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Students from diverse academic, cultural, disability, and socio-economic backgrounds are enrolling in postsecondary settings at higher rates. Concurrently, postsecondary faculty are increasingly mindful of how to design accessible classroom learning environments for students with a wide range of characteristics and backgrounds. This attention to accessible teaching and learning is a key component of educational effectiveness and equity. Inclusive teaching strategies have the potential to reduce extraneous obstacles for students and increase access to the content of classroom instruction. The current study utilized exploratory factor and path analyses to examine relationships between student executive function, perceived cognitive load, accessible teaching strategies, and course instructor ratings. Results of the study indicated relationships were found between constructs of cognitive load and inclusive approaches to assignment logistics, and cognitive load and ratings of teaching effectiveness. Results are discussed within the context of possible considerations for faculty in the design of their classroom activities and contributions to student rating of teaching effectiveness.

Keywords: Inclusion, Cognitive Load, Teaching, Observation, Faculty Development

Equity in education is oftentimes best understood within the contexts of equal outcomes and opportunities for academic growth (Neito, 1996). Within higher education, educational equity is quite complex with systems interactions at many levels with societal, cultural, familial and individual student factors, to name a few (Junor & Usher, 2002). Unlike secondary education, postsecondary education and training is not compulsory, and thus not protected in the same manner as elementary and secondary education. And yet access to postsecondary education and training can yield several benefits: higher salaries, helping to shape the future, and reduction of economic disparity for underserved populations (National Center on Education Statistics, 2011). In fact, college enrollment and completion are two of the most important factors that determine an individual's earning power over the course of a lifetime. For example, males who completed a bachelor's degree were more likely to be employed and earn significantly more than those with only a high school diploma, with a median salary of $63,700 vs. $40,060 for the two groups, respectively (National Center on Education Statistics, 2011). Completion of postsecondary education and training is thus a potential strategy to address socioeconomic inequities in historically underserved populations.

Accessible Instructional Strategies

Unfortunately, only half of students who enter a four-year institution will complete a bachelor's degree, an attrition rate that represents loss opportunities for students and is an indicator of systemic barriers to degree completion (Kuh et al., 2011; National Center on Education Statistics, 2012). Although there are many factors that contribute to drop out rates in postsecondary education and training (Tinto, 2012), the degree to which students from diverse backgrounds can gain access to the content of instruction has been the focus of increasing discussion over the past decade. Traditional approaches to instruction focus on faculty lecturing, minimal student engagement, and assignments that are decontextualized and removed from the life experiences of students. Universal Design for Learning (UDL), in contrast, provides principles that seek to meet the needs of the community of learners while focusing on access for individual learners (Rose et al., 2006). UDL strategies focus on flexibility and different approaches to learning, such as assignment

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alternatives, testing options, and/or adaptations to meet the challenge of expanding access for the diverse set of postsecondary learners. In the Higher Education Opportunity Act (Pub L 110-315, August 2008), Congress defines UDL as:

> A scientifically valid framework for guiding educational practice that –
>
> (a) provides flexibility in the ways information is presented, students respond or demonstrate knowledge and skills, and students are engaged; and
>
> (b) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient (p. 122 Statute 3088).

UDL requires intentionality in how students engage with course material. For example, in a classroom with group activities, a faculty member can make choices about how students communicate with each other during class in a way that facilitates best practices with interpreters. Furthermore, activities can leverage the resources of technology, such as live chat rooms for discussions or use of a collaborative cloud file to document information reviewed in class. This shift in pedagogy is sometimes subtle, such as providing students time for self-paced review of the visual materials before providing "live" expansion and elaboration by the faculty member in a lecture format. And yet the UDL approach is also one of a change in attitude, not just practice. UDL encourages faculty to be mindful, positive, and creative about their classroom and how they communicate information.

It is equally important to understand how principles and outcomes of UDL strategies are implemented, maintained, and measured across various systems. In fact, previous research identified four areas of concern from the perspectives of disabled students and their parents, which include (a) inaccessible physical structures, (b) negative educator attitudes towards disability, (c) limited educator knowledge, and (d) a lack of inclusive education policy (Pivik, McComas, & Laflamme, 2002). Such findings highlight the importance of recognizing a systems-level approach to producing active educational change. For example, students in higher education most often interface with their instructor, who typically structures the classroom, makes academic decisions, and evaluates student performance. Whether or not the instructor adopts inclusive teaching strategies depends on various individual factors, namely personal beliefs, experience with disabled students, and perspectives on diversity (Aragon, Dovidio, & Graham, 2016; Crowson & Brandes, 2014). More specifically, educators who endorsed a diversity ideology that ignored/downplayed differences in gender or color were less likely to adopt inclusive teaching strategies than educators who recognized and embraced student differences (Aragon et al., 2016). That said, educators' attitudes are predicted by factors at the institutional level, including workplace stress and access to training opportunities, the latter of which are often limited due to inadequate time or resources, as well as the absence of a legal mandate for UDL implementation (Galaterou & Antoniou, 2017; Lombardi, Murray, & Dallas, 2013; Raue & Lewis, 2011). Furthermore, even in the context of positive attitudes towards inclusive learning and disabled students, faculty do not consistently implement UDL strategies intheir classroom, often citing a lack of experience or knowledge of these principles (Lombardi, Vukovic, & Sala-Bars, 2015).

These aforementioned findings recognize the importance of intensive and accessible educator training to shape attitudes, knowledge, and skills related to UDL implementation. The benefits also extend to the educators themselves; after receipt of UDL and diversity training, instructors report increased self-efficacy, perceived social/institutional support, understanding of their students, and job satisfaction (Katz, 2015). Taken together, the confluence of the individual, institutional, and state/federal level affect whether educators adopt UDL principles into their classroom. However, students themselves are a sorely under-used resource in postsecondary settings, and there is scant research related to their perspectives on inclusive learning (Gardebo & Wiggberg, 2012). This is concerning, as the curricular or pedagogical development of a classroom could certainly benefit from the experiences of those who are educated in these spaces. To this end, the present study contributes to the developing literature base by examining the student-reported impact of inclusive learning in higher education settings.

Role of Cognitive Load in Accessible Instruction

One of the goals of inclusive teaching, including those approaches that follow UDL, is to reduce extraneous work that students need to do in order to access the actual content of instruction. Inclusive teaching is thus intricately related to how students retrieve and process information in the learning environment. Cognitive Load Theory, as posited by Sweller and colleagues (Paas et al., 2003; Paas & Sweller, 2014; Sweller et al., 2011), focuses on the relationship between academic tasks and the cognitive demand on students.

Cognitive load relies on the idea that all tasks impose demands on a learner's cognitive system (Sweller, 1999). Independent tasks that can be processed one at a time require low cognitive load; tasks with multiple elements that are interrelated and must be processed simultaneously require high cognitive load (Van Merrienboer & Sweller, 2005). Furthermore, there are different types of cognitive load, some that are mutable and some that are not (Paas, et al., 2003). *Intrinsic* cognitive load is inherent to the content itself and thought not to be alterable by assessment design (i.e., aligned with student's proficiency with the target skill). *Extraneous* cognitive load, on the other hand, refers to demand that is due to how the information is presented during assessment (i.e., what is navigated by a student's access skills). Finally, the *germane* load consists of the cognitive resources needed to construct new knowledge and integrate it into one's cognitive schema. A learner has a finite cognitive capacity to perform a task: depending on task demands, the sum of the intrinsic, extraneous, and germane load can either be the limit or even, at times, exceed the cognitive capacity available to perform a particular task.

Reducing extraneous cognitive load that puts demands on working memory so as to primarily activate intrinsic cognitive load can be achieved through specific pedagogical choices. For example, the complexity of language on test items becomes a potential extraneous cognitive load in content assessments (e.g., mathematics and science) where reading is not the targeted skill (Abedi et al., 2005). One strategy for reducing extraneous load in this condition may be to offer the student a glossary of vocabulary not directly related to the test item content. Measures from studies of cognitive load in online learning environments serve as potential starting points for study of their application in postsecondary classrooms with diverse learners. The concept (but not the direct measurement) of cognitive load for students with disabilities has been applied to frameworks for developing accessible assessments for students with disabilities (Elliott et al., 2010).

Executive Functioning, Cognitive Load, and Inclusive Teaching Practices

Conversations centered on the relationship between inclusive instruction and cognitive load typically focus on visible measures of engagement or teaching practice. Yet for many students in postsecondary education, a high degree of executive functioning is required to manage the large amount of information input, make decisions about how to use that information, and then again how to express one's understanding and application in high-demand performance tasks such as a final exam or project. Executive functioning, generally, refers to an individual's ability to guide, direct, and manage cognitive, emotional, and behavioral functioning (Diamond, 2013). From a specific neurological perspective, executive functioning centers on the frontal lobe (Duncan et al.,1995; Miyake et al., 2000). Diamond (2013) discusses three core executive functions: Working memory, inhibitory control (e.g., behavioral inhibition, cognitive inhibition, and selective attention), and cognitive flexibility (e.g., adapting to the changing demands or priorities.

The connection to cognitive load theory is a complex but an important one. Learning new material is supported by all three areas of executive functioning (Schwaighofer et al., 2017). When cognitive load surpasses an individual's working memory capacity, such as environments where recognition is difficult, knowledge is not readily available, or there is a high demand for attention and effort this can introduce different and unintended behavior (Kalyuga, 2007). Differences in working memory capacity have been associated with fluctuation in multiple complex learning outcomes. Specifically, working memory is correlated with reading comprehension, math and chemistry achievement, and problem solving (Schwaighofer, et al., 2017). One study considered how students' executive functions are advanced through UDL principles, guidelines, and checkpoints. García-Campos and colleagues (2018) conclude that by supporting specific executive functions identified (e.g., working memory and abstract reasoning) through the implementation of specific UDL strategies, teachers create opportunities for the entire class and increase student involvement. These findings call upon both the institution and faculty to consider strategies in order to ensure accessibility, which may in turn reduce the cognitive load of students and potentially improve their learning experience.

Purpose of this Study

Gaining access to the content of course instruction is a complex process, one that includes student, faculty, and systemic factors. Furthermore, teaching effectiveness is an elusive outcome to measure, as are the predictors of teaching success. Longitudinal data with indicators of teaching effectiveness as measured by student success in both academic and applied experiences after the end of their coursework are rarely available. This study sought to explore the potential relationship between student processing of information, teaching strategies, and teaching effectiveness. More specifically, this study investigated the relationships between executive function, cognitive load, accessible teaching strategies, and course instructor ratings at a large public university through a path analysis. It is proposed that student levels of executive functioning and accessible teaching strategies have a direct effect on levels of experienced cognitive load, and that levels of cognitive load and accessible teaching strategies, in turn, will both have an effect on course instructor ratings.

Methods

Procedure

Students took a pre-screening survey for all studies that were a part of the university research subject pool and then had the opportunity to choose from a list of available studies, including the current study. Participants were recruited from February to April 2017. Eligibility requirements included: (a) 18 years of age or older (b) enrolled in a course with a Subject Pool requirement (c) did not have a registered disability (see below). Once participants registered for the current study, they were able to click on a link that took them to the Qualtrics survey platform, where they were given a consent form that described the nature of the study. Participants were able to decline upon reading the form and at any point during the survey without penalty. The survey took approximately one hour to complete, and participants received one credit for their time. The study was reviewed and approved by the university's Institutional Review Board.

Participants

Study participants were 271 undergraduate students at a large public university who were enrolled in one of a number of courses within the College of Education with a research participation option to fulfill course requirements. The demographics of the study participants are provided in Table 1. A total of 65% of the sample was female, 41% were 20 years old or younger, and 84% of the sample spoke English as their native language. Only 21% of the sample was fluent in a language other than their native language, while a very large proportion (42%) of the sample was conversant in another language. Also, only 4.8% of the sample was registered with the office for student disabilities; since this potentially represented a qualitatively different group of students than students without a disclosed disability, these individuals were omitted from the remaining analyses. For confidentiality reasons, students did not report their ethnicity.

Of these demographic variables, ten were used as covariates in the path analysis. The first three of these included the number of semesters the student was enrolled at the university, the student's age in years, and the student's major. An indicator variable for being male was included, as well as indicator variables for students who were only fluent in English, Spanish, and Chinese languages, and an indicator variable for students who were conversant in at least one other language. The last indicator variable denoted whether the student had gone to high school in the United States for at least one year. The final covariate included the approximate number of books the student read in the past 12 months.

Independent Variables

The independent variables included a variety of factors obtained from the LEAF, an instrument designed to measure executive functioning (Kronenberger, Castellanos, & Pisoni, 2018). Fifty-five items were intended to assess eight cognitive and three academic domains. These cognitive domains were comprehension and conceptual learning, factual memory, attention, processing speed, visual-spatial organization, sustained sequential processing, working memory/processing complex information, and novel problem solving and learning. The academic domains were mathematics skills, basic reading skills, and written expression skills. Internal consistency for all LEAF subscales measured 0.79 or higher with the exception of the visual-spatial organization subscale (Castellanos, Kronenberger, & Pisoni, 2018). Test-retest reliability ranged from 0.74 – 0.88 across all subscales (Castellanos, et al., 2018). However, all these purported domains were for an entirely different sample than the sample in the current study. Ensuring the construct validity of the path analysis involved estimating a set of exploratory factor analyses (described in the results section), which found factors that were slightly distinct from the domains listed above.

Mediators

Two other instruments were included as possible mediators in the path analysis. The first instrument was a cognitive load measure, adapted from Leppink et al. (2013), including 12 items intended to measure the difficulty, clarity, and helpfulness of the learning activities in class. Test-retest reliability ranged from 0.71 – 0.94, and the internal consistency for the scales measured between 0.80 – 0.89 (Leppink et al., 2013). The other instrument was a ratings of strategies measure, which was created for this study. Students rated, on a ten-point scale, the degree to which certain teaching strategies helped their learning experience. The items in this adapted instrument are included in Appendix A. Both of these measures were also subjected to exploratory factor analysis to ensure construct validity prior to path analysis.

Dependent variable

The dependent variable was a standard course-instructor survey used at the University of Texas at Austin. The wordings of these six items were altered somewhat, since the survey was administered mid-semester, rather than at the end of the semester. Since the wording was altered, this dependent variable was also subject to exploratory factor analysis.

Analysis Plan

Analysis proceeded in two steps. In the first step, a set of exploratory factor analyses were conducted to ensure the construct validity of the independent variables, the mediating variables, and the dependent variable. Once the factor structure was established, factors were parceled by taking the

Table 1. *Demographic and descriptive statistics*

Variable	Percentage
Female	65.3
Number of years in postsecondary education	
1	1.0
2	3.4
3	19.6
4	23.7
5	37.1
6 or more	7.1
Number of semesters at UT	
1	8.6
2	0.7
3	22.3
4	2.4
5	19.9
6	2.1
7	26.5
8	2.7
9+	6.8
Age	
18	4.1
19	16.5
20	20.6
21	32.0
22	12.4
23	2.4
24+	3.3
Is a veteran	1.0
Native language is…	
English	84.2
Spanish	8.6
Chinese	4.1
Sign Language	0.3
Hindi	1.0
Korean	1.0
Urdu	1.0
Vietnamese	2.1
Other	4.5
Is fluent in another language	21.3
English	3.2
Spanish	4.8
American Sign Language	0.3
Indian languages	4.9
Other Asian languages	1.9
Middle-Eastern languages	0.6
Is conversant in another language	41.6
English	1.3
Spanish	16.5
American Sign Language	3.3
Indian languages	5.3
Other Asian languages	6.3
French	3.7
German	1.7
Number of books read in the last year	
1-10	66.0
11-20	18.6
21-30	5.5
31-40	0.3
61+	1.0
Went to high school in the U.S. for at least one year	89.3
Had an IEP/ARD/504 plan or other formal accommodations	2.1
Is registered with Office of Student Disabilities for accommodations	4.8
Requested accommodations	4.8

average of each item that loaded 0.4 or greater onto the factor (Stevens, 2009). Given the complexity of the model, shown in Figure 1, compared to the sample size of 271, parceling was used to increase the estimation stability of the solution (Matsunaga, 2008). Additionally, since exploratory factor analyses were conducted in the first step, the threat of multidimensionality on parceling was less severe (Matsunaga, 2008).

In the second step, a path analysis was conducted. In the path analysis, the independent variables had direct effects with the mediating variables and the dependent variable, while the mediating variables only had direct effects on the dependent variable. Mediating variables were allowed to correlate with each other, and covariates were allowed to co-vary with every variable in the analysis. Finally, indirect effects from the independent variables to the dependent variable through the mediating variables were estimated. A visual representation of this path analysis may be found in Figure 1.

Results

Step one: Exploratory Factor Analyses

Overview

A similar procedure was followed for each of the following factor analyses. First, a principal components analysis, using an oblimin rotation, was conducted to determine the overall number of factors to retain. The determination of this was based on the use of a scree plot and Kaiser's rule, along with overall interpretability (Henson & Roberts, 2006). After the number of factors was decided, factors were named assuming that items which loaded 0.4 or greater were associated with that factor (Stevens, 2012).

Exploratory factor analysis for the LEAF

Overall, the exploratory factor analysis for the LEAF indicated that the items in the present dataset followed the factor structure in the original publication (Kronenberger et al., 2018). However, there were some differences in that certain questions cross-loaded, and certain factors were combined. The scree plot for this factor structure may be found in Figure 2. While the scree test indicated that only two factors may be retained, Kaiser's rule suggested that eight factors could be retained. The two-factor solution, which is not printed here for parsimony, had a first factor onto which 42 out of 55 items loaded, and a second factor onto which reading and writing related items loaded. We found the eight-factor solution to be more interpretable, and more related to the original publication (Kronenberger et al., 2018). A listing of loadings for the eight-factor solution may be found in Appendix B. The eight-factor solution explained 63.96% of the total variance in the LEAF items, while the two-factor solution explained 41.70% of the total variance in the LEAF items.

Most of the factors corresponded rather directly to those found in the original work (Kronenberger et al., 2018), and so only those factors that were collapsed are reported here. The first factor included questions relating to two academic content areas, written expression skills and basic reading skills, called WE and RD in the original publication using this measure. So, for the present study, the first factor was named Reading/Writing to reflect this combination. Also, questions from the comprehension and conceptual learning (CC) and novel problem solving (NP) cognitive domains loaded onto a single factor, which we named Unfamiliar Content for the present work. Finally, questions from the processing speed (PS) and working memory (WM) cognitive domains both loaded onto a factor we named Working Slowly.

Exploratory factor analysis for the cognitive load measure

The scree plot in Figure 3 suggests a four-factor solution for the cognitive load measure. Since additional items from the original Leppnik et al. (2013) were included in the present work, the scree test was followed directly. We named the factors clarity, complexity, assignment utility, and content familiarity. See Table 2 for more detail on the factor loadings. The four-factor solution explained 76.32% of the total variance in the 12 items.

Exploratory factor analysis for the ratings of strategies measure

This original questionnaire had four factors, according to the scree test. The four factors explained 56.72% of the variance in the sixteen items. The scree plot may be found in Figure 4. Each factor loaded onto between three and six of the original sixteen items. We named the factors extra time to view lectures, longer duration assignments, briefer assignments, and visual material during lectures. More detail on the factor structure may be found in Table 3.

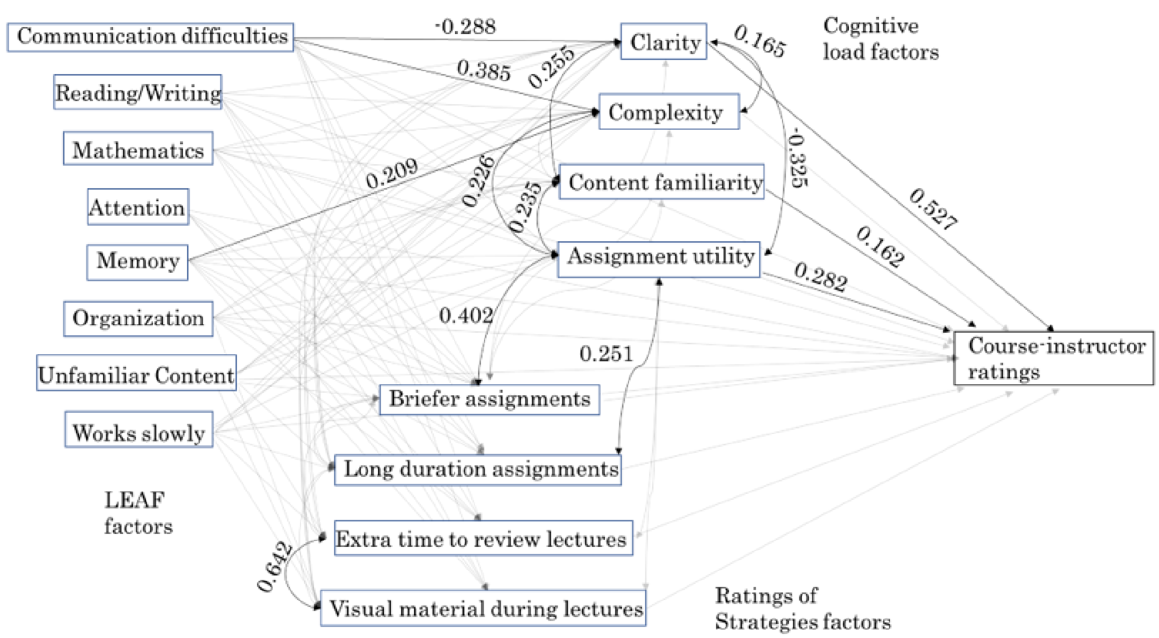

Figure 1. *Path diagram for the path analysis.* For the sake of parsimony, only effects significant at the 0.01 level are reported, however, the partly transparent paths were all estimated.

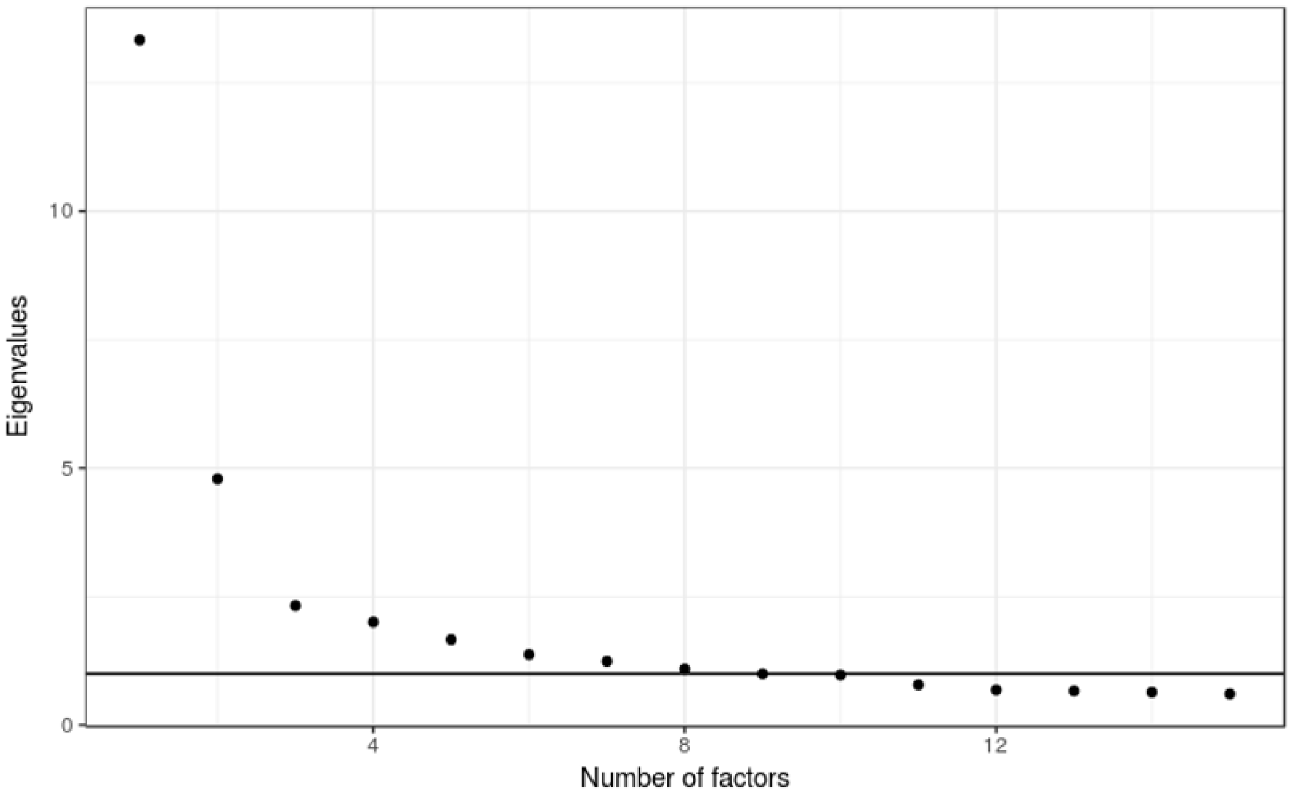

Figure 2. *LEAF principal components scree plot.*

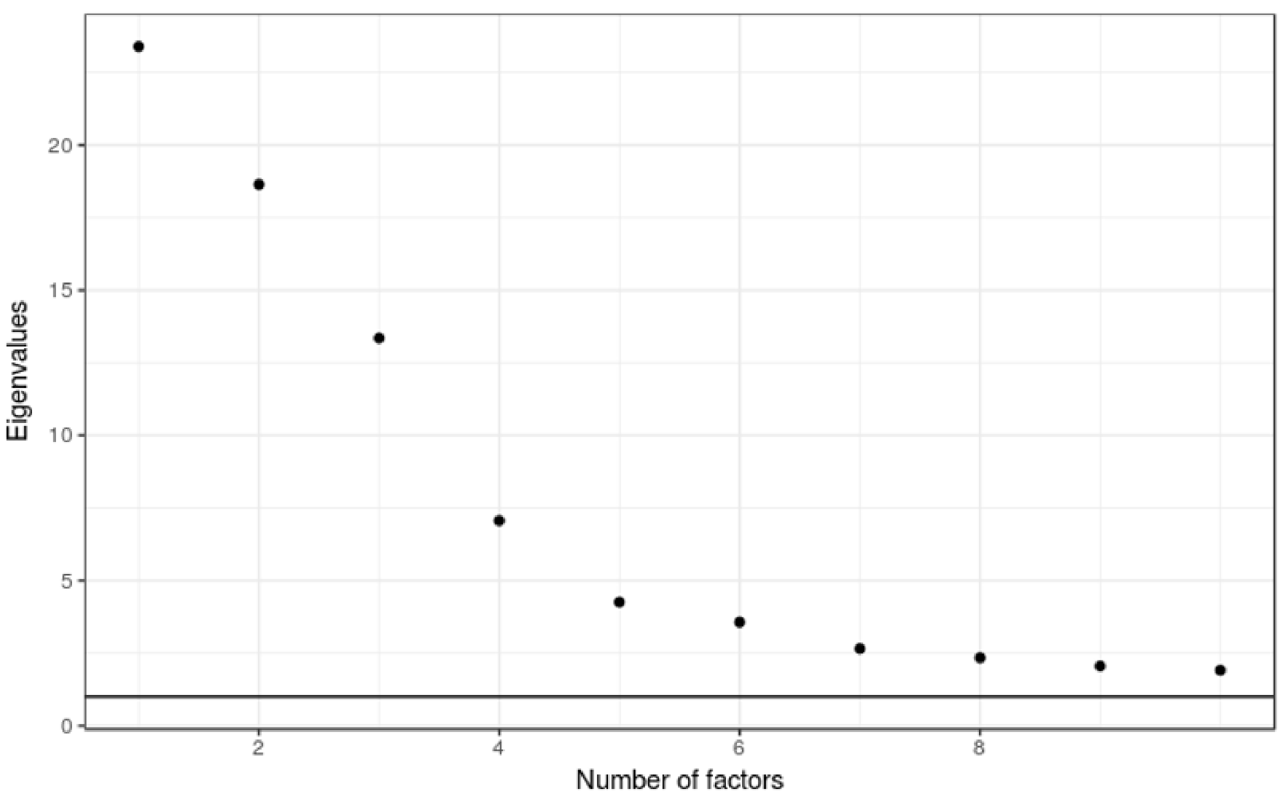

Figure 3. *Cognitive load scree plot.*

Table 2. *Factor loadings for the Cognitive Load measure*

Item	Clarity	Complexity	Assignment utility	Content familiarity
Content is familiar				0.9207
Content similar to previous classes				0.8662
Comfortable with content	-0.505			0.4561
Content is complex		0.9123		
Activities are complex		0.8626		
Concepts are complex		0.9126		
Unclear directions	0.8529			
Examples not useful	0.8415			
Confusing presentations	0.8707			
Useful homework			0.9171	
Useful activities			0.8865	
Exams help me learn			0.6025	

Note. For the sake of parsimony, only factor loadings greater than 0.4 in absolute value are reported here.

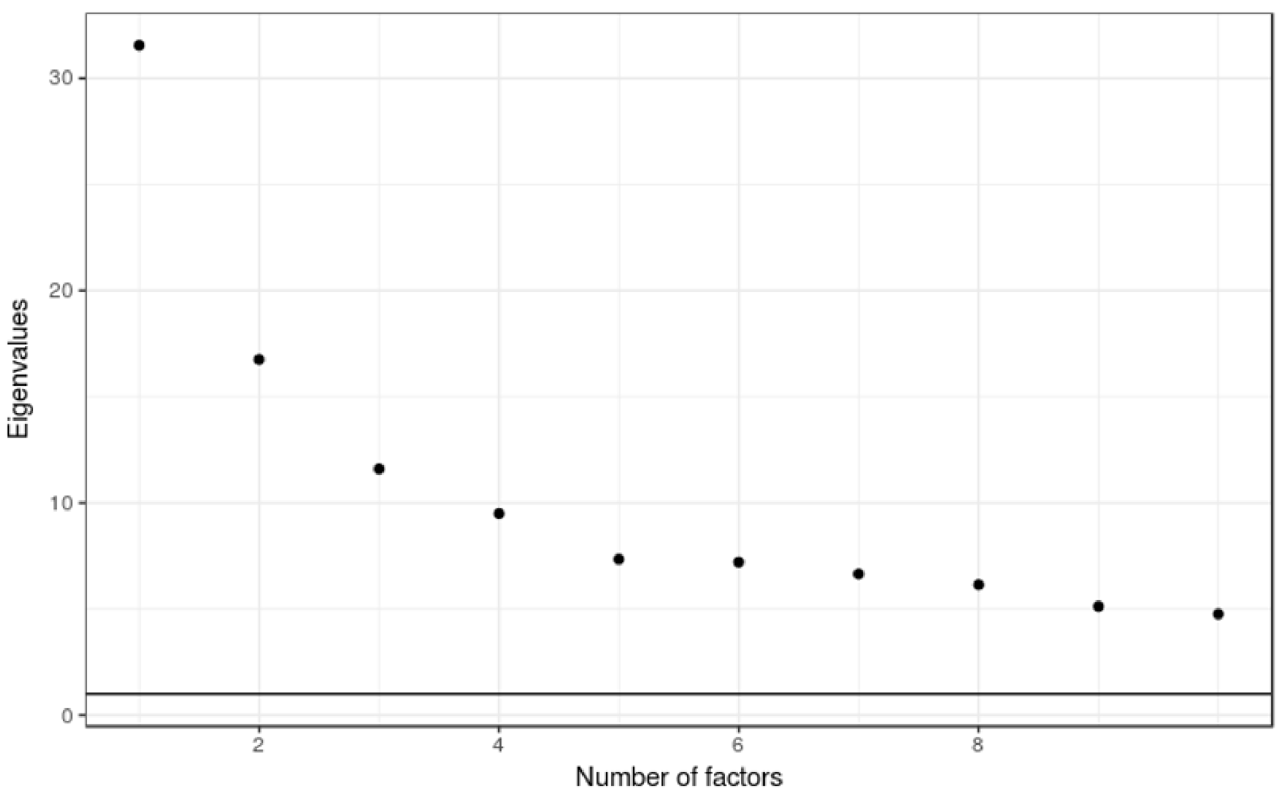

Figure 4. *Scree plot for the ratings of strategies measure.*

Table 3. *Factor loadings for the Ratings of Strategies measure*

Item	Extra time to review lectures	Longer duration assignments	Visual material during lectures	Briefer assignments
Quizzes				0.6215
Small projects		0.7297		
Short frequent reading assignments				0.5775
In class exams				0.7769
Take home exams				
Out-class group assignments		0.8397		
In-class group assignments		0.7384		
Captioned videos			0.7964	
Graphics			0.7054	
Online discussion		0.4673		
Pre-class PowerPoints	0.4471		0.5536	
Pre-class lecture outlines	0.4451		0.5666	
Daily objectives	0.5826			
Thinking time after questions	0.7221			
Thinking time for PowerPoints	0.8632			
Thinking time for class activities	0.798			

Note. For the sake of parsimony, only factor loadings greater than 0.4 in absolute value are reported here.

Exploratory factor analysis for the Course-Instructor Survey

Both Kaiser's rule and the scree test indicated unidimensionality for the course instructor survey (CIS). Figure 5 displays the scree plot. Every item loaded 0.4 or greater onto the single factor. More detail on the factor loadings may be found in Table 4.

Step two: Path analysis

Overview

As described above, the path analysis involved regressing the dependent variable, the course-instructor survey, on the moderators, covariates, and independent variables. The moderators, which included four factors from the cognitive load measure and four factors from the ratings of strategies measure, were also regressed on the independent variables and the covariates. Finally, the independent variables, the eight LEAF factors, were regressed on the covariates. The moderating variables were allowed to correlate with each other. A summary of all statistically significant direct effects and correlations may be found in Figure 1.

Fit statistics

The chi-square test of model fit was statistically significant, overall [$\chi^2(54) = 190.90$, $p < 0.001$], which indicates poor fit; however, this fit index is sensitive to power (Keith, 2014). The CFI was 0.952, while the SRMR was 0.032, which, together, indicate the model fit the data adequately (Hu & Bentler, 1999). On the other hand, the TLI was 0.791; the TLI is an index which penalizes more heavily for non-parsimonious models (Keith, 2014).

Summary of significant indirect effects

With eight independent variables and eight moderators, a total of sixty-four indirect effects were tested, but only one was statistically significant at an alpha level of 0.01. The clarity factor of the cognitive load questionnaire moderated the effect of self-reported communication difficulties on the course-instructor survey ($\beta = -0.152$, $z = 3.632$, $p < 0.001$). The effect size is moderate to large, for an indirect effect (Pituch et al., 2006).

Summary of significant direct effects

The only significant effects on the course-instructor survey were from the cognitive load factors. Specifically, a lack of clarity has a moderately strong negative effect on the course-instructor survey; students who rated their teachers one

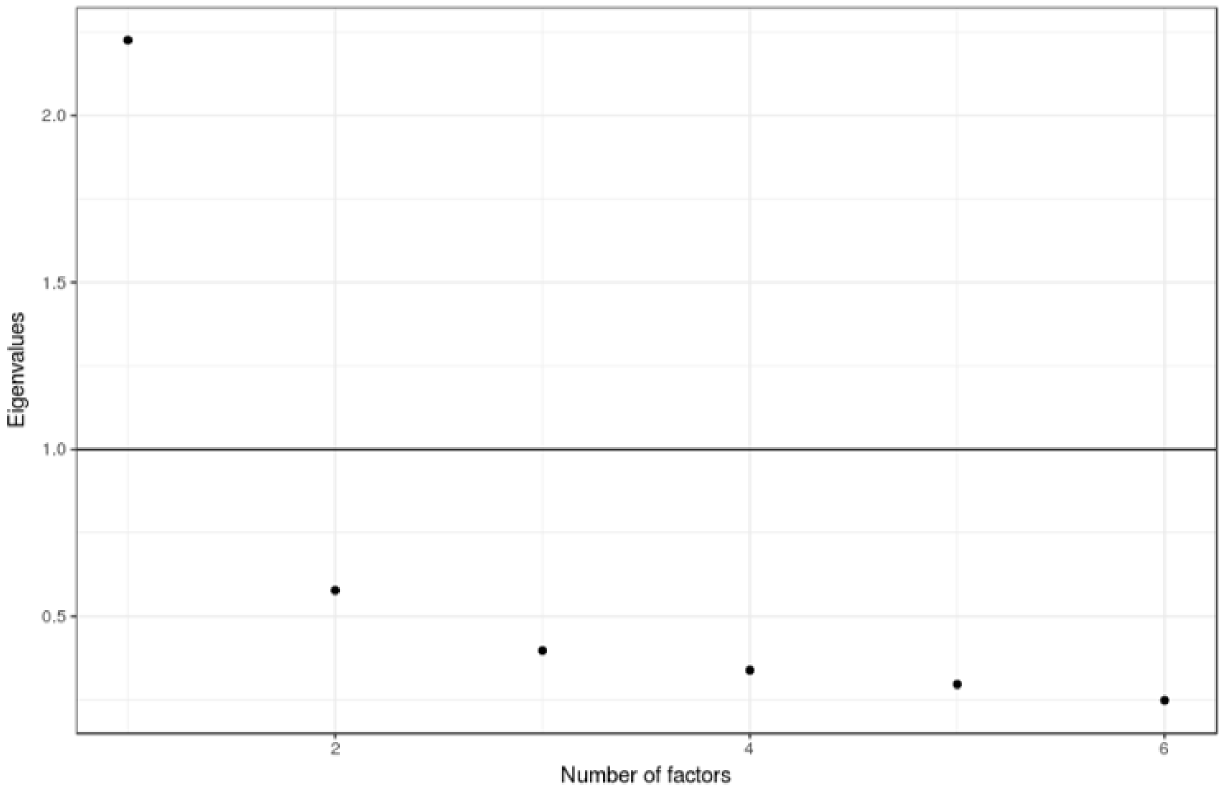

Figure 5. *Course-instructor survey scree plot.*

Table 4. *Factor loadings for the course-instructor survey*

Prompt	Loading
The course is well organized.	0.762
The instructor communicates effectively.	0.821
The instructor shows interest in the progress of students	0.793
The tests/assignments are usually graded and returned properly.	0.466
The instructor makes me feel free to ask questions, disagree, and express my ideas.	0.769
At this point in time, I feel that the course will be (or has already been) of value to me.	0.738

standard-deviation more unclear rated the instructors 0.527 standard deviations lower on the CIS ($z = -9.810$, $p < 0.001$). Also, useful class assignments had a modest, but meaningful effect on the CIS; students who had a 1-standard deviation higher rating of the utility of the assignments on the cognitive load measure rated the instructors 0.282 standard deviations higher on the CIS ($z = 4.997$, $p < 0.001$). Finally, there was a statistically significant, but practically minor effect of content familiarity on the CIS. Students who rated themselves as 1 standard deviation higher on content familiarity for the course rated the instructors only 0.162 standard deviations higher ($z = 3.30$, $p < 0.002$).

The independent variables, particularly, the LEAF factors, significantly impacted certain cognitive load factors, but not ratings of strategies factors. A one-standard-deviation increase in memory problems reported on the LEAF was associated with a 0.209 standard-deviation increase in the reported complexity of the class, a small but meaningful effect ($z = 2.754$, $p < 0.01$). Also, a one-standard-deviation increase in communication problems reported on the LEAF increased the reported complexity of the class by 0.385 standard deviations, a small-to-moderate effect ($z = 5.078$, $p < 0.001$). Finally, a one-standard-deviation increase in communication problems was also associated with a reported lack of clarity in the cognitive load measure ($\beta = 0.288$, $z = 3.910$, $p < 0.001$).

Summary of correlations between constructs

There were surprisingly few significant relationships between the constructs. Students who rated the assignments as useful on the cognitive load measure tended to report that they benefited more from brief assignments like quizzes ($\beta = 0.402$, $z = 6.03$, $p < 0.001$) and also that they benefited more from longer assignments like class projects ($\beta = 0.251$, $z = 3.582$, $p < 0.001$). In other words, students who self-report that assignments are useful believe that they benefit from those assignments, regardless of what sort of assignments they are. These correlations were the only significant relationships between the cognitive load measure and the ratings of strategies measure.

Naturally, certain cognitive load factors correlated with other cognitive load factors, and certain strategy factors correlated with other strategy measures. These factors were drawn from the same scale and are not assumed to be orthogonal. Details on those correlations can be found in Figure 1.

Discussion

The relationship between accessible classroom environments, faculty characteristics, and student characteristics is quite complex. This discussion section addresses some limitations of the study, a discussion of the measures utilized, and implications of the findings for both research and practice.

Study Limitations

The current research was limited by the sample of students which came from one public four-year university taking courses within the College of Education. As such, the characteristics of this learning environment may not be generalizable to other settings, subject areas, or types of institutions. Challenges in generalizability extend to the student participants in the study. To protect the confidentiality of student participants, ethnicity was not reported. Ethnicity may have been helpful information to determine sample representativeness within the overall university population. The study also did not have enough students with disclosed disabilities to allow for a comparison group or disaggregated analysis between those students with and without disclosed disabilities. Future research should allow for students to describe a broader range of disability-related characteristics. Self-report measures, in lieu of other more direct measures of cognitive load and executive functioning, are a second potential limitation to this study. While the study included exploratory factor analyses and measures of path model fit to inform evaluation of the statistical approaches, more proximal measures of the study constructs may have resulted in different findings about their relationships to each other. Finally, for the teaching effectiveness measure, specifically, there is an intense debate in the field regarding the use of student evaluations as a measure of teaching effectiveness (Lopez-Pastor & Sicilia-Camacho, 2015; Marsh, 1984). Furthermore, the timing of the survey meant that students were rating faculty on only a portion of the teaching-learning experience. Although the students had at least 2 months of exposure to the classroom practices prior to taking the teaching effectiveness survey, there could be culminating learning experiences that were not yet a part of their understanding and conceptualization of the faculty members' effectiveness.

Study Measures

This study included exploratory factor analyses for several of the measures included in the study to confirm that they could be used in the subsequent path analysis. This was especially critical for the inclusive teaching strategies measure that was developed specifically for this study. While exploratory factor analysis yielded satisfactory construct validity for the purposes of this study, this measure has not been examined with other populations or in other settings. Further inquiry into its psychometric properties and potential applications is warranted. The LEAF and cognitive load measures, while used previously in research, have not been normed or tested with college-aged students. Rather, especially with the LEAF, clinical populations such as those seeking psychological evaluations were part of the sample in which the psychometric analysis was conducted. The present paper's use of the LEAF and cognitive load measures with college students without disabilities or who may potentially be a member of a clinical population, may also be an area of future study. This would ensure that the LEAF and cognitive load measures are useful instruments when performing research in a postsecondary environment.

Role of Cognitive Load

Significant direct effects in this study were only noted for cognitive load factors. Students who perceived their instructors as unclear were more likely to produce a lower rating on the CIS. When information is not presented in an easily comprehensible manner, the basic transaction between faculty and students is compromised. Students also reported a relationship between the cognitive load factor of "assignment utility" and their ratings of two of the inclusive teaching strategies related to assignment length and timing. Students seem to associate the degree to which an assignment was useful with logistics and format of an assignment. It appears that, for cognitive load factors, items related to communication and the type of course activities are most salient in this model. Most importantly for improving the quality of instruction, both of these are malleable and can be responsive to intervention by a faculty development opportunity or peer feedback.

Predictors of Teaching Effectiveness

In addition to cognitive load, higher ratings of teaching effectiveness were indicated by useful class assignments and content familiarity. This was also indicated when examining correlations between constructs, as students who believed the assignments were useful reported benefitting from the assignments regardless of the assignment type. Taken together, these particular findings indicate that students value assignments that are clear, increase their understanding of the course material, and are germane to the content being taught. Deviating from these strategies (i.e., assigning "busy work") may increase negative student views of the class, making them at-risk for decreased motivation and willingness to engage in the course. While there were no direct effects of executive functioning and ratings of teaching effectiveness, there was a relationship between working memory (within executive functioning) and complex content. This relationship makes sense, given that more complex assignments and content are likely to require a higher degree of working memory to complete. Faculty may want to be particularly attentive to the degree to which complex assignment formats are necessary for students to demonstrate their understanding of the content. For students who may not have access to high levels of working memory, which can occur for many reasons (e.g., inability to attend to information for extended periods of time, recall multi-step directions, and low impulse control), reducing unnecessary assignment complexity may support more equitable learning experiences for diverse students.

Recommendations for Research and Practice

Research concerning educational effectiveness and equity has steadily increased over time; postsecondary faculty have, as a result, become progressively mindful about designing accessible learning environments for students. However, attrition rates have remained static for students attending four-year institutions, indicating that existing supports for students in their degree completion may not be sufficient. Postsecondary dropouts can be attributed to many different factors but shifting the focus towards increasing student's ability to gain access to the content of instruction holds promise. Replication studies that take these variables and explore them further in different course contexts and postsecondary settings is warranted. We especially recommend a focus on courses that have high rates of students who receive a D, F, or who withdraw all together, to see what impact inclusive teaching strategies may have on courses that seem to be challenging environments for students. Further research into specific accessibility strategies as well as their relationship with learning, course progression, and degree completion is needed. The day-to-day activities in the classroom may not seem to have a direct relationship with decisions to stay or leave postsecondary training. However, there may be cumulative preventative effects of accessible teaching strategies, perceived inclusivity, and reduced extraneous load for students who already may have to work harder than their peers due to systemic barriers in education, more generally. The role of teaching approaches, and the attitudes that they reflect, may play a significant role in the overall climate of support.

Our findings contribute further insight about cognitive load, working memory, and teaching effectiveness and encourage the creation of alternative teaching strategies for inclusive education. Findings such as these could be incorporated into concrete recommendations for faculty professional development, either at hire or later into their tenure. One possible consideration for faculty when designing coursework is the format of assignments. Creating assignments that capture both the main course objectives and increase understanding by being applicable and relevant to various fields of study is one strategy to engage students. Assignments that are structured and clear but allow students to flexibly incorporate their own interests may increase motivation and engagement. Although mastery of specific content needs to be demonstrated for valid measurement of student knowledge or skills, the level of intricacy required during the assignment needs to be considered as well. There are times when having support tools may allow students to successfully complete more complex tasks. For example, faculty might permit students to bring an external aid to exams (e.g., one note card) or provide a handout for assignments with key information to support the comprehension of patterns, critical features, and relationships. Finally, it can be important for faculty to ask students to complete mid-semester feedback in order to tailor the remainder of the course by including additional strategies suggested to ensure that course objectives are being achieved. Shifting the focus to proactively create learning environments that consider these predictors will be an important next step in the field.

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Appendix A

Items in the Ratings of Strategies Measure.

I learn better when there are...

Quizzes throughout the course

Small projects throughout the course

Shorter but more frequent reading assignments throughout the course

In class exams

Take home exams

Small group assignments outside of class

Small group assignments inside of class

Captioned videos and movies

Visual images and other graphics

Online discussions on Canvas

Power points posted ahead of class

Lecture outlines posted ahead of class

Objectives for the day

Extra time to think after the instructor asks a question

Time to read a power point slide before the instructor talks about its content

Time to think about a question or topic before the start of class activity.

Appendix B

Factor loadings for the LEAF exploratory factor analysis

	Reading, Writing (WE/RD)	Math (MT)	Attention (AT)	Factual Memory (FM)	Unfamiliar content (CC, NP)	Works slowly (PS, WM)	Visual-Spatial Organization (VSO)	Comprehension and Conceptual learning (CC)
Question 1								0.6677
Question 2								0.593
Question 3								0.5267
Question 4								0.6298
Question 5								0.6756
Question 6				0.8322				
Question 7				0.9081				
Question 8				0.8403				
Question 9				0.5460				
Question 10				0.6332				
Question 11			0.5308					
Question 12			0.6952					
Question 13			0.7684					
Question 14			0.8187					
Question 15								
Question 16								
Question 17						0.7313		
Question 18						0.7331		
Question 19						0.7241		
Question 20			0.4495					
Question 21							0.6815	
Question 22							0.7070	
Question 23								
Question 24							0.6382	
Question 25							0.5693	
Question 26							0.6350	
Question 27							0.5072	
Question 28								
Question 29								
Question 30								
Question 31						0.4313		
Question 32								
Question 33			0.4816					
Question 34								
Question 35					0.4484			
Question 36					0.5500			
Question 37					0.4606			
Question 38					0.7465			
Question 39					0.8227			
Question 40					0.7734			
Question 41		0.9149						
Question 42		0.8378						
Question 43		0.8624						

	Reading, Writing (WE/RD)	Math (MT)	Attention (AT)	Factual Memory (FM)	Unfamiliar content (CC, NP)	Works slowly (PS, WM)	Visual-Spatial Organization (VSO)	Comprehension and Conceptual learning (CC)
Question 44		0.7890						
Question 45		0.8974						
Question 46	0.5036					0.4521		
Question 47	0.8089							
Question 48	0.8434							
Question 49	0.9046							
Question 50	0.8789							
Question 51						0.6376		
Question 52								
Question 53	0.7150							
Question 54	0.5329							
Question 55	0.4551							

For the sake of parsimony, only loadings greater than 0.4 in absolute value are reported here.