Self-Perceived Dispositions That Predict Challenges during Student Teaching: A Data Mining Analysis

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Over the past decade, United States educators, researchers, and policymakers have advocated the need to facilitate student learning through effective teaching. Their goal has been to increase the achievement levels of all students, especially to enhance the achievement of minority and low-income students to close the achievement gap (Haycock, 2001; Ladson-Billings, 2006; McKinsey & Company, 2009; National Research Council, 2000). Consequently, growing attention has been directed at how quality teachers should be better prepared through teacher education programs (Darling-Hammond, 2010; Darling-Hammond & Bransford, 2005; Darling-Hammond, Chung, & Frelow, 2002; Garcia, Arias, Murri, & Serna, 2010; Gay, 2010; Kumashiro, 2010; Lieberman & Mace, 2010).

For instance, California statute (Chap. 517, Stats. 2006) was introduced to guide the effort to prepare quality teachers. This law now addresses and regulates the process of student teacher evaluation; preservice teachers are screened to determine whether or not they have developed knowledge and skills that are necessary for their future roles as elementary and secondary teachers. Specifically, since July of 2008 the state of California will only award a preliminary Multiple or Single

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Subject teaching credential to candidates who pass the Teacher Performance Assessment (TPA). The TPA is an assessment which determines if teacher candidates possess knowledge, skills, and dispositions that meet the criteria set forth in Teacher Performance Expectations (TPEs) (Commission of Teacher Credentialing, 2009). There are 13 elements of the TPEs that encompass the knowledge, skills, and dispositions teachers should be able to demonstrate as professionals within the following six domains: (a) Making Subject Matter Comprehensible to Students, (b) Assessing Student Learning, (c) Engaging and Supporting Students in Learning, (d) Planning Instruction and Designing Learning Experiences for Students, (e) Creating and Maintaining Effective Environments for Student Learning, and (f) Developing as a Professional Educator.

It should be noted that the TPEs and the TPA represent standards and the corresponding assessment tool to effectively evaluate pre-service teacher development at the end of their teacher-credentialing program. The TPEs and TPA do not predict whether or not pre-service teachers will execute their newly acquired knowledge and skills while maintaining effective dispositions upon the conclusion of their programs and entrance into a paid position. It is important that dispositions and competencies of teacher candidates, as described in TPEs, are measured at different points in a pre-service teacher's credential program to guide their growth as teacher candidates. Accordingly, such teacher standards and assessments are futile without a predictive model that not only determines probable courses of pre-service teachers' growth at different points in the credential program but that can ultimately lead to effective intervention.

The absence of such a predictive model may stem in part from some fundamental issues that surround the mere operationalization of teacher dispositions. The National Council for Accreditation of Teacher Education (NCATE), the largest accreditation body for teacher education programs in the U.S., has defined teacher dispositions as "professional attitudes, values, and beliefs demonstrated through both verbal and non-verbal behaviors as educators interact with students, families, colleagues, and communities" (NCATE, 2008, pp. 89-90). The growing interest in dispositions is mirrored in a growing effort of educational researchers and policy makers to investigate the appropriate definition and assessment of what constitutes a disposition (Damon, 2007; Diez, 2007; Murray, 2007; Villegas, 2007). However, to date, a shared definition of dispositions has yet to be established. Rather, contrasting views still remain on how dispositions impact effective teaching and learning (Borko, Liston, & Whitcomb, 2007), even though some researchers have already reported positive associations between desirable teacher dispositions and effective teaching (Taylor & Wasicsko, 2000).

In light of this issue related to consensus about the definition of dispositions and the larger issue pertaining to the absence of a model to predict the growth of pre-service teachers in their knowledge, skills, and dispositions that TPEs specify, the purpose of this study was two-fold. First, we aimed at testing the hypothesis that teacher candidates who faced challenges in student teaching had lower self-rating scores of teacher dispositions, or lower degrees of alignment between disposition and standards, than their counterparts who did not face challenges in student teaching. Second, this study aimed at developing an explanatory model to predict teacher candidates' effectiveness in student teaching based on their assessed disposition. The disposition survey in this study directly reflected the dispositional requirements of California's TPEs. To the degree that one's student teaching mimics one's later professional classroom instruction, it would be useful to have a model to predict teacher candidates' success or challenges in student teaching. The teacher education community in particular would be better able to develop programs that would prepare competent and caring classroom teachers. Such a predictive model would also provide teacher candidates with a template for a periodical check on whether or not and how they have aligned their dispositions to standards.

Method

Participants

This study analyzed responses to the disposition survey from 277 teacher candidates in a Multiple Subject Credential Program (MSCP) that prepares elementary school teachers at a public urban university in Southern California. At the time the survey was administered, the participating teacher candidates were scheduled to complete a semester-long (15 weeks) student teaching, a culminating field experience at the university. The teacher candidates completed student teaching in Fall 2005 and Spring 2006 in two classrooms, one at a primary grade (K-2) and the other at an intermediate grade (3-5). The 277 participants were part of a larger pool of 563 student teachers of which 246 were completing a blended program between the Liberal Studies department and the MSCP; 41 were pursuing a Spanish-emphasis bilingual cross-cultural language and academic development (BCLAD) credential and 12 were pursuing an Asian language emphasized BCLAD credential. In Fall 2005 and Spring 2006, university supervisors administered the disposition survey to their supervisees at the beginning of the student teaching semester. Although the completion of the survey was voluntary, 277 teacher candidates (49.20%) returned their surveys to 36 University Supervisors.

Instrument

The information analyzed in this study was derived from the 15-item survey on teacher dispositions. Because an existing data set was made available for this study without participant identifiers, a review by the Institutional Review Board was not required. The 15 items in the survey reflected all elements in TPE 12 and TPE 13, as described below.

Teacher Performance Expectation (TPE) 12: Professional, legal, and ethical obligations.

Candidates for a Teaching Credential:
1. Take responsibility for student academic learning outcomes.
2. Are aware of their own personal values and biases and recognize ways in which these values and biases affect the teaching and learning of students.
3. Resist racism and acts of intolerance.
4. Manage their professional time spent in teaching responsibilities to ensure that academic goals are met.
5. Understand important elements of California and federal laws and procedures pertaining to the education of English learners, gifted students, and individuals with disabilities, including implications for [the students'] placement in classrooms.
6. Identify suspected cases of child abuse, neglect, or sexual harassment; Maintain a non-hostile classroom environment; Carry out laws and district guidelines for reporting such cases.
7. Understand and implement school and district policies and state and federal law in responding to inappropriate or violent student behavior.
8. Understand and honor legal and professional obligations to protect the privacy, health, and safety of students, families, and other school professionals.
9. Are aware of and act in accordance with ethical considerations and they model ethical behaviors for students.
10. Understand and honor all laws relating to professional misconduct and moral fitness.

Teacher Performance Expectation (TPE) 13: Professional growth

Candidates for a Teaching Credential:
1. Evaluate their own teaching practices and subject matter knowledge in light of information about the state-adopted academic content standards for students and student learning.
2. Improve their teaching practices by soliciting feedback and engaging in cycles of planning, teaching, reflecting, discerning problems, and applying new strategies.
3. Use reflection and feedback to formulate and prioritize goals for increasing their subject matter knowledge and teaching effectiveness.

4. Develop appropriate plans for professional growth in subject matter knowledge and pedagogy.
5. Access resources such as feedback from professionals, professional organizations, and research describing teaching, learning, and public education.

Table 1
Description of the 15 Items in the Survey and Their Association with Specific Elements in TPE 12 and TPE 13

Item #	*Item Description*	*TPE*
1	I feel confident when I teach without planning or with an incomplete lesson plan.	12-1, 13-2
2	I communicate effectively when I speak and write.	13-4
3	Implementing suggestions from my Master teacher and University Supervisor will help me become a better teacher.	13-2, 3, 5
4	I am confident that I will maintain a positive attitude and be enthusiastic when I teach the children.	12-1, 2, 3, 6
5	Adherence to standards of professional ethics will be a priority for me during my student teaching.	12-9, 10
6	Collaborating with my Master teacher and University Supervisor will help me become a better teacher.	13-2, 3, 5
7	I am comfortable with receiving feedback.	13-2, 3, 5
8	I believe family and community resources positively affect student learning.	12-2, 8
9	It is necessary for me to use a variety of instructional strategies to meet the needs of my students.	12-5,13-1, 2, 3
10	If I experience difficulties during my student teaching assignment, I think it will be due to external factors beyond my control.	12-1, 13-2
11	I am comfortable with volunteering for additional tasks and going over and above what is expected of me during my student teaching assignment.	12-1, 10
12	I expect that I will ask for help from my Master teacher and/or University Supervisor.	13-2, 3, 5
13	It is easy for me to follow time schedules, adhere to deadlines for assignments, and to be punctual during my student teaching.	12-4
14	I am flexible and can adapt to new attitudes, practices, policies, and procedures during my student teaching assignment.	12-2, 3, 7, 10
15	Reflecting on my student teaching performance will be necessary for my professional growth.	13-1, 2, 3, 4, 5

Table 1 lists the 15 items in the survey and intended associations between the items and the specific elements of TPEs 12 and 13 as shown above. Respondents answered each item in the survey by selecting an option from among four choices—"Always," "Sometimes," "No opinion," and "Never." "Always" was assigned the score of 4, "Sometimes," 3, "No Opinion," 2, and "Never," 1. The scores on Items 1 and 10 were reversed to ensure that higher scores indicated a closer alignment with a desirable teaching disposition as outlined by the TPE and TPA.

Data Analysis

In a post-survey review of final grades, it was found that 12 of the 277 teacher candidates received an Incomplete or a Withdrawal in their student teaching practicum. Qualitative information in students' files revealed that these 12 candidates faced a high number of challenges during one or more of their student teaching experiences. These 12 students who struggled with student teaching constituted the "Challenge Group" in this study, while the remaining 265 teacher candidates were classified into the "No Challenge Group." Using this classification, two types of analyses were conducted to accomplish the two purposes of this study: (1) a Mann-Whitney *U* test to compare distribution of scores from the two groups, and (2) a data mining analysis to build a predictive model of pre-service teachers' challenging experiences in the student teaching practicum.

Results

Table 2 includes means and standard deviations for survey item scores in a total sample, as well as means and standard deviations of disaggregated scores based on: (1) those who faced challenges in student teaching, referred to as the "Challenge Group," and (2) those who did not face challenges, or the "No Challenge Group." With each item having a possible score range between one and four, many items had means over 3.5. In the total sample, the item mean was highest for Item 5 (M=3.99) and lowest for Item 10 (M=2.19). A high score on item 5 refers to maintaining as a priority an "adherence to standards of professional ethics." A low score on item 10 minimizes the chance that "difficulties during…student teaching…will be due to external factors beyond [one's] control."

To test the hypothesis that teacher candidates who successfully completed student teaching had significantly higher self-rating scores on dispositions than their counterparts who faced notable challenges, a Mann-Whitney *U* test was conducted. The Mann-Whitney *U* test is a

non-parametric test to compare two groups on their score distributions from a test variable. This non-parametric approach helps researchers alleviate the issue of inflated Type II error rates in a parametric test with unequal group sizes. The results of the test supported the hypothesis, revealing that those in the "Challenge Group" scored lower on the composite disposition score than their counterparts in "No Challenge Group," as the former had an average rank of 86.79, while the latter had an average rank of 141.36, z=-2.33, p<.05. As seen in the last column in Table 2, Cohen's D of 0.62 (a large difference effect) was identified in comparing the group means of the composite disposition score (Cohen, 1988). Also as seen in Table 2, the "No Challenge Group" had higher group means than the "Challenge Group" for 10 out of 15 items, and such group mean differences were especially large for Items 6 and 13, with Cohen's D of .90 and .86 that demonstrated large effect sizes, respectively. Essentially, the No Challenge Group scored higher than the Challenge Group in that they were more likely to value collaboration with their Master teachers and the University and they were more likely to report that time management is "easy" for them.

Table 2
Means and Standard Deviations of the 15 Items in the Survey Separately for Teacher Candidates Who Faced Challenges during Student Teaching (N=12) and Those Who Did Not (N=265), and in the Total Sample (N=277)

	Challenge		*No Challenge*		*Total*		*Cohen's D*
	M	*SD*	*M*	*SD*	*M*	*SD*	
Item 1	2.42	0.90	2.47	0.90	2.47	0.89	0.06
Item 2	3.25	0.62	3.51	0.52	3.50	0.52	0.50
Item 3	4.00	0.00	3.83	0.41	3.84	0.40	-0.42
Item 4	3.92	0.29	3.94	0.25	3.94	0.25	0.08
Item 5	4.00	0.00	3.99	0.11	3.99	0.10	-0.10
Item 6	2.83	0.72	3.48	0.73	3.46	0.74	0.90
Item 7	3.92	0.29	3.79	0.41	3.80	0.40	-0.32
Item 8	3.83	0.39	3.88	0.33	3.88	0.33	0.15
Item 9	3.92	0.29	3.94	0.24	3.94	0.24	0.08
Item 10	2.00	0.60	2.20	0.65	2.19	0.65	0.31
Item 11	3.67	0.49	3.75	0.44	3.75	0.44	0.18
Item 12	3.33	0.49	3.47	0.52	3.47	0.51	0.27
Item 13	3.58	0.90	3.89	0.32	3.88	0.37	0.86
Item 14	3.92	0.29	3.88	0.34	3.88	0.34	-0.12
Item 15	4.00	0.00	3.97	0.18	3.97	0.18	-0.17
Composite Score	52.58	2.11	54.00	2.32	53.94	2.33	0.62

To accomplish our study's second objective, a Classification and Regression Tree (CART) technique was employed. The goal of this data mining analysis was to develop an explanatory model to predict teacher candidates' experiences in student teaching using the 15 self-rating disposition scores. According to a number of researchers, the CART technique has been regarded as an alternative to the traditional prediction methods, and is helpful in solving problems in authentic settings (Breiman, 2001; Breiman, Friedman, Olshen, & Stone, 1984; Hand, Blurt, Kelly, & Adams, 2000; Steinberg & Colla, 1995; 1997). Breiman (2001) insightfully observed:

> There are two cultures in the use of statistical modeling to reach conclusions from data. One assumes that the data are generated by a given stochastic data model. The other uses algorithmic models and treats the data mechanism as unknown. The statistical community has been committed to the almost exclusive use of data models. This commitment has led to irrelevant theory, questionable conclusions, and has kept statisticians from working on a large range of interesting current problems. Algorithmic modeling, both in theory and practice, has developed rapidly in fields outside statistics. It can be used both on large complex data sets and as a more accurate and informative alternative to data modeling on smaller data sets. If our goal as a field is to use data to solve problems, then we need to move away from exclusive dependence on data models and adopt a more diverse set of tools. (Breiman, 2001, p. 199)

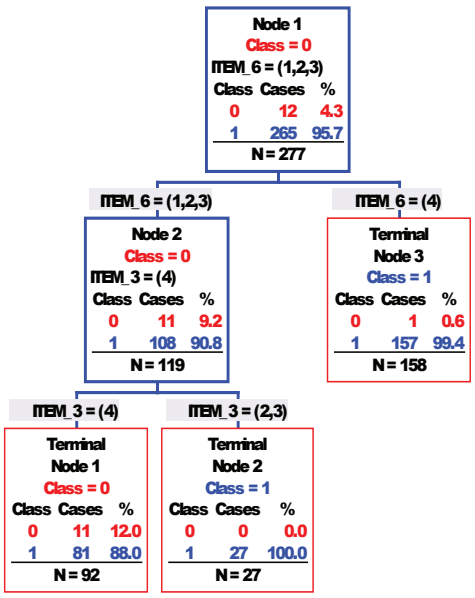
To specify a classification tree, the CART program repeatedly splits the data set into the two subgroups that are the most different with respect to the outcome; that is, "Challenges" and "No Challenges" in student teaching. Although no attempt was made to obtain a new sample to test the predictive accuracy of the generated model, the CART technique allowed us to test the predictive accuracy in a cross-validation procedure that determined how well the classification tree would perform on completely fresh data.

Figure 1 demonstrates a generated prediction tree, in which Item 6 was the best predictor. As seen in Terminal Node 3 on the right, 157 of 265 participants who did not face challenges were successfully classified into the "No Challenge Group" with the maximum possible score of four on Item 6. Only one of the 12 participants who faced challenges was misclassified into the "No Challenge Group" with a score of four on Item 6. As seen in Node 2 on the left of Node 3, the remaining 119 participants were classified into the "Challenge Group" with Item 6 scores of one, two, or three. Data mining, including modeling with CART, relies on recognition of patterns that are present in the data and does

not involve probabilistic inferences or parametric assumptions such as multivariate normality or homogeneity of variance. Therefore, the high variation in the group size, such as the one found in the present study, is less consequential in using CART than in using probabilistic statistical modeling where an emphasis is placed on confirming or disconfirming a pre-defined hypothesis or model (Larose, 2005; Streifer & Schumann, 2005).

The 119 participants who were classified into the "Challenge Group" consisted of 11 out of 12 candidates who indeed faced a high number of challenges in student teaching, and 108 of 265 candidates who did not face such challenges. At this point, these 108 candidates were misclassified in the "Challenge Group," but an additional division using scores two and three on Item 3 successfully classified 27 of the 108 candidates into the "No Challenge Group."

Figure 1
Prediction Tree Based on 277 Teacher Candidates Who Completed Student Teaching. Nodes 1 and 2 in the Upper Section of the Figure Denote Intermediate Subgroups Subject to Further Splitting, and Terminal Nodes 1 though 3, Located at the End of Splits, Denote Terminal Subgroups. Class 0 is to Classify People into the "Challenge Group" and Class 1, to Classify People in the "No Challenge Group."



This predictive model accurately classified 184 (69.43%) of 265 participants who did not face challenges into the "No Challenge Group," and misclassified 81 (30.57%) of them into the "Challenge Group." Among the 12 participants who faced challenges in student teaching, the predictive accuracy was as high as 91.67% after accurately classifying 11 of them into the "Challenge Group." The CART model had an overall predictive accuracy of 70.40% and a six-fold cross-validation with a predictive accuracy of 72.20%. Specific classifications in the cross-validation sample are shown in Table 3.

Discussion

The purposes of this study were to: (1) test the hypothesis that teacher candidates who faced challenges in student teaching had lower self-ratings on teacher dispositions than their counterparts who did not face challenges in student teaching, and (2) develop an explanatory model to predict teacher candidates' challenging experiences in student teaching. This study is important as it demonstrates one method for building a model to predict student progress in a teacher education program. Such models to predict pre-service teachers' growth in teacher education programs are strongly sought to help teacher educators effectually guide pre-service teachers in their programs.

As we hypothesized, teacher candidates who successfully completed student teaching had significantly higher self-rating scores on dispositions than their counterparts who faced notable challenges. This result lends support to the literature indicating that positive teacher dispositions predict effective, successful teaching. Teacher candidates are especially encouraged to develop skills in collaboration as seen in Item 6 "Collaborating with my Master teacher and University Supervisor will help me become a better teacher." Among all 15 items, the mean of Item

Table 3
Prediction Success Table for the Cross-validated Sample Based on 277 Teacher Candidates

	Predicted Class		
Actual Class	*Challenge*	*No Challenge*	*Actual Total*
Challenge	7	5	12
No Challenge	72	193	265
Predicted Total	79	198	277
Correct	58.33%	72.83%	

Note: Overall cross-validated accuracy rate = 72.20%.

6 in the "No Challenge Group" (M=3.48) was most distant from that in the "Challenge Group" (M=2.83), with Cohen's D of 0.90. In the CART analysis, teacher candidates who had the highest possible score of four on Item 6 were successfully classified into the "No Challenge Group."

In light of recent studies on expertise development, it also makes sense that the high score on Item 6 predicted successful experiences in student teaching. Collaborative work with Master teachers and University Supervisors, as described in Item 6, will likely provide student teachers with ample opportunities to receive immediate feedback on their performances, reflect on their own progress, and model superior performances. Studies on expertise development have implied that such opportunities are essential for student teachers to develop advanced expertise in teaching, as high-level expertise in any domain is attained only through what Ericsson, Krampe, and Tesch-Römer (1993) have characterized as "deliberate, well-structured practice." Deliberate, well-structured practice is not a sheer repetition of performances, but focused practices guided by immediate feedback from coaches, conscious performance monitoring (as opposed to automated performance that does not involve conscious monitoring), analyses of expertise, identification of errors, and programs well-designed to eliminate errors (Ericsson, 2009; Ericsson, Charness, Feltovich, & Hoffman, 2006).

However, a somewhat conflicting result emerged when the second predictor, Item 3, was introduced in the CART model. Contrary to our expectation of a lower score, the highest possible score on Item 3 classified 11 candidates who faced difficulties in student teaching into the "Challenge Group." As Item 3 read "Implementing suggestions from my Master teacher and University Supervisor will help me become a better teacher," those 11 candidates who were successfully classified into the "Challenge Group" had the highest level of self-perceived disposition to seek feedback. It is perplexing that Items 6 and 3 were related to student teachers' experiences in an opposite manner; both lower scores on Item 6 and the highest possible score on Item 3 accurately classified candidates who faced challenges into the "Challenge Group."

Of noteworthy interest is that, even though Item 6 and Item 3 are both indicators of TPE 13, they seem to manifest different levels of expectation for professional development. Following and implementing suggestions from others, as denoted in Item 3, is less involved than shaping their own roles in collaboration with others and improving their own performances while reflecting on the collaborative experiences, as denoted in Item 6. It might be the case that the 11 teacher candidates who faced challenges in student teaching were ready to follow suggestions from their supervisors (Item 3) but were not quite ready for

more-involved, self-regulated cycles of planning, teaching, reflecting, discerning problems, analyzing and incorporating feedback, and applying new strategies, and pursing all these things in collaboration with their supervisors as delineated in TPE13-2 and Item 6. At a minimum, this hypothesis is one that should be carefully addressed in future studies on teacher dispositions. Also of noteworthy interest is that Item 3 had a relatively high mean of 3.84 within the total sample, which signifies that the sheer majority of student teachers in this study were certain that they would implement suggestions from their supervisors.

Limitations

The survey instrument analyzed in this study was established in a prior study from which we obtained the data. In the survey's original use, a pilot to determine its wording logic and reliability was not undertaken. So, it remains possible that responses to the survey might have been inaccurate due to issues in wording, misunderstanding, and other methodological weaknesses. In light of this, the results from the current study are to be regarded mainly as indicators to support additional research, and the generalization of findings should be planned after the future studies support the findings from the present study.

Moreover, the dataset in this study included only 12 teacher candidates who experienced challenges in student teaching. This small group of 12 might not represent a larger population of teacher candidates who face difficulties in student teaching. The criterion that this study used to determine "challenges" might not be ideal, as there could be a group of student teachers who faced significant challenges in student teaching but managed to obtain the grade "Credit" in the student teaching course. It could be the case that the 81 student teachers who were misclassified into the "Challenge Group" did face considerable challenges in student teaching, but their course grades were not an Incomplete or a Withdrawal. The accuracy of the predictive model obtained in this study should be further tested in a larger sample of teacher candidates that is reflective of both those who face challenges in student teaching and those who succeed in the practicum experience.

Perhaps most importantly, attention should be drawn to how the study participants were obtained. The study sample constituted 277 volunteers who responded to the survey. As those 277 volunteers came from a larger group of student teachers (N=563), it remains possible that those responding possessed some characteristics related to disposition that induced them to respond. If it is so, there is a possible subject bias. Furthermore, if such a bias exists and were related to the perceptions

being measured, the collected data could also be biased. The selection of a representative sample, instead of relying on volunteers who complete surveys, might be another essential key for future investigations.

Conclusion and Implications

Despite these limitations, the findings from this study have provided useful information for teacher educators, teacher candidates, and educational researchers. For example, if this study's results are supported by additional studies, teacher educators might consider developing a curriculum that will assist their students in internalizing dispositions that emphasize a collaborative approach, in addition to directly teaching the specific skills of collaboration. As Alger (2006) claims, individuals who have knowledge of a skill might not be able to translate the skill into the "doing of a skill," if they do not have dispositions to support the translation process. If a gap between skill and performance exists based on disposition, collaborative behaviors would be actualized only when teacher candidates possess both the skills and dispositions to collaborate, particularly those relevant and desirable in a teaching context. The curriculum to assist students internalize dispositions to collaborate would be helpful even to those who already have dispositions and skills to collaborate, as it will alarm them how imperative it is to fully align and integrate skills with dispositions to attain high levels of performances.

Teacher candidates might also need periodic checks to assess whether or not they are equipped with appropriate dispositions to collaborate. Probably most importantly, the findings from this study stand to advance our understanding of how dispositions relate to instructional practices and approaches. If a model, such as ours, indicates that specific elements of dispositions predict successful teaching, then educational researchers can design focused studies to further investigate how teacher dispositions affect student learning. Specifically, if additional studies support this study's results, such findings will encourage educational researchers to plan focused investigations to examine the relationship between teacher candidates' "dispositions to collaborate, reflect, model, and monitor" and student learning and development.

In conclusion, this study applied the classification tree (CART) technique, an algorithmic model that has gained increasing prominence, to a small data set with a hope that such application would draw important implications for statistical modeling within the teacher education community. This study revealed that the application of the CART technique to a smaller data set indeed is an informative alternative to data modeling as Breiman (2001) observed. This technique holds promise for

future research on teacher dispositions, and we are hopeful that future research will produce outcomes to realize our ultimate goal that effective teaching optimizes the learning and development of all children in our nation.

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