<td>46.1</td>
<td>30.3</td>
<td>17.6</td>
<td>4.2</td>
<td>1.8</td>
</tr>
<tr>
<td>24. Class size is not right for online learning</td>
<td>63.0</td>
<td>22.4</td>
<td>9.7</td>
<td>3.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Overall</td>
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<td>28.3</td>
<td>19.0</td>
<td>7.1</td>
<td>2.6</td>
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<table>
<thead>
<tr>
<th>(2) Social interactions.</th>
<th>No</th>
<th>Weak</th>
<th>Moderate</th>
<th>Strong</th>
<th>Very</th>
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</thead>
<tbody>
<tr>
<td>28. Lack of interaction/communication among students</td>
<td>40.6</td>
<td>21.8</td>
<td>20.0</td>
<td>10.9</td>
<td>6.7</td>
</tr>
<tr>
<td>25. Online learning seems impersonal</td>
<td>38.2</td>
<td>26.7</td>
<td>20.0</td>
<td>8.5</td>
<td>6.7</td>
</tr>
<tr>
<td>27. Afraid of feeling isolated</td>
<td>58.2</td>
<td>21.8</td>
<td>8.5</td>
<td>7.9</td>
<td>3.6</td>
</tr>
<tr>
<td>29. Lack of social context cues</td>
<td>43.6</td>
<td>19.4</td>
<td>20.6</td>
<td>10.9</td>
<td>5.5</td>
</tr>
<tr>
<td>30. Lack of student collaboration</td>
<td>38.8</td>
<td>21.8</td>
<td>25.5</td>
<td>9.7</td>
<td>4.2</td>
</tr>
<tr>
<td>26. Prefer to learn in person</td>
<td>29.7</td>
<td>16.4</td>
<td>23.0</td>
<td>16.4</td>
<td>14.5</td>
</tr>
<tr>
<td>Overall</td>
<td>41.5</td>
<td>21.3</td>
<td>19.6</td>
<td>10.7</td>
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### (3) Academic skills.

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<th>Weak</th>
<th>Moderate</th>
<th>Strong</th>
<th>Very</th>
</tr>
</thead>
<tbody>
<tr>
<td>36. Lack language skills for online learning</td>
<td>81.2</td>
<td>9.1</td>
<td>6.1</td>
<td>3.0</td>
<td>0.6</td>
</tr>
<tr>
<td>31. Lack writing skills for online learning</td>
<td>70.9</td>
<td>20.0</td>
<td>6.7</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>33. Lack reading skills for online learning</td>
<td>77.0</td>
<td>13.3</td>
<td>7.3</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>35. Lack communication skills for online learning</td>
<td>69.1</td>
<td>19.4</td>
<td>9.1</td>
<td>1.8</td>
<td>0.6</td>
</tr>
<tr>
<td>32. Lack typing skills for online learning</td>
<td>78.8</td>
<td>13.9</td>
<td>4.8</td>
<td>1.8</td>
<td>0.6</td>
</tr>
<tr>
<td>34. Shy or lack confidence for online learning</td>
<td>69.7</td>
<td>17.0</td>
<td>9.7</td>
<td>1.8</td>
<td>1.8</td>
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<td><strong>Overall</strong></td>
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### (4) Technical skills.

<table>
<thead>
<tr>
<th>Item</th>
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<th>Weak</th>
<th>Moderate</th>
<th>Strong</th>
<th>Very</th>
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<tbody>
<tr>
<td>11. Fear new tools for online learning</td>
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<td>19.4</td>
<td>4.8</td>
<td>1.8</td>
<td>0.6</td>
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<tr>
<td>7. Fear computers and technology</td>
<td>86.1</td>
<td>10.3</td>
<td>2.4</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>9. Lack online learning software skills</td>
<td>70.9</td>
<td>24.2</td>
<td>4.2</td>
<td>0.6</td>
<td></td>
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<tr>
<td>6. Lack skills for using the delivery system</td>
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<td>21.1</td>
<td>6.1</td>
<td>4.8</td>
<td>0.6</td>
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<tr>
<td>3. Unfamiliar with online learning technical tools</td>
<td>53.9</td>
<td>31.5</td>
<td>10.3</td>
<td>3.0</td>
<td>1.2</td>
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<tr>
<td>12. Fear different learning methods used for online learning</td>
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<td>2.4</td>
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<td>5.6</td>
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### (5) Learner motivation.

<table>
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<tr>
<th>Item</th>
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<th>Weak</th>
<th>Moderate</th>
<th>Strong</th>
<th>Very</th>
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<tbody>
<tr>
<td>39. Procrastinate, cannot get started</td>
<td>33.9</td>
<td>24.2</td>
<td>21.2</td>
<td>13.9</td>
<td>6.7</td>
</tr>
<tr>
<td>38. Lack personal motivation for online learning</td>
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<td>25.5</td>
<td>14.5</td>
<td>10.9</td>
<td>4.8</td>
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<tr>
<td>37. Must take on more responsibility for learning</td>
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<td>18.2</td>
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<td>10.9</td>
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<tr>
<td>40. Choose easier, less demanding aspects of assignments</td>
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<td>26.1</td>
<td>23.0</td>
<td>11.5</td>
<td>5.5</td>
</tr>
<tr>
<td>41. Online learning environment is not inherently motivating</td>
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<td>22.4</td>
<td>21.2</td>
<td>15.8</td>
<td>6.7</td>
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<tr>
<td><strong>Overall</strong></td>
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<td>23.3</td>
<td>19.6</td>
<td>13.3</td>
<td>6.9</td>
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<tr>
<td>(6) Time and support for studies.</td>
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<td>Moderate</td>
<td>Strong</td>
<td>Very</td>
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<td>---------------------------------</td>
<td>------</td>
<td>------</td>
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<td>--------</td>
<td>------</td>
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<tr>
<td>45. Fear family life will be disrupted</td>
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<td>18.2</td>
<td>6.7</td>
<td>3.0</td>
<td>1.2</td>
</tr>
<tr>
<td>46. Online learning cuts into my personal time</td>
<td>40.6</td>
<td>31.5</td>
<td>20.6</td>
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<td>4.2</td>
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<tr>
<td>44. Lack support from family, friends, employer</td>
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<td>20.0</td>
<td>12.1</td>
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<td>1.8</td>
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<td>43. Significant interruptions during study at home/work</td>
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<td>29.1</td>
<td>26.1</td>
<td>12.7</td>
<td>4.2</td>
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<td>22.4</td>
<td>7.3</td>
<td>2.4</td>
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<tr>
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<td>24.7</td>
<td>17.6</td>
<td>5.7</td>
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<table>
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<tr>
<th>(7) Cost and access to the Internet.</th>
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<th>Weak</th>
<th>Moderate</th>
<th>Strong</th>
<th>Very</th>
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<tbody>
<tr>
<td>4. Lack adequate Internet access</td>
<td>58.2</td>
<td>20.0</td>
<td>13.9</td>
<td>3.6</td>
<td>4.2</td>
</tr>
<tr>
<td>5. Online learning technology costs too much</td>
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<td>25.5</td>
<td>10.9</td>
<td>8.5</td>
</tr>
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<td>1. Needed technology is not available</td>
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<td>11.5</td>
<td>6.1</td>
<td>4.8</td>
</tr>
<tr>
<td>Overall</td>
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<td>21.2</td>
<td>17.0</td>
<td>6.9</td>
<td>5.8</td>
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<table>
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<tr>
<th>(8) Technical problems.</th>
<th>No</th>
<th>Weak</th>
<th>Moderate</th>
<th>Strong</th>
<th>Very</th>
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<tbody>
<tr>
<td>8. Lack of consistent platforms, browsers, software</td>
<td>49.7</td>
<td>33.9</td>
<td>14.5</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>13. Incompatibility creates technical problems</td>
<td>52.1</td>
<td>29.7</td>
<td>14.5</td>
<td>3.0</td>
<td>0.6</td>
</tr>
<tr>
<td>10. Lack technical assistance</td>
<td>51.5</td>
<td>32.7</td>
<td>11.5</td>
<td>3.0</td>
<td>1.2</td>
</tr>
<tr>
<td>7. Fear computers and technology</td>
<td>86.1</td>
<td>10.3</td>
<td>2.4</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>6. Lack skills for using the delivery system</td>
<td>67.3</td>
<td>21.2</td>
<td>6.1</td>
<td>4.8</td>
<td>0.6</td>
</tr>
<tr>
<td>3. Unfamiliar with online learning technical tools</td>
<td>53.9</td>
<td>31.5</td>
<td>10.3</td>
<td>3.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Overall</td>
<td>60.1</td>
<td>26.6</td>
<td>9.9</td>
<td>2.8</td>
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</table>
APPENDIX J

SATISFACTION: INSTRUMENT
Satisfaction

Module 1

Instructions: Please answer the following questions.

1. I am in a hurry and/or distracted right now.
   a. ☐ Strongly Agree
   b. ☐ Agree
   c. ☐ Neither Agree nor Disagree
   d. ☐ Disagree
   e. ☐ Strongly Disagree

2. I am currently excited and/or energized.
   a. ☐ Strongly Agree
   b. ☐ Agree
   c. ☐ Neither Agree nor Disagree
   d. ☐ Disagree
   e. ☐ Strongly Disagree

3. I feel tired and/or frustrated right now.
   a. ☐ Strongly Agree
   b. ☐ Agree
   c. ☐ Neither Agree nor Disagree
   d. ☐ Disagree
   e. ☐ Strongly Disagree

4. I feel bored right now.
   a. ☐ Strongly Agree
   b. ☐ Agree
   c. ☐ Neither Agree nor Disagree
   d. ☐ Disagree
   e. ☐ Strongly Disagree
5. I read all or at least some of Chapter # from the book Communication: A Critical/Cultural Introduction by J. T. Warren & D. L. Fassett.
   a. ○ Strongly Agree
   b. ○ Agree
   c. ○ Neither Agree nor Disagree
   d. ○ Disagree
   e. ○ Strongly Disagree

6. I found the module content confusing and/or difficult to follow.
   a. ○ Strongly Agree
   b. ○ Agree
   c. ○ Neither Agree nor Disagree
   d. ○ Disagree
   e. ○ Strongly Disagree

7. I enjoyed the content more than I thought I would.
   a. ○ Strongly Agree
   b. ○ Agree
   c. ○ Neither Agree nor Disagree
   d. ○ Disagree
   e. ○ Strongly Disagree
8. I prefer to watch television more than read a book.
   a. ☐ Strongly Agree
   b. ☐ Agree
   c. ☐ Neither Agree nor Disagree
   d. ☐ Disagree
   e. ☐ Strongly Disagree

9. I am more frustrated after reviewing the module content than before reviewing it.
   a. ☐ Strongly Agree
   b. ☐ Agree
   c. ☐ Neither Agree nor Disagree
   d. ☐ Disagree
   e. ☐ Strongly Disagree

10. When I think of how I prefer content to be delivered, I disliked this content.
    a. ☐ Strongly Agree
    b. ☐ Agree
    c. ☐ Neither Agree nor Disagree
    d. ☐ Disagree
    e. ☐ Strongly Disagree
APPENDIX K

VAK: AUTHOR EMAIL
Email 1

From: donclark@nwlink.com

Hi Blair,
Please feel free to use the material and good luck with your dissertation!

Cheers,
Don

Donald Clark ~ http://www.nwlink.com/~donclark

On 1/16/2015 1:16 PM, Blair Copeland wrote:
I have run into a problem.

Due to circumstance beyond my control I find myself starting my dissertation study on Tuesday but I need a new Modal Preference Inventory.

I am seeking permission to use your instrument for my dissertation.

I would like to put it on my survey system and not reveal the learner Modal Preference to the learner until the end of my study.

Would it be possible to use your VAK Instrument for my research and place it on my survey system?

Most Sincerely,

Blair Copeland
Doctoral Candidate
Subject: Re: VAK Instrument
From: donclark@nwlink.com
Date: Mon, 23 May 2016 18:16:07 -0700

Hi Blair,

Please feel free to use either method.
- Don

On 5/23/2016 3:38 PM, Blair Copeland wrote:

I apologize if my last message wasn't properly introduced.

Back in January you gave me permission to use the VAK for my dissertation study, that message is attached below.

I wanted to include the version of your VAK I used in my study in the appendix, so that if anyone else wanted to repeat my study they would know what materials I used.

I am seeking permission to either include

1) the text of the VAK as used in the study exactly (with a copyright notice/warning and link to the VAK website),

2) or a date or version number you provide (with a copyright notice/warning and link to the VAK website)?

If one of these options is acceptable to you, or if you prefer something else, please let me know what would be acceptable so I may properly credit and identify your existing work.

I apologize if I have not asked or requested permission in a way that would be acceptable.

Most Sincerely,
Blair Copeland
APPENDIX L

VAK: INSTRUMENT

Reproduced with permission from Donald Clark.
Research Survey

VAK Questionnaire
Learning Styles Survey

Read each statement carefully and select the option that best describes you.

© Copyright (2013) Donald Clark

Section One

1. I take written notes and/or draw mind maps.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

2. When talking to someone else I have a difficult time understanding those who do not maintain good eye contact with me.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies
3. I make lists and notes because I remember things better if I write them down.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

4. When reading a novel, I pay a lot of attention to passages that help me to picture the clothing, description, scenery, setting, etc.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

5. I need to write down directions so that I can remember them.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

6. I need to see the person I am taking to in order in order to keep my attention focused on the subject.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies
7. When meeting a person for the first time, I notice the style of dress, visual characteristics, and neatness first.

1. ☐ Almost Never Applies
2. ☐ Applies Once in a While
3. ☐ Sometimes Applies
4. ☐ Often Applies
5. ☐ Almost Always Applies

8. When I am at a party, one of the things I love to do is stand back and observe the people.

1. ☐ Almost Never Applies
2. ☐ Applies Once in a While
3. ☐ Sometimes Applies
4. ☐ Often Applies
5. ☐ Almost Always Applies

9. When recalling information I can see it in my mind and remember where I saw it.

1. ☐ Almost Never Applies
2. ☐ Applies Once in a While
3. ☐ Sometimes Applies
4. ☐ Often Applies
5. ☐ Almost Always Applies
10. If I had to explain a new procedure or technique, I would prefer to write it out. |

1. ☐ Almost Never Applies
2. ☐ Applies Once in a While
3. ☐ Sometimes Applies
4. ☐ Often Applies
5. ☐ Almost Always Applies

11. In my free time I am most likely to watch television or read.

1. ☐ Almost Never Applies
2. ☐ Applies Once in a While
3. ☐ Sometimes Applies
4. ☐ Often Applies
5. ☐ Almost Always Applies

12. If my boss has a message for me, I am most comfortable when she sends a memo.

1. ☐ Almost Never Applies
2. ☐ Applies Once in a While
3. ☐ Sometimes Applies
4. ☐ Often Applies
5. ☐ Almost Always Applies
Section Two

1. I read out loud or move my lips to hear the words in my head.
   1. Almost Never Applies
   2. Applies Once in a While
   3. Sometimes Applies
   4. Often Applies
   5. Almost Always Applies

2. When talking to someone, I have a difficult time understanding those who do not talk or respond with me.
   1. Almost Never Applies
   2. Applies Once in a While
   3. Sometimes Applies
   4. Often Applies
   5. Almost Always Applies

3. I do not take a lot of notes, but I still remember what was said. Taking notes often distracts me from the speaker.
   1. Almost Never Applies
   2. Applies Once in a While
   3. Sometimes Applies
   4. Often Applies
   5. Almost Always Applies

4. When reading a novel, I pay a lot of attention to passages involving conversations, talking, speaking, dialogues, etc.
   1. Almost Never Applies
   2. Applies Once in a While
   3. Sometimes Applies
   4. Often Applies
   5. Almost Always Applies
5. I like to talk to myself when solving a problem or writing.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

6. I can understand what a speaker says, even if I am not focused on the speaker.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

7. I remember things easier by repeating them over and over.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

8. When I am at a party, one of the things I love to do is talk in-depth about a subject that is important to me with a good conversationalist.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies
9. I would rather receive information from the radio, rather than read a newspaper.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

10. If I had to explain a new procedure or technique, I would prefer talking about it.
    1. ☐ Almost Never Applies
    2. ☐ Applies Once in a While
    3. ☐ Sometimes Applies
    4. ☐ Often Applies
    5. ☐ Almost Always Applies

11. With my free time I am most likely to listen to music.
    1. ☐ Almost Never Applies
    2. ☐ Applies Once in a While
    3. ☐ Sometimes Applies
    4. ☐ Often Applies
    5. ☐ Almost Always Applies

12. If my boss has a message for me, I am most comfortable when he or she calls me on the phone.
    1. ☐ Almost Never Applies
    2. ☐ Applies Once in a While
    3. ☐ Sometimes Applies
    4. ☐ Often Applies
    5. ☐ Almost Always Applies
Section Three

1. I am not good at reading or listening to directions. I would rather just start working on the task or project at hand.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

2. When talking to someone, I have a difficult time understanding those who do not show any kind of emotional or physical support.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

3. I take notes, doodle, and/or make mind maps, but I rarely go back and look at them.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

4. When reading a novel, I pay a lot of attention to passages revealing feelings, moods, action, drama, etc.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies
5. When I am reading, I move my lips.
   1. ☐ Almost Never Applies
   2. ☑ Applies Once in a While
   3. ☑ Sometimes Applies
   4. ☑ Often Applies
   5. ☑ Almost Always Applies

   I often exchange words, such as places or things, and use my hands a lot when I can't remember the right thing to say.
   1. ☐ Almost Never Applies
   2. ☑ Applies Once in a While
   3. ☑ Sometimes Applies
   4. ☑ Often Applies
   5. ☑ Almost Always Applies

7. My desk appears disorganized.
   1. ☐ Almost Never Applies
   2. ☑ Applies Once in a While
   3. ☑ Sometimes Applies
   4. ☑ Often Applies
   5. ☑ Almost Always Applies

8. When I am at a party, one of the things I love to do is enjoy the activities such as dancing, games, and totally losing myself in the action.
   1. ☐ Almost Never Applies
   2. ☑ Applies Once in a While
   3. ☑ Sometimes Applies
   4. ☑ Often Applies
   5. ☑ Almost Always Applies
9. I like to move around. I feel trapped when seated at a meeting or a desk.
   1. ☐ Almost Never Applies
   2. ☐ Applies Once in a While
   3. ☐ Sometimes Applies
   4. ☐ Often Applies
   5. ☐ Almost Always Applies

10. If I had to explain a new procedure or technique, I would prefer actually demonstrating it.
    1. ☐ Almost Never Applies
    2. ☐ Applies Once in a While
    3. ☐ Sometimes Applies
    4. ☐ Often Applies
    5. ☐ Almost Always Applies

11. With my free time I am most likely to exercise.
    1. ☐ Almost Never Applies
    2. ☐ Applies Once in a While
    3. ☐ Sometimes Applies
    4. ☐ Often Applies
    5. ☐ Almost Always Applies

12. If my boss has a message for me, I am most comfortable when she talks to me in person.
    1. ☐ Almost Never Applies
    2. ☐ Applies Once in a While
    3. ☐ Sometimes Applies
    4. ☐ Often Applies
    5. ☐ Almost Always Applies
APPENDIX M

SPSS ITEM ANALYSIS CODE
***This Item Analysis syntax follows the example from the SPSS White Paper on the same subject.
* Data file must contain consecutive numeric variables q1 To qN where N is the number of questions (other variables are ignored)
* The last case of the file must contain the key (the correct answer) to each question.

*Instructions:
* To use the syntax, you only need to modify the macro call (in the last line of this syntax) to provide the data file specifications and the number of questions.
* Run the entire syntax.

* Initial syntax by Ray 2003/01/27 .
* Syntax improved by Raynald Levesque 2007/10/13.
* Tested with SPSS 15.

* 2015/09/01 The line 'SELECT IF NOT id_key.' before calling !keys macro was replaced with 'SELECT IF id_key.' as otherwise macro incorrectly marked last but one case as key case. That misprint affected only key marking with asterisk, without affecting test scoring. The problem was noted by Blair Copeland, Senior Network Engineer from University of North Texas System. Thanks, Blair!
* A.B.

*/////////. DEFINE !keys(nbq=!TOKENS(1) /QVARS = !TOKENS(1)) /* This macro adds the * after the correct answer number */ WRITE OUTFILE='temp/define labels.sps'
!DO !cnt=1 !TO !nbq /!QUOTE(!CONCAT('VALUE LABELS ',!QVARS,!cnt," "))!CONCAT(!QVARS,!cnt)'*'.
!DOEND.
EXECUTE.
!ENDDEFINE.
*/////////. DEFINE !item(fileName=!TOKENS(1) /nbQuestions = !TOKENS(1) /QVARS = !TOKENS(1)) CD !fileName.
DATASET CLOSE ALL .
GET FILE = !fileName .
PRESERVE.
SET TVARS=LABELS /TNUMBERS=LABELS.
COMPUTE id_tmp = $CASENUM.
SORT CASES BY id_tmp(D).
COMPUTE id_key = ($CASENUM=1).
DO REPEAT key=#1 TO !CONCAT('#',!nbQuestions) / q=!CONCAT(!QVARS,1) TO !CONCAT(!QVARS,!nbQuestions).
- DO IF $CASENUM=1.
- COMPUTE key = q.
- ELSE.
- COMPUTE q = (q=key).
- END IF.
END REPEAT.

SORT CASES BY id_tmp (A).
***Delete the record containing the key.
SELECT IF NOT id_key.

***Compute the score for each record.
COMPUTE score = MEAN(!CONCAT(!QVARS,1) TO !CONCAT(!QVARS,!nbQuestions))*100.

***Compute and append the ranking of each score.
RANK VARIABLES = score (D) /NTILES (3) INTO group /PRINT=YES /TIES=MEAN.
FORMATS group (F8).
VALUE LABELS group 1 'high' 2 'middle' 3 'low'.
SAVE OUTFILE='temp/scored.sav'.

***run against the resulting scored data to produce the output seen in Figures 3-4.
AGGREGATE OUTFILE=* /BREAK=group !DO !idx=1 !TO !nbQuestions /!CONCAT(!QVARS,!idx, ' "percentage right ",'!QVARS,!idx','=MEAN('!',!QVARS,!idx,')' ) !DOEND.

STRING nnames(A3).
COMPUTE nnames = CONCAT('v',LTRIM(STRING(group,F8))).

FLIP VARIABLES=!CONCAT(!QVARS,1) TO !CONCAT(!QVARS,!nbQuestions) /NEWNAMES=nnames.
RENAME VARIABLES (case_lbl=qnum) (v1=high) (v2=middle) (v3=low).
COMPUTE index = high - low.
FORMATS high TO index (F4.2).
SUMMARIZE /TABLES=qnum high middle low index /FORMAT=VALIDLIST NOCASENUM TOTAL /TITLE='Index of Discrimination' /MISSING=VARIABLE /CELLS=NONE.

***Compute - among other things - corrected point biserial correlations.
GET FILE= 'temp/scored.sav'.
RELIABILITY
/VARIABLES=!CONCAT(!QVARS,1) TO !CONCAT(!QVARS,!nbQuestions)
/FORMAT=NOLABELS
/SCALE(ALPHA)=ALL/MODEL=ALPHA
/STATISTICS=DESCRIPTIVE CORR
/SUMMARY=TOTAL MEANS.

*** Produce a table similar to that in figure 5.

***Item distracter analysis setup.
GET FILE=!fileName.
COMPUTE nobreak=1.
ADD FILES FILE=* /BY=nobreak /LAST=id_key.
SELECT IF id_key.
FORMATS !CONCAT(!QVARS,1) TO !CONCAT(!QVARS,!nbQuestions)(F1).
!keys nbq=!nbQuestions QVARS=!QVARS.
GET FILE=!fileName.
COMPUTE nobreak=1.
ADD FILES FILE=* /BY=nobreak /LAST=id_key.
SELECT IF NOT id_key.
MATCH FILES/FILE=* /FILE='temp/scored.sav'
/RENAME (!CONCAT(!QVARS,1) TO !CONCAT(!QVARS,!nbQuestions)= d1 TO !CONCAT('d',!nbQuestions))
/DROP=d1 TO !CONCAT('d',!nbQuestions)).

VARIABLE LABELS group 'Percentage answering distracter'.
VALUE LABELS group 1 'high 1/3' 2 'middle 1/3' 3 'low 1/3'.
FORMATS !CONCAT(!QVARS,1) TO !CONCAT(!QVARS,!nbQuestions) (F8).
INSERT FILE='temp/define labels.sps'.
CROSSTABS
/TABLES=group BY !CONCAT(!QVARS,1) TO !CONCAT(!QVARS,!nbQuestions)
/FORMAT=AVALUE TABLES
/CELLS=ROW.

RESTORE.
!ENDDEFINE.

*\\\\\\\\\\\\\\\\\\\\\.

SET MPRINT=YES.

!item fileName="c:\Dissertation\A-DATA\Working\ItemAnalysis\Item-Analysis-Modules-0-9.sav" nbQuestions=15 QVARS=s1m0pre1q.
!item fileName="c:\Dissertation\A-DATA\Working\ItemAnalysis\Item-Analysis-Modules-0-9.sav" nbQuestions=10 QVARS=s1m1q.
!item fileName="c:\Dissertation\A-DATA\Working\ItemAnalysis\Item-Analysis-Modules-0-9.sav" nbQuestions=10 QVARS=s1m2q.
!item fileName="c:\Dissertation\A-DATA\Working\ItemAnalysis\Item-Analysis-Modules-0-9.sav" nbQuestions=10 QVARS=s1m3q.
!item fileName="c:\Dissertation\A-DATA\Working\ItemAnalysis\Item-Analysis-Modules-0-9.sav" nbQuestions=10 QVARS=s1m4q.
!item fileName="c:\Dissertation\A-DATA\Working\ItemAnalysis\Item-Analysis-Modules-0-9.sav" nbQuestions=10 QVARS=s1m5q.
!item fileName="c:\Dissertation\A-DATA\Working\ItemAnalysis\Item-Analysis-Modules-0-9.sav" nbQuestions=10 QVARS=s1m6q.
!item fileName="c:\Dissertation\A-DATA\Working\ItemAnalysis\Item-Analysis-Modules-0-9.sav" nbQuestions=10 QVARS=s1m7q.
!item fileName="c:\Dissertation\A-DATA\Working\ItemAnalysis\Item-Analysis-Modules-0-9.sav" nbQuestions=10 QVARS=s1m8q.

!item fileName="c:\Dissertation\A-DATA\Working\ItemAnalysis\Item-Analysis-Modules-0-9.sav" nbQuestions=15 QVARS=s1m9post1q
REFERENCES


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