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Models of pre-service teachers' academic achievement: The influence of cognitive motivational variables

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Abstract: Theoretical models were tested using structural equation modeling to evaluate the interrelations among cognitive motivational variables and academic achievement using a sample of 128 predominately Hispanic pre-service teachers enrolled in two undergraduate educational psychology classes. Data were gathered using: (a) a quantitative questionnaire to assess personal control, internal causality, self-efficacy, mastery goal orientation, and final course grade and (b) a problem-solving activity to identify engagement style: action- or process-oriented. The proposed theoretical model produced a poor model fit and thus a modified model was forwarded that directly linked self-efficacy with final course grade rather then mediated by mastery goal orientation. Results supported the modified model and suggested that the cognitive motivational variables under investigation played important roles in predicting students' grades, with self-efficacy acting as the mediator between both internal causality and personal control and students' final course grade. This study also demonstrated that the modified model was relatively invariant across gender, ethnicity, and engagement style. Implications for both teacher educators and pre-service teachers for understanding the complex links between cognitive motivational variables and academic achievement with a predominately Hispanic sample are discussed.

For educators, determining how to maximize student learning is a continuous and never-ending process. A rich literature base in cognitive motivational processes demonstrates that student academic achievement extends beyond quality of instruction, curricular content, and student ability to include student attributions, beliefs, engagement, and goal setting (Corno & Mandinach, 2004; Schunk, 2008; Wolters, Yu, & Pintrich, 1996). While relations between various cognitive motivational processes and academic achievement have been documented with non-minority populations, the U.S. student body has grown increasingly diverse (Pressley & Harris, 2006) therefore introducing the need for theoretical models to not only predict student academic achievement but also to generalize across diverse populations. As an example, one study conducted with a specific and homogeneous minority sample showed different pathways for predicting GPA and stronger magnitudes among predictor variables than for non-minority groups (Garriott & Flores, 2013).

Several cognitive motivational variables have emerged as strong predictors of academic achievement including self-efficacy, locus of causality, achievement goal orientation, controllability, and academic engagement. Self-efficacy has repeatedly shown to significantly predict academic achievement while beliefs, attributions, achievement goal orientation, and

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engagement have also acted as predictor, mediator, and criterion variables in theoretical models (Castro-Villarreal, Sullivan, Sass, & Guerra, 2012; Locke & Latham, 2002). However, the predictive ability of these variables amidst increasing educational requirements and expectations with a predominately Hispanic pre-service teacher sample has yet to be examined. Considering the rich literature on complex cognitive processes (Wolters et al., 1996), the contribution of the present study is not in the inclusion of the variables but in the examination of relative contribution and placement in the model as recent findings suggest psychological variables contribute in different ways for different populations (Castro-Villarreal et al., 2012; Locke & Latham, 2002). For example, previous research has shown important relations between self-efficacy and academic performance for Mexican-American females (Flores & O'Brien, 2002). From this viewpoint, the purpose of this study was to establish and test a theoretical framework examining how predominately Hispanic pre-service teachers' beliefs, attributions, achievement goal orientation, and engagement relate to their academic achievement.

Cultural and linguistic diversity combined with increased accountability and expectations for both educators and their students has effectively altered the United States (U.S.) education system (U.S. Department of Education, 2010). At the same time, minorities, namely Hispanics are still underrepresented in the teaching profession (U.S. Department of Education, 2010). Ostensibly, understanding how predominately Hispanic pre-service teachers' cognitive motivational variables interact to predict academic achievement could be one piece toward understanding teacher recruitment, retention, burn out, and persistence (U.S. Department of Education, 2010). Although determining whether ethnicity moderates models of teacher's academic success appears critical due to changing U.S. demographics and U.S. education system status, this study was also interested in whether teacher's engagement preference and gender moderated the theorized model.

Specifically, the research questions guiding this inquiry were: (1) What model including personal control, internal causality, self-efficacy, and achievement goal orientation best predicts academic achievement and (2) Does engagement style, gender, and ethnicity moderate the model's parameter estimates? Findings from this study can potentially aid teacher educators in recognizing and managing predominately Hispanic pre-service teachers', beliefs, attributions, self-efficacy, goal orientation, and level of engagement to support undergraduate academic achievement. The predicted relations among the included variables are detailed in theorized order next.

Theoretical Model

Attribution

Weiner (1986) defined attribution as the explanations people ascribe to their successes and failures. Within this theory, attributions fall along three dimensions, *locus*, *control,* and *stability.* The *stability* dimension refers to the stability of attributed causes of events and is most closely related to expectancies for success, unsuccessful events attributed to this factor can lead to learned helplessness (Weiner, 2004). The *control* dimension refers to the perceived source of control over events and is related to future effort and expectancies, it is also related to responsibility-taking, level of engagement, and academic success (Andrews & Debus, 1978; Perry, Hladkyj, Pekrun, & Pelletier, 2001; Shell & Husman, 2008; Tollefson, 2000; Weiner, 1994, 2004). Unlike the *stability* dimension, attributing both successes and failures to personal

controllable factors gives individuals a sense of responsibility, ownership, and control, which in turn influences engagement and efficacy. Given the importance of developing responsible self-regulated learners, teaching students to attribute outcome of performances to strategy use and effort (some examples of personal control attribution) has been the focus of attribution retraining as these factors are controllable by the individual and are considered healthy attributions (Castro-Villarreal & Schallert, 2008; Castro-Villarreal, Sullivan, & Guerra, 2007). The *locus* dimension refers to the location of the cause of events and is either internal or external. Personal control and internal causality have been shown to predict self-efficacy, which relates with academic success. Therefore, internal causality and personal control were examined as predictor variables and stability was omitted from our model.

Self-efficacy

Self-efficacy, people's beliefs about their ability to successfully complete a task (Bandura, 1977; 1997), is found to influence effort, persistence, and goal setting (Pajares, 2003; Pintrich, 2003; Wigfield & Eccles, 2000). To that end, research has shown self-efficacy to be a powerful predictor of grade point average and final course grade (Devonport & Lane, 2006; Graham & Weiner, 1996; Liem, Lau, & Nie, 2008; Multon, Brown, & Lent, 1991; Pajares, 2003; Ryan & Pintrich, 1997; Zajacova, Lynch, & Espenshade, 2005), and to relate with other behaviors, actions, affect, and goals (Patrick, Ryan, & Kaplan, 2007; Shell & Husman, 2008).

Because the belief individuals have about the amount of control they have over performance can influence their sense of being able to effectively deal with a task, it is appropriate to examine the relation between self-efficacy and the control dimension of Weiner's attributional model (Bandura, 1977; Poulou & Norwich, 2002). Researchers suggest that the more students believe that success is due to personal control factors, the higher their self-efficacy (Bond, Biddle, & Ntoumanis, 2001) and when students attribute failure to factors outside of their volitional control, their self-efficacy suffers (Castro-Villarreal & Schallert, 2008; Castro-Villarreal et al., 2007; Castro-Villarreal et al., 2012). Further, Rudisill (1989) found that students who perceived their performance as due to an internal, unstable, but personally controllable cause reported having higher self-efficacy and had better performance than students who attributed their performance to internal, stable, and uncontrollable causes. For this study, it was theorized that feeling in control over the learning situation and outcome (i.e., having personal control) gives students a higher sense of self-efficacy and therefore self-efficacy was tested for mediator effects.

Achievement Goal Orientation

Achievement goal orientation can be defined as the purpose for students' engagement in academic tasks (Elliott & Church, 1997). Traditionally, students who are motivated to learn and acquire knowledge have *mastery* goals, while those who exert effort in academic tasks in order to receive favorable judgments are said to have *performance* goals (Pintrich, 2003). Three types of goal orientations have been identified: *mastery*, in which students' main goal is to master new skills, *performance-approach*, where students' main concern is receiving favorable judgments from others, and *performance-avoidance*, where students worry about failure and focus primarily on how not to look bad (Elliott & Church, 1997). Although a revised 2 x 2 achievement goal framework has been proposed where mastery orientation is also subdivided into approach and

avoidance, with avoidance being more negative than approach but more positive than the traditional performance-avoidance goals, the traditional one-dimensional mastery orientation was the only variable utilized in the present study (Elliot & McGregor, 2001).

Students' achievement goal orientation has been found to relate to motivation, self-efficacy, use of "deep processing" strategies, engagement, and persistence in the face of challenge (Elliot & Church, 1997; Friedel, Cortina, Turner, & Midgley, 2007; Kaplan & Middleton, 2002; Liem, Lau, & Nie, 2008; Pajares, Britner, & Valiante, 2000; Patrick, Ryan, & Kaplan, 2007; Pintrich, 2003). Students with mastery goal-orientations tend to perform better academically than those with performance goals (Button, Mathieu, Zajac, 1996; Harackiewicz & Elliot, 1993; Phillips & Gully, 1997; Castro-Villarreal et al., 2007). In addition, students with higher self-efficacy adopt significantly more mastery goals than those who have lower self-efficacy (Greene, Miller, Crowson, Duke, & Akey, 2004; Harackiewicz, Durik, Barron, Linnenbrink-Garcia, & Tauer, 2008; Castro-Villarreal et al., 2007). Similarly, students with mastery goals had higher self-efficacy while the opposite was true for students with performance goals (Phillips and Gully, 1997). Results indicate precedence for mastery goals over performance goals yet also points to the complexity of the relations among the variables, and provides justification for the inclusion of mastery goal orientation to follow high self-efficacy in the proposed theoretical model.

Moderator variables

Engagement

Engagement is the degree to which students' perceive, attend, and persist with a task and is largely influenced by values, beliefs, self-efficacy, and goal orientation (Corno & Mandinach, 2004, Castro-Villarreal et al., 2012). Although engagement has been divided into behavioral, cognitive, and motivational components, the present study focused on the cognitive aspects of engagement that are observed in goal-setting, planning, and task management (Carver & Scheier, 1991; Hickey & Granade, 2004; Linnenbrink & Pintrich, 2003).

Findings indicate engaged students attend more closely to tasks, set goals that challenge and encourage learning, and exhibit greater persistence than their less engaged counterparts (Dolezal, Welsh, Pressley, & Vincent, 2003; Linnenbrink & Pintrich, 2003; Talyor, Pearson, Peterson, & Rodriguez, 2003). Student engagement is also associated with persistence, attentiveness, self-regulation, and active participation, while non-engagement is associated with minimal to no task investment (Steinberg, 1996). Carver and Scheier (1991) maintain that there are levels of consciousness in engagement and self-regulation. Because self-regulated students defined as students who set goals and actively monitor their progress toward task completion must also be engaged, the two constructs are often used interchangeably (Castro-Villarreal et al., 2012; Zimmerman & Schunk, 2001). They assert that at an initial level, (a) one finds automaticity, (b) second, one is likely to observe a conscious set of processes involved in decision making, this level will include goal-setting and self-monitoring, and (c) a third level includes the meta-cognitive processes of self-awareness and self-reflection about one's decisions.

In accordance with this research, engagement style can be examined from students' problem solving (Guerra, 2005, 2009). Considering reliance on planning, managing, and outcome expectations, researchers maintain that individual's investment and automaticity can be

observed in their problem solving (Carver & Scheier, 1991; Zimmerman, 2000). The LIBRE Model Problem Solving Activity (LMPSA) incorporates the three essential skills agreed to represent engagement and self-regulation: planning, monitoring, and evaluation. As such, the LMPSA is a tool designed to record one's progress through the levels of self-regulation put forth by Carver and Scheier (1991) and to identify engagement style (Guerra, 2004; 2006; 2007; 2009a; 2009b; Guerra, Flores, & Claeys, 2009; Guerra, & Bollinger, 2011).

In this study, engagement styles are defined as dichotomous categories of 1) Action-Oriented engagement, which involves taking an active role in creating a plan towards reaching a goal, or 2) Process-Oriented engagement, which involves a passive role in contemplation with no identifiable goal related plans. Participants respond to the LIBRE Model prompts and the LMPSA protocol functions as a visual guide to organize interaction between participants and researchers and to record the students' responses. LMPSA respondents have been observed to offer similar expressions based on the extended underlying goal information of "how" (motivated direction) and "why" (motivated impetus) included with the selected goal. Because engagement is the cornerstone to learning, engagement style and its association with academic achievement is examined (Guerra et al., 2009). Therefore, our study tested whether one's engagement style moderated our theorized model and resulted in significant mean differences on those model variables.

Gender

Some research cites gender differences in cognitive motivational variables and how it relates with academic achievement. For example, research has shown females to be more likely to ascribe failure to internal attributes and successes to external factors (Seegers & Boekarets, 1993; Skaalvik & Skaalvik, 2004). Similarly, gender differences were seen with self-efficacy with males reporting higher levels than females (Seegers & Boekarets, 1993). To test whether the effects in our theoretical model are different for male versus female students, we examined gender as a moderator. Gender differences will be examined in an exploratory manner.

Ethnicity. Ethnicity and academic achievement have long been examined together and although the relationship is complex, some have reported differences (Flores & O'Brien, 2002; Garriott & Flores, 2013; Warikoo & Carter, 2009). Unfortunately, much of the research is conceptual and theoretical in nature and fails to examine the complex interactions among race, culture, ethnicity, and academic achievement. Although some have found stronger associations between self-efficacy and academic achievement for minority versus Caucasian participants (Garriott & Flores, 2013; Flores & O'Brien, 2002), Warikoo and Carter (2009) suggested future research on culture and academic achievement focus on uncovering the *when* and *how* ethnicity and culture matter for academic achievement. Thus, empirical study through the deployment of structural equation modeling that examines *when* and *how* to elucidate the interplay and interaction of ethnicity on academic achievement is long overdue (Warikoo & Carter, 2009). Therefore, our study tested whether ethnicity moderated our model or resulted in significant mean differences on those model variables.

The Present Study

Although the research on the relation between cognitive motivational variables and academic achievement is rich, study of the unique and independent contributions of each variable

to academic achievement is less available. Despite the considerable amount of literature on teacher education and academic achievement, very few studies have tested for moderation effects (especially, engagement style and ethnicity) within a theoretical modeling framework. Given well known association between self-efficacy and academic achievement and the especially important role self-efficacy plays in teacher performance, we examined pre-service teachers' academic achievement by investigating the predictive relations among attributions, self-efficacy, engagement, and goal orientation and theorized that attribution variables would come before self-efficacy and be followed by learning orientation with engagement, gender, and ethnicity acting as moderators.

Method

Participants

Participants were 128 pre-service teachers from a large southwest U.S. metropolitan Hispanic-serving institution (the current student body is 44% Hispanic), a federal designation given to non-profit institutions with Hispanic student body populations of at least 25% (U. S. Dept. of Education, 2010). This sample of convenience was comprised of individuals drawn from two undergraduate educational psychology courses. This course is an early entry course into the pre-service teacher program and is also part of their core curriculum. Thus, most students reported to be earning degrees from the College of Education and Human Development (42%), followed by 29% from the College of Liberal and Fine Arts, and 20% in the College of Sciences. Additionally, most participants reported being juniors (49%) or seniors (42%). The sample was 72% female; 54% Hispanic, 35% White, 7% African American, 3% Asian, and 1% Native American. The gender representation is comparable to other education programs and the ethnic breakdown mirrors the larger Hispanic-serving university population breakdown of 44% Hispanic and 33% Caucasian. Participation was voluntary and participants were not compensated.

Methodology

Interviewer training to administer the LIBRE Model Problem Solving Activity occurred two weeks before the beginning of the semester for ten graduate students enrolled in a Counselor Education program at the university. During the week of the first course exam, questionnaires and individual problem solving interviews were completed with informed consent. All participant responses were recorded and assessed according to the established protocol. Questionnaires and interviews were completed consecutively within an hour timeframe.

Instrumentation

Causal Dimension Scale II

This self-report instrument was designed to measure causal attributions for academic performance (McAuley, Duncan, & Russell, 1992). This instrument consisted of 12 items that measured four subscales using a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). The four subscales were as follows: (a) *locus of causality* (is due to a factor

inside the individual), (b) *stability* (whether the cause is stable over time), (c) *personal control* (whether the cause is controllable by the individual), and (d) *external control* (whether the cause resides outside the individual). The justification of variable inclusion into the model was provided in the introduction. Our internal consistency reliability coefficients (see Table 1) were acceptable and comparable with previous findings (McAuley et al., 1992).

Table 1.

Provides the inter-factor correlations that were adjusted for measurement error using the internal consistency reliability coefficients.

	1.	2.	3.	4.	5.
1. Final course grades	**0.90**	0.27	0.21	0.60	-0.06
2. Internal causality	*0.37*	**0.61**	0.41	0.29	0.14
3. Personal control	*0.26*	*0.59*	**0.78**	0.17	0.49
4. Self-efficacy	*0.68*	*0.40*	*0.20*	**0.90**	0.18
5. Mastery goal orientation	*-0.07*	*0.19*	*0.60*	*0.20*	**0.86**

Note. The diagonal represents the internal consistency reliability coefficients (bolded), the bottom-left off-diagonal represents the correlations between factors (italicized), and the upper-right off-diagonal are not corrected for measurement error (neither bolded or italicized). Correlation coefficients of .18 or greater were statistically significant at .05.

Academic Self-Efficacy Scale

The six-item self-report academic self-efficacy scale from the Patterns of Adaptive Learning Scales (PALS; Midgley et al., 2000) was modified to measure students' beliefs about their ability to complete the course successfully. This 5-point scale, ranging from 1 (*not at all true of me*) through 5 (*very true of me*), included questions like "I am certain I can figure out how to do the most difficult work in this class". This measure had an internal consistency coefficient of .96.

Achievement Goal Orientation

The 18-item questionnaire (Elliot & Church, 1997) measured learners orientations and was comprised of three subscales: *mastery goal orientation* (e.g., I want to learn as much as possible while in this class), *performance-approach* (e.g., I want to do well in this class to show my ability to my family, friends, or others), and *performance-avoidance* goals (e.g., I just want to avoid doing poorly in this class) (Pintrich, 2000). For each question, students were asked to rate whether they agree or disagree with the statements using a 5-point Likert scale, with scores ranging from 1 (strongly disagree) to 5 (strongly agree). Our analyses indicated acceptable internal consistency reliability coefficients (see Table 1). As justified in the introduction, only mastery goal orientation was incorporated into this model. To ensure this was a valid assertion, the correlations between performance-approach, performance-avoidance, and final course grades was tested and found to be statistically and practically insignificant.

Final course grade

Final course grades, which were based on students' homework assignments, projects, quizzes, midterm exam, and final exam, served as the academic achievement measure and was obtained from official University records and entered into the data file.

Engagement style

The LIBRE Model protocol and LMPSA tool were used to assess engagement style of action versus process orientation, which were determined from participant responses (Guerra, 2004; 2005; 2006). Test-retest analysis suggests that individuals are very consistent in their manner of response and engagement as determined by their LIBRE qualitative responses. Students' specificity and the number of solutions generated were indicators used to determine engagement style (see Guerra, 2004; 2006).

The assessment and categorization of the LMPSA was conducted in three steps to determine *Action* versus *Process* orientation. First, a trained interviewer administered the LMPSA. Each protocol was then individually scored. Second, a trained research associate, not involved with the interviews, also independently scored the Stick Figure Protocols. Third, one of the researchers who conducted the LIBRE Model training, provided oversight of the assessed protocols, scoring, and rubric completion to determine scoring accuracy. An ex post facto examination of independent categorization found an inter-rater reliability of .90. This means that of the 128 completed LMPSA interviews, 115 were scored exactly the same by the first and second clinicians. The remaining 13 protocols were examined and categorization was determined by consensus among the three reviewers.

Each LMPSA was then categorized as: Action- or Process-Oriented depending on the (1) specificity, quality, and quantity (expanse, breadth, elaboration, relevance) of the responses provided to each prompt and (2) the articulation and inclusion of a feasible problem-solving plan (see Guerra, 2009a; 2009b for more theory detail and LMPSA categorization).

Statistical Analyses

Model identification and estimation

Given the relatively small sample size to model both the items and the structural coefficients, a more complex model that incorporated each measured item was not selected. Instead, the measurement error was integrated into the model by using each measure's internal consistency reliability coefficient (i.e., Cronbach's coefficient α) to disattenuate (i.e., correct the structural coefficients for measurement error) the structural coefficients (i.e., the relationships between latent variables). Note, whether the measure's internal consistency reliability or the individual measured items are modeled should not influence the magnitude of the structural coefficients if the scales are unidimensional (see Sass & Smith, 2006). Stated differently, the structural coefficient magnitudes (see γ's and β's in Figure 1 & 2) should be nearly identical regardless of whether the individually measured items or internal consistency reliability was modeled. This modeling procedure is justifiable given that the psychometric properties of the measures used in this model have been evaluated elsewhere and therefore were not of primary interest. However, it is worth noting that when the confirmatory factor analysis model was

estimated it provided a good model fit when using the WLSMV estimator with our data, χ^2 (129) = 211.05, $p < .0001$, CFI = .969, TLI = .964, RMSEA = .071, WRMR = .868.

Using the internal consistency reliability coefficients as the model's measurement component, the degree of structural coefficient disattenuation was represented by λ_x and λ_y. The amount of measurement error in the latent variable was computed using the following equation: $\sigma_\eta^2 - (\sigma_\eta^2 \alpha)$, where σ_η^2 represents the total variance in the scale score variable (η) and α corresponds to the internal consistency reliability coefficient (i.e., Cronbach's α coefficient) for each scale. Note that all latent variables were corrected for measurement error using the reliability coefficients computed from the data in this study. The exception was final course grades (measured using a percent of points awarded), which was assumed to have a reliability of .90. This coefficient was selected to adjust for minor measurement imperfections without assuming too much measurement error and making large adjustments to the structural coefficients.

Data analyses were conducted using Mplus 7 (Muthén & Muthén, 1998-2012) on a covariance matrix using a maximum likelihood robust estimation (MLR, Yuan & Bentler, 2000). This estimation method was employed given that the scale scores were significantly skewed based on the Shapiro-Wilk test of normality (using α = .01) and the Q-Q plots for all variables/scales used in the model. Therefore, when testing the differences between two nested models the strictly positive Satorra-Bentler χ^2 difference test (see Satorra & Bentler, 2010) was used (Mplus website for more details), rather than simply subtracting the two χ^2 statistics. No missing data were present on any of the model variables.

Model fit

The statistics employed to evaluate model fit for each sample were the robust χ^2, Comparative Fit Index (CFI), Tucker Lewis index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). A detailed description of these model fit statistics is provided by Hu and Bentler (1999), and Marsh, Hau, and Wen (2004). Based on their research, SRMR values below .08, RMSEA below .06, and CFI and TLI greater than .95 are deemed appropriate.

Results

Proposed model

The *proposed model* (see Figure 1) produced an inadequate model fit, χ^2 (5) = 84.265, $p < .0001$, CFI = .270, TLI = -.460, RMSEA = .353, SRMR = .188, which suggested that this model was incorrectly specified and should be revised. The modification indices, along with the parameter estimates (see $\beta_{3,2}$ in Figure 1), suggested that mastery goal orientation is unrelated to final course grades, but instead self-efficacy is the primary predictor of final course grades. For this reason, we removed mastery goal orientation from the model (thus implying that it does not mediate the relationship between self-efficacy and final course grade) and proposed that self-efficacy directly related to final course grades (see Figure 2). As past literature suggests there is also considerable evidence for this direct link between self-efficacy and final course grades.

Modified model

The *modified model* (see Figure 2) produced an excellent model fit, χ^2 (2) = 2.773, $p <$ 0.2500, CFI = 0.989, TLI = 0.967, RMSEA = .055, SRMR = .031, and suggests this model accurately represents the data. Moreover, with the exception of internal causality regressed on self-efficacy, the other structural coefficients are statistically and practically significant. These analyses imply that the relationship between personal control and final course grades is mediated by self-efficacy, which was further supported by the direct relationship between personal control and final course grades (r = .26, p = .011). Conversely, internal causality did not predict self-efficacy after controlling for personal control, thus indicating that self-efficacy does not mediate the relationship between internal causality and final course grades. This occurred despite the larger bivariate correlations (see Table 1) between internal causality and self-efficacy (r = .40, p < .001) and internal causality and final course grades (r = .37, p = .001). The reason for these results was the rather large correlation between personal control and internal causality, thus resulting in personal control having a larger unique contribution after adjusting for internal causality.

To better portray this finding, models (see Figure 3) were tested using a single exogenous variable. As expected, these analyses provided a good model fit for the personal control (Model 3A), χ^2 (1) = 2.124, $p <$ .1450, CFI = 0.974, TLI = 0.923, RMSEA = 0.094, SRMR = 0.032, and internal causality (Model 3B), χ^2 (1) = 1.552, $p <$ .7479, CFI = 0.989, TLI = 0.966, RMSEA = 0.066, SRMR = 0.023, models and both exogenous variables significantly predicted self-efficacy when not adjusting for the other. In fact, these analyses contradict the Model 2 results (see Figure 2) that suggest personal control is the better predictor, but instead provide more evidence in favor of internal causality being the stronger predictor variable. The one partial limitation associated with this conclusion is that internal causality has a lower reliability coefficient, thus a larger correction for measurement error was made. However, even the unadjusted correlation coefficients (see Table 1) and unadjusted path coefficients (see Models 3A & 3B) were larger for internal control than personal control.

Collectively, the results from Figure 2 and 3 imply that self-efficacy is a mediator for the relationships between the exogenous variables (i.e., personal control and internal causality) and final course grades, with the perceived benefit of these variables based on how they are defined (i.e., partial or full relationship with self-efficacy). That is, personal control explains more unique variance in the prediction of self-efficacy, whereas internal causality has a larger total contribution to self-efficacy. This distinction is noteworthy because researchers who model these variables simultaneous will draw conflicting conclusions than when modeling these variables in isolation. In fact, these results imply that internal causality is likely a better variable to include in future models than personal control.

The previous statement is further supported based on the R^2 statistics (see Figure 2 & 3), as the change in R^2 (or ΔR^2) did not change greatly when adding personal control to the model (i.e., ΔR^2 = .166 - .165 = .001, rounded to three rather than two decimals). In any case, self-efficacy continued to be a strong predictor of final course grades, as 57% of the variance in final course grades can be explained by self-efficacy. In general, all the R^2 statistics in Figure 2 and 3 possessed medium to large effect size based on the tentative standards proposed by Cohen (1988): small R^2 = .01, medium R^2 = .09, and large R^2 = .25. The only exception was for Model 3A when examining the relationship between personal control and self-efficacy (R^2 = .02 or .04 for unadjusted and adjusted statistics, respectively).

Figure 1. Provides the *proposed model's* (Model 1) standardize factor loadings, structural coefficients, and R^2 statistics.

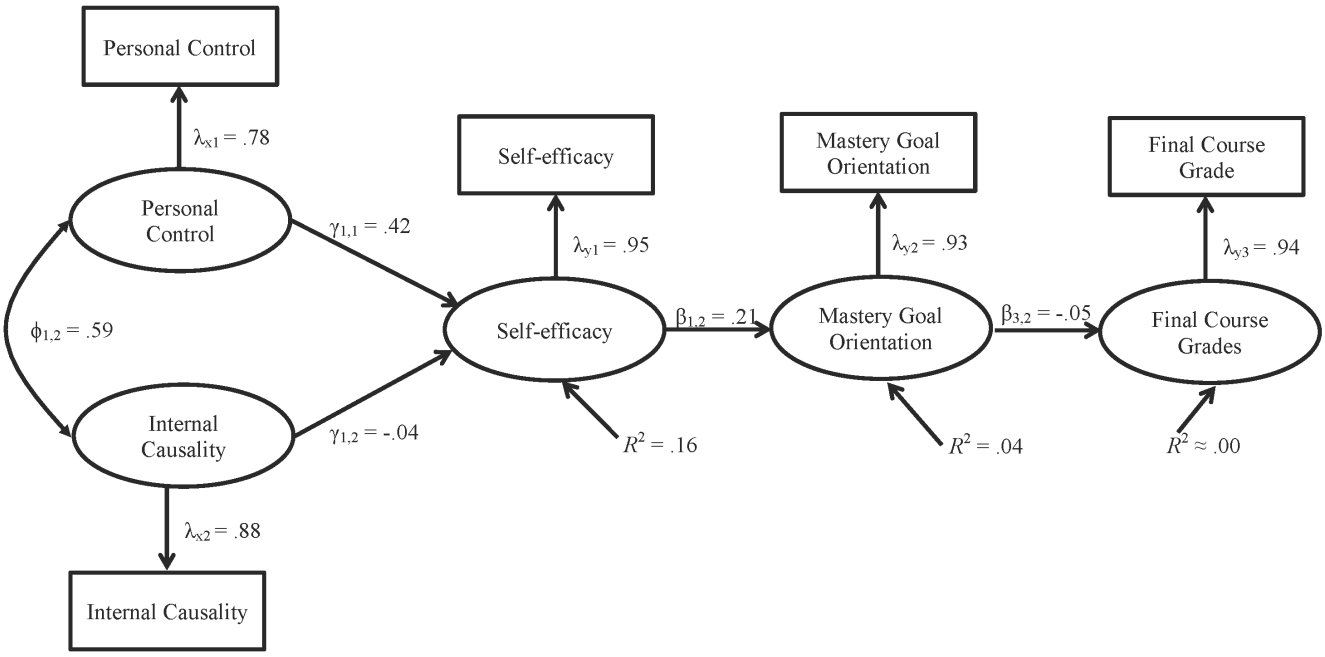


Figure 2. Provides the *modified model's* (Model 2) standardized factor loadings, structural coefficients, and R^2 statistics. Path coefficients not corrected for measurement error, along with the R^2 statistics, are also provided in parentheses for comparison purposes.

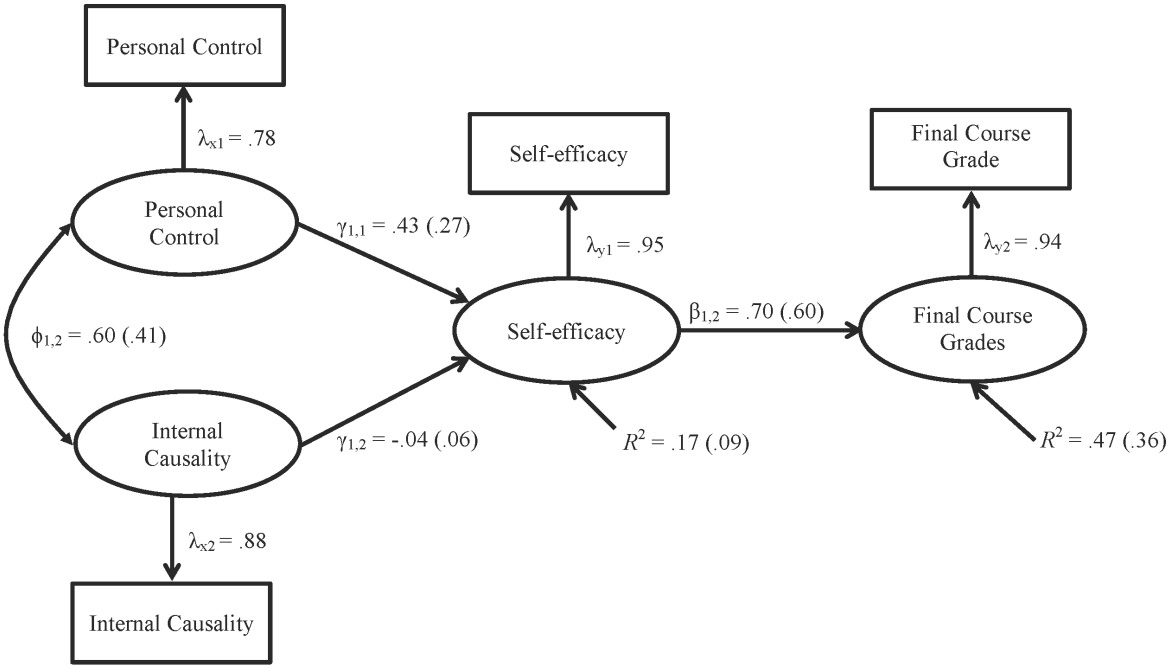
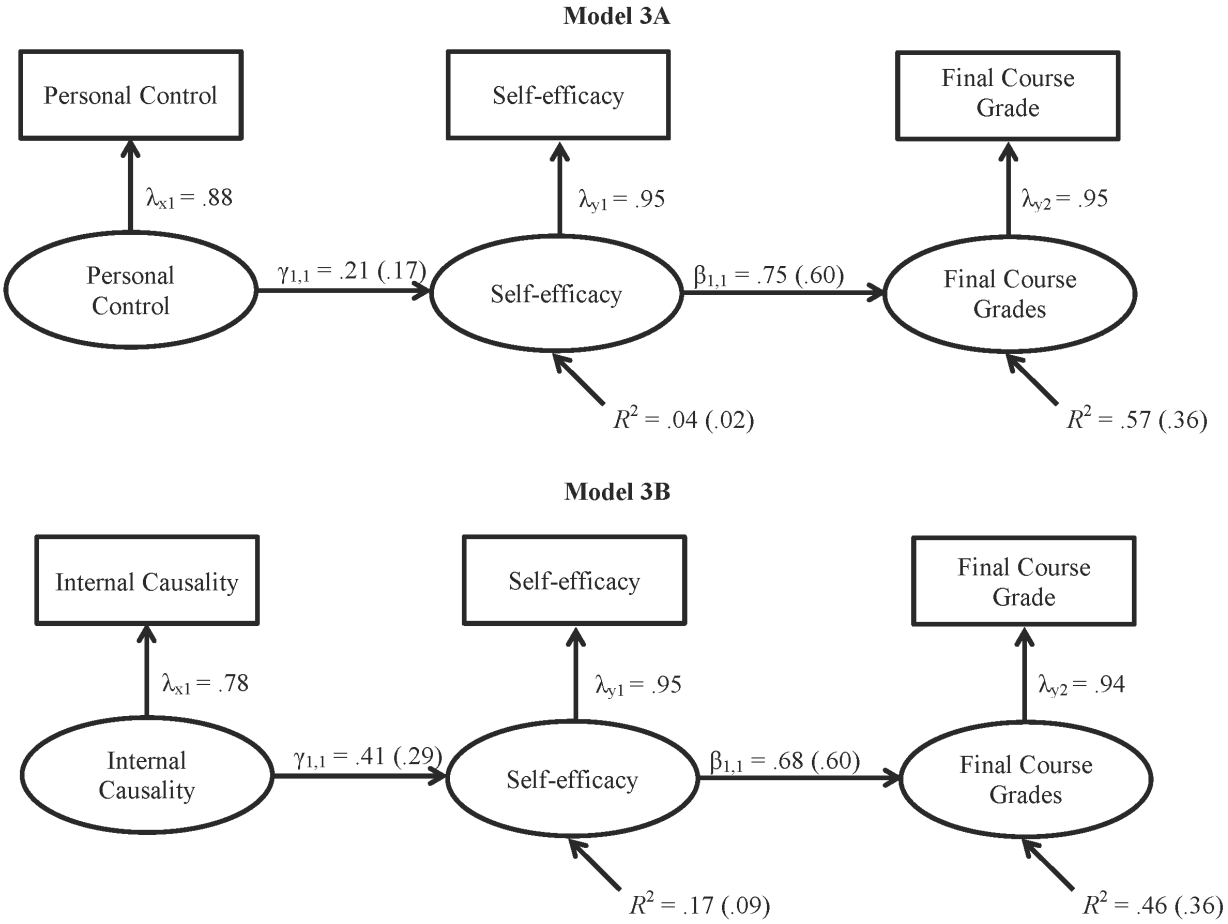


Figure 3. Model results for analyses using a single exogenous variable rather than having them in a single model. Parameter estimates in parenthesis represent the estimates unadjusted for measurement error.



Moderation/invariance and mean difference results

Ideally when testing for moderation effects (or invariance across groups), the scales should be tested for measurement invariance before proceeding to test for structural invariance. However, due to the small sample sizes per group these analyses were not appropriate. Instead, we assumed these scales were invariant and tested whether engagement preference, gender, and ethnic group moderated the path coefficients (uncorrected for measurement error) using the $\Delta\chi^2$ ($\Delta\chi^2 = \chi^2_{PI} - \chi^2_{CI}$), where the configural invariance (CI) model allowed the path coefficients to differ across groups and the path invariant (PI) model fixed the path coefficients to be equal across group membership. Recall, MLR estimation uses the Satorra-Bentler $\Delta\chi^2$ test, so a simple subtraction of χ^2 statistics is not appropriate, and it tests the difference between unstandardized (not standardized) path coefficients. To ensure the covariance between personal control and internal control and adjustments for measurement error did not inadvertently influence the moderation/invariance conclusions, Models A and B (see Figure 3) were evaluated using the variables unadjusted for measurement error and in isolation.

Gender

Invariance/moderation analyses revealed no statistically significant difference between males (n = 36) and females (n = 91) for Model 3A, $\Delta\chi^2$ (df = 2) = 1.154, p = .5616, or Model 3B, $\Delta\chi^2$ (df = 2) = 1.243, p = .5371. As seen in Table 2, some coefficient differences started to appear (e.g., personal control to self-efficacy); however, it is unknown whether these tests were simply unpowered due to the small sample size or these differences simply emerged due to chance.

When examining mean and variance differences, no statistically significant differences existed between gender based on the Levene's test for equality of variances and t-tests for equality of mean differences. Using Cohen's d (Cohen, 1988) tentative effect size standards of small (d = |0.2| to |0.3|), medium (d around |0.5|), and large (d > |0.8|), the largest effect size (d = -0.32, p = .091) was on internal control, with males having a lower mean than females (see Table 3). The second largest effect size was for self-efficacy, with the average male score being 0.29 estimated standard deviations above the mean for females.

Ethnicity

Analyses revealed no statistically significant differences between Caucasian (n = 44) and Hispanic (n = 68) students for Model 3A, $\Delta\chi^2$ (df = 2) = 3.832, p = .1472, or Model 3B, $\Delta\chi^2$ (df = 2) = 3.084, p = .214. However, as seen in Table 2, several notable differences are starting to emerge. For example, the relationship between personal control and self-efficacy was much larger for Caucasian than Hispanic students, as was the relationship between internal causality and self-efficacy. This same trend appeared when testing the relationship between self-efficacy and final course grades. Collectively, these results imply the relationships between these variables are much stronger for Caucasian than Hispanic students; however, the relatively small sample sizes prohibit adequate power to definitively make adequate inferences.

No statistically significant mean or variance differences emerged between Caucasian and Hispanic subjects, as seen in Table 3. The largest mean difference was on the personal control scale (d = 0.38, p = .071) with Caucasian students scoring on average 0.38 estimated standard deviations above Hispanic students. A smaller effect size also emerged for mastery orientation, with males scoring higher than females. These results suggest relatively small differences between these groups on these variables when focusing on the mean differences.

Engagement style

Results suggested there was no statistically significant difference between Action Oriented Engagement preference (n = 39) and Process Oriented Engagement preference (n = 42) students for Model 3A, $\Delta\chi^2$ (df = 2) = 2.220, p = .3296, or Model 3B, $\Delta\chi^2$ (df = 2) = 0.535, p = .7653. From a practical standpoint, these differences were rather small (see Table 2). The largest difference existed between Action and Process groups for the personal control to self-efficacy link; however, both path coefficients were relatively small and in the opposite direction (i.e., positive relationship for Process and negative relationship for Action).

When examining mean (see Table 3) and variances differences, the only statistically significant difference emerged on the self-efficacy scale for the mean differences (d = 0.48, p = .035). These analyses suggested that Action-Oriented students reported noticeably higher self-

efficacy scores than Process-Oriented students, with a similar trend also emerging for final course grades ($d = 0.29$, $p = .173$).

Table 2.

Standardized and unstandardized path coefficients associated with moderation effects.

			Gender			Ethnicity			Engagement style	
	Path		US	S		US	S		US	S
Model 3A	PC to SE	Male	0.07	0.08	Caucasian	0.23	0.31	Action	-0.15	-0.15
	PC to SE	Female	0.18	0.20	Hispanic	0.02	0.03	Process	0.21	0.22
	SE to FG	Male	10.33	0.55	Caucasian	14.38	0.73	Action	12.61	0.64
	SE to FG	Female	14.81	0.64	Hispanic	9.16	0.45	Process	12.36	0.53
Model 3B	IC to SE	Male	0.36	0.32	Caucasian	0.50	0.56	Action	0.11	0.11
	IC to SE	Female	0.33	0.32	Hispanic	0.18	0.16	Process	0.21	0.21
	SE to FG	Male	10.33	0.55	Caucasian	14.38	0.73	Action	12.61	0.64
	SE to FG	Female	14.81	0.70	Hispanic	9.16	0.45	Process	12.36	0.53

Note. PC = Personal Control, IC = Internal Causality, SE = Self-Efficacy, FG = Final course Grade, US = Unstandardized coefficients, and S = Standardized coefficients.

Table 3.

Displays the mean differences on the outcome variables of interest for each of the quasi-independent variables.

	Gender	Ethnicity	Engagement style
Final course grades	-0.16	0.06	0.29
Mastery goal orientation	-0.10	0.26	-0.02
self-efficacy	0.29	0.13	0.48
Internal causality	-0.32	0.18	0.04
Personal control	-0.05	0.38	-0.04

Note. Mean differences were computed as follows: Males – females, Caucasians – Hispanics, and Action – Process orientation.

Discussion

With push to increase student academic success and graduation rates, models that predict academic achievement and ultimately student graduation appear timely. Therefore, structural equation modeling was employed to address the former component by answering the following research questions: (a) What model including personal control, internal causality, self-efficacy, and mastery goal orientation best predicts academic achievement and (b) Are the variables moderated by engagement style, gender, and ethnicity?

Theoretical model conclusions

The proposed model (see Figure 1) yielded a poor fit and indicated that mastery goal orientation is unrelated to final course grades. As such, mastery goal orientation was removed from the model and self-efficacy was examined for its direct relationship with academic achievement. This modified model (see Figure 2) suggested that self-efficacy mediated the relationship between personal control and final course grades. Because personal and internal causality were so strongly related, a third and fourth model (see Figure 3) with a single exogenous variable was tested and found internal causality to be the stronger predictor variable. Collectively, these results suggest that personal control is the better predictor variable when modeled with internal causality (i.e., larger unique contribution), whereas internal causality is the better bivariate predictor of self-efficacy. This finding is important as researchers could falsely conclude from modeling both variables simultaneously that only personal control predicts self-efficacy, when in fact internal causality is really the best predictor. This is supported by the fact that the R^2 (or percent of variance explained in self-efficacy) did not change when including both variables ($R^2 = .017$) or only internal causality ($R^2 = .017$). Regardless of the model, self-efficacy appears to be a good mediator in predicting final course grades.

Collectively, the results of this study provide support for previous research linking self-efficacy and academic achievement. In addition, our findings underscore the role attributions play in learning and achievement. This is one of few studies to utilize structural equation modeling to investigate the unique and combined contribution of variables known to predict academic achievement. Models of this statistical sophistication are needed if teacher educators are to accurately identify cognitive motivational factors critical to learning and subsequently support these factors in students through explicit instruction in complex cognitive processes and innovative instructional techniques.

Moderation/invariance conclusions

Although no moderation effects were found to be statistically significant based on the change in χ^2, some emerging trends are worth noting. Foremost, ethnicity appeared to play a noticeable role in model prediction, with the relationships always being considerably higher for Caucasian (C) than Hispanic (H) pre-service teachers. This is most evident when evaluating the standardized parameter estimates, as the relationship from personal control to self-efficacy ($\beta_C = .31$ vs. $\beta_H = .03$) and internal causality to self-efficacy ($\beta_C = .73$ vs. $\beta_H = .45$) were always much larger for Caucasian students, as was the relationship from self-efficacy to final course grades ($\beta_C = .73$ vs. $\beta_H = .45$). The implications of this finding are that the path to academic success for Hispanic students may be very different from Caucasians, thus implying that additional research is needed to determine those variables likely to predict academic success for Hispanic students. Moreover, it would be interesting to determine why these paths differ to such a degree based on ethnicity and what other cultural variables contribute to these differences.

Regardless, the emerging ethnic differences suggest that this model may be a better fit for Caucasians, as the relationships among these variables was much stronger for Caucasians than for Hispanics. The larger model coefficients may indicate that Caucasians are more likely to believe events and conclusions to be well within their control and this belief perhaps also explains their enhanced sense of self-efficacy. However, this study also demonstrates that these

differences in structural coefficients are not translating to higher final course grades for Caucasian students.

Mean difference conclusions

Generally speaking, no large mean differences (based on Cohen's effect size standards) emerged between gender, ethnic, and engagement style groups on any of the model variables (see Table 3). In fact, the only statistically significant difference existed between the Active and Process engagement preference groups when evaluating self-efficacy. These results imply that students who are more actively engaged have almost a half standard deviation (d = 0.48) higher self-efficacy than those who utilize a process type engagement style. Perhaps worthy of note is these same students have a higher final course grade (d = 0.29). Other notable mean differences were on mastery goal orientation and personal control, with mean scores always higher for Caucasian students. Different relationships for different ethnic groups are consistent with previous findings that demonstrated a greater relationship between self-efficacy and academic performance for minority populations (Garriot & Flores, 2013). In addition, although self-efficacy was higher for males, they also tended to have a lower internal locus of causality.

Model Implications for Teacher Educators and Pre-Service Teachers

The theoretical models proposed suggest that cognitive motivational variables interact to play key roles in predicting pre-service teachers' final course grade as the proxy for academic achievement. In general, results indicated that students who believe they have personal control over events and attribute successes and failures to internal causes over the learning situation tend to have higher self-efficacy, which leads to higher final course grade. This model demonstrates that self-efficacy, perceived control, and academic achievement are linked in important ways, as students with high self-efficacy are more likely to engage in the learning process likely due to their perception of control and causality. However, our findings suggest that this model may not generalize to Hispanic students, as the relations between these variables was much smaller for this subsample.

Although literature suggests a link between mastery goal orientation and academic achievement, the present findings suggest this relationship to be much more complex and involving more beliefs and attributions. Our findings suggest precedence for explicit instruction in metacognitive strategy use, development, and monitoring, strategies seldom explicitly taught (Pressley & Harris, 2006). Explicit instruction on "thinking about the thinking" and recognizing and monitoring good problem solving, learning, and logic strategies to cultivate personal control and internal causality is recommended to augment and enhance curricular content and material.

Instructional Techniques to Enhance Learning

The modified model revealed that self-efficacy was a strong predictor of final grades and served as a mediator for the relation between personal control and internal causality and academic achievement consistent with recent findings that showed a strong link between self-efficacy and academic achievement (Al-Harthy & Was, 2011). Because these findings support the linkage between self-efficacy and academic success (Devonport & Lane, 2006), what can teacher educators do to utilize such findings? As teacher educators strive to graduate students,

improve teacher retention, decrease burnout, and produce highly qualified teachers, the modified model points to some potential targets for intervention. For example in this study, self-efficacy and perceived control are imperative to the prediction of academic outcomes. With the understanding of the significant roles these variables play, educators should implement strategies to increase students' self-efficacy and make students aware of their role in the learning process and outcomes (developing self-regulation skills and attributing outcomes to "internal causes and within personal control"). One method of doing this is through attribution re-training where students are explicitly taught the importance of these variables and then asked to identify their own personal attributions and learning strategies, attend to task requirements and demands, engage in goal setting, and evaluate their learning (Andrews & Debus, 1978; Castro-Villarreal et al., 2007). The LIBRE stick figure tool is one way to teach students how to identify and manage their engagement, attention, effort, and persistence (Pressley & Harris, 2006).

The models also suggest a need for teachers and teacher educators to support attributions and beliefs through task manipulation. To illustrate, several novel instructional techniques have been shown to positively impact self-efficacy, such as altering and increasing the response set, diversifying instruction for increased opportunity for success, problem interspersal, and attribution retraining. Altering the response set by increasing the opportunities to practice and respond during the acquisition phase of learning is critical to success with a task and dealing effectively with a task is essential for increasing self-efficacy. By the same token, decreasing the number of items and/or assignments can also serve to enhance self-efficacy by making the task more manageable and feasible. To enhance self-efficacy, educators may consider providing instructions, materials, goals, and expectations with some flexibility offered to the student to self-regulate and manage task requirements, order, and sequence. That is, students should be offered various assignments to choose from and perhaps even select the assessment technique drawing upon individual student strength and diversity.

Success is also known to enhance self-efficacy. As such, a logical suggestion would be to allow for opportunities for success, which often entails offering various and diverse assignment and assessment methodologies. Increased opportunities for success can unfold in a variety of ways. As an illustration, success with instructionally appropriate materials could potentially impact feelings of competency and efficacy and additionally build on engagement and self-regulation through appropriately leveled tasks. Another method would be to allow students the flexibility to choose assignments, purposefully assign assignments and activities ranging from easy to difficult, opt for some activities clearly below instructional levels, or adopt problem interspersal techniques where each problem or assignment is followed by an easier one. Item interspersal has been found to contribute to feelings of control and competence shown to enhance self-efficacy and locus of causality. In addition to providing multiple and diverse opportunities for success, students should be provided with corrective and performance feedback to maximize engagement, persistence, and goal setting thereby creating a feedback loop essential for learning from successes and failures. Findings suggest that teachers and teacher educators should incorporate ways to support self-efficacy, personal control, and internal causality into their lesson planning just as they prepare for the provision of curricular content.

Limitations of the Study

The results of our study should be interpreted in light of several limitations. Foremost, the rather small sample size limits our ability to adequately test whether our models are invariant

across gender, ethnicity, and engagement style. Therefore, our interesting ethnic group differences should be tested not only with a larger sample size, but also across different college majors and other ethnic groups. Along a similar vein, the statistical power to detect mean differences is also a limitation, thus the mean differences should be interpreted more tentatively. Secondly, data were based on self-report and may have reflected social desirability, interviewer-participant level of rapport, rather than actual perspectives. This limitation is most concerning for the LIBRE Model, which assess problem-solving and self-reflection activity to identifying engagement preference. A third limitation is that other variables (e.g., academic and additional psychological variables) were not included in the model. If in fact these variables truly are poor predictors of academic success for Hispanic students, it is unknown what variables are good predictors for this population.

Conclusions

One purpose of this study was to provide empirical support for the belief that teaching is not only about curricular content, but also about complex cognitive motivational processes. As predicted, findings highlighted the importance of personal control and internal causality, which appear mediated by self-efficacy, in the prediction of pre-service teacher academic success. Considering the contribution of personal control, internal causality, and self-efficacy in our model, instructional emphasis on complex cognitive processing is in order and can be accomplished through the use of instructional techniques to promote academic efficacy and explicit instruction in problem solving to foster deep processing and reflection as a means to cultivate control (Pressley & Harris, 2006). However, our results provide some evidence that although the model may be invariant across gender and engagement style, this may not be the case for ethnicity. Therefore, the exploration of alternative theoretical models that are perhaps more generalizable across ethnicity appear imperative, while at the same time including variables in the model that predict academic success for non-Caucasian students. Overall, our findings demonstrate the complex relations among cognitive psychological variables and academic achievement and also showcased that relations do differ between groups and continued research into variable functioning, predictive ability, and placement will continue to be a need.

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