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Developing Metrics for Effective Teaching in Agricultural Education

Rebecca G. Lawver
Utah State University

Billy R. McKim
Texas A&M University

Amy R. Smith
University of Minnesota

Mollie S. Aschenbrener
California State University, Chico

Kellie Enns
Colorado State University

Abstract

Research on effective teaching has been conducted in a variety of settings for more than 40 years. This study offers direction for future effective teaching research in secondary agricultural education and has implications for career and technical education. Specifically, 142 items consisting of characteristics, behaviors, and/or techniques considered indicative of effective teaching, identified in the qualitative strand of this sequential mixed–method study, were assessed using quantitative methods to identify constructs of effective teaching in agricultural education. A total of 1,631 secondary agriculture teachers, from 37 states, served as the population. Fifty perceived indicators of effective teaching were identified, representing 10 constructs. Psychometric evaluation of the items yielded 10 constructs with associated Cronbach's alpha coefficients ranging from .83 to .93. A panel of experts reviewed the construct items and loadings; item constructs were developed to reflect the summated item descriptions. Many items aligned with effective teaching concepts identified in previous research.

Keywords: effective teaching, agricultural education, metric development

Introduction

The educational system in the United States has faced tremendous scrutiny in recent years. At all levels—local, state, and national—heightened efforts currently focus on reforming and improving the entire educational system, particularly elementary and secondary education. Educational programs targeting reform include initiatives such as *Race to the Top*, the reauthorization of the Elementary and Secondary Education Act, and *No Child Left Behind*. In fact United States Secretary of Education Arne Duncan suggested the *Carl D. Perkins Career and Technical Education Act* is in need of significant reform and updating; he stated, "The need to strengthen and elevate CTE is urgent" (USDE, 2011). Each initiative calls for an increased focus on accountability, assessment, and data collection.

While these educational reform efforts and initiatives may have positive implications for the CTE and agricultural

education, Wong and Wong (2010) suggested "assessment and data will not improve student learning and achievement. All assessments and data do is inform[;] effective teaching drives and determines the data to show improvement in the quality of student learning and achievement" (p. 2). According to Hershberg (2005), quality instruction has between 15 and 20 times more impact on student achievement than other explanatory factors including family background, income, race, and gender. Wong and Wong (2010) stated "the difference in teacher effectiveness is the single largest factor affecting academic growth of populations of students" (p. 1). If such statements are true, perhaps increased efforts to produce and prepare effective teachers would yield greater dividends in student achievement than reform initiatives.

The concept of effective teaching is not new among teachers, administrators, and others involved in teacher education. Cruickshank (1996) suggested renewed interest among researchers to comprehend and define effective teaching began more than 40 years ago. In fact, substantial research has investigated teaching effectiveness (e.g., Buchanan, 1997; Feldman, 1976; Nicholls, 2002; Reid & Johnstone, 1999; Rosenshine & Furst, 1971; Scheeler, 2008; Walls, Nardi, von Minden & Hoffman, 2002; Westmeyer, 1988; & Westwood, 2003). Effective teaching has been linked to student achievement, student engagement and motivation, and teacher efficacy, but it is often difficult to define (Young & Shaw, 1999). Although effective teaching may be recognized when observed, it is difficult to measure and perhaps more challenging to critically define given the great variation observed in effective teaching literature.

Within career and technical education (CTE), effective teaching is a priority, as well. For CTE and agricultural education to remain rigorous and relevant as a contributor to successful lives and careers of students, teachers must be effective. Ruhland and Bremer (2002) recommended further research be conducted to examine the content of pre-service and in-service programs to ensure that CTE teachers are effective in the school and classroom environment. The need to clearly define parameters of effective teaching in agricultural education and CTE provides opportunities to refine teacher training and professional development.

Literature Review

According to DeVellis (2012), the purpose of scale development is to provide a measure or measures of elusive phenomena that cannot be directly observed; in this study we are concerned with measuring the latent variable of effective teaching. Expansive research has been conducted to better understand the phenomena of effective teaching; however, a direct measure of effective teaching is not overtly evident in the literature. Thus, effective teaching can, by definition, be considered a *latent variable*. Therefore, developing a quantifiable measurement model consisting of individual items or indicators to measure the strength or magnitude of the phenomena (effective teaching) would be valuable for secondary teachers, administrators, teacher educators, and others. Further, developing a quantifiable measurement model of effective teaching would provide metrics to test the influences of external stimuli, such as professional development courses, or conditions, such as years of experience.

DeVellis (2012) noted the process of scale development must not begin without reviewing appropriate theory and literature. A frequently cited endeavor to define and evaluate effective teaching occurred nearly four decades ago. Rosenshine and Furst (1971) sought to identify variables related to

effective teaching. Their findings revealed five variables that have the greatest impact on student learning: clarity, variability, enthusiasm, task-oriented and/or businesslike behavior, and student opportunity to learn criterion material. Feldman (1976) found clarity and stimulating student interest highly related to good teaching. Feldman also suggested effective instructors were knowledgeable about their content, prepared and organized for class, and enthusiastic. Furthermore, Reid and Johnstone (1999) identified six components to good teaching, including approachability, clarity, depth of knowledge, interaction, interest, and organization.

More recently, Westwood (2003) found effective teachers manage classrooms, provide students with opportunity to learn, maintain academic focus, establish high expectations, demonstrate business-like and work-oriented behaviors, show enthusiasm, maintain task-oriented behaviors, are organized and teach in sequential steps, use direct and explicit instructional procedures, provide clear instructions and explanations, employ task-approach strategies, monitor students and adjust instruction to individual needs, re-teach content when necessary, provide frequent student feedback, use a variety of resources, and interact with students.

Notwithstanding, Wong and Wong (2010) suggested that many years of research on effective teaching could be summarized in three characteristics: 1) good classroom management; 2) knowledge of how to teach a lesson for student learning and mastery; and 3) positive expectations for student success. Further, they proposed these effective teacher characteristics could be used to form the framework of an effective professional development program to train teachers (Wong & Wong, 2010). Danielson (1996) also developed a framework for teaching, based upon research and experience in the area of teaching and learning. According to Danielson, such a framework answers the following questions: "What does an effective teacher know?" and "What does an accomplished teacher do in the performance of [his or her] duties?" (p. 6). Now, widely adopted by school districts, teacher preparation programs, and state departments of education, the Danielson framework suggests effective teaching can be categorized into four domains: planning and preparation, classroom environment, instruction, and professional responsibilities.

Research surrounding effective teaching is not absent from CTE. Gordon and Yocke (1999), stated effective teaching requires students be offered the best possible chance to learn, regardless of the nature of their individual preference. Specific research in agricultural education focused on effective teaching (Dyer, & Osborne, 1996; Johnston & Roberts, 2011; Miller, Kahler, & Rheault, 1989; Newcomb, McCracken, & Warmbrod, 1993; Roberts, Dooley, Harlin, & Murphrey, 2007; Roberts & Dyer, 2004) have identified frequent performance areas demonstrated by effective teachers, including productive teaching behaviors, organized and structured classroom management, positive interpersonal relationships, professional responsibilities, and personal characteristics.

Newcomb et al. (1993) identified 13 principles of teaching and learning, including that subject matter to be learned must possess meaning, organization, and structure, student readiness is a prerequisite for learning, students must be motivated to learn, success is a motivating factor, students are motivated when attempting challenging tasks, students should have knowledge of their learning process, reinforced behaviors are most likely to be learned, reinforcement must immediately follow desired behaviors, directed learning

is more effective than undirected learning, students should inquire into the subject matter, problem-oriented approaches to teaching improve learning, student learn what they practice, and effective supervised practice occurs in a functional educational experiment.

Additionally, Roberts and Dyer (2004) identified a model of effective teaching for agricultural education, which included instruction, FFA, SAE, building community partnerships, marketing, professional growth/professionalism, program planning, and personal qualities. This model highlights the unique nature of agricultural education.

As a result of this *uniqueness*, the evaluation of teacher effectiveness in agricultural education may offer additional measurement challenges. In their *Handbook on Agricultural Education in Public Schools*, Phipps, Osborne, Dyer, and Ball (2008) suggested practices or elements educational researchers believed to be associated with effective teaching in agricultural education. However, they also noted the need for the development of additional expertise among agriculture teachers, in part due to the wide variety of roles and responsibilities expected when providing leadership for a complete agriculture program. Researchers have noted the unique work environment for agricultural education teachers when compared to other secondary teachers (Harper, Weiser, & Armstrong, 1990).

Not surprisingly, criterion developed to evaluate teacher effectiveness in one setting cannot be assumed to be accurate or appropriate in another when differences in the work environment exist (Borman & Vallon, 1974). Further, as DeVellis (2012) noted, scales are sometimes intended to measure very specific behaviors or situations, whereas, other scales are intended to measure phenomena on a more general level. In most of the literature reviewed, the level of specificity of the items and concepts was inconsistent and disparate. For example, Rosenshine and Furst's (1971) meta-analysis described *teacher performance criteria* as vaguely as "whether the cognitive level of the teacher's lesson appeared to be 'just right most of the time'" (p. 44) and as specific as "Acknowledging the student's ideas by repeating the nouns and logical connectives he has expressed" (p. 49). Moreover, Rosenshine and Furst (1971) introduced their research as a starting point for further research: "...[W]e know very little about the relationship between classroom behavior and student gains. [This] is a plea for more research on teaching" (Rosenshine & Furst, 1971, p. 37). With regard to their findings, Rosenshine and Furst (1971) stated,

> The results of these studies provide hypotheses upon which to build teacher training models. However, these are not variables, which can be placed in teacher education programs with the assurance that training teachers in these behaviors will enhance student performance. Much more study is needed before these behaviors and their effects will be clarified. (p. 43)

Although additional research on effective teaching in general is certainly warranted, the need for a model of effective teaching specifically focused on agricultural education is even more critical given state and federal attempts to create standards based testing, performance measures, and accreditation programs to measure and document effectiveness, efficiency, and impact in education (Doerfert, 2011).

Theoretical Guidance

Operational approaches to scale development vary greatly, often by discipline or content area; thus, we followed the procedures suggested by DeVellis

(2012). Most of the conceptual and theoretical underpinning of scale development can be traced back to Spearman (1904a; 1904b; lead to classical test theory and Spearman's *G*), whose work provided a basis for Guttman (1945; relationship between items in a test), Cronbach (1951; Cronbach's alpha and subsequently generalizability theory), and Nunnally (1967; psychometric theory). Psychometric theory was important to this study because our approach to measuring the latent variable *effective teaching* required the measurement of beliefs or psychological attributes.

Psychometric Theory

Psychometrics allows researchers to objectively measure concepts through indirect means rather than physical characteristics (Nunnally, 1967). Measurements must include rules for assigning numbers to objects to represent quantities of attributes "…to objectify the recording of impressions (e.g., rating scales) and to objectify the analysis of the results" (Nunnally, 1967, p. 486). When proposing a new measure (or revising an existing measure), it is important to clearly qualify and quantify the properties of the concept. This provides the rules of the measure and the mechanism to establish validity and reliability.

Classical Test Theory

We approached this study from a holistic approach, with respect to the sum of items, rather than on an individual item basis. DeVellis's (2006) explanation of classical test theory guided our methods and analyses. DeVellis (2006) noted, fundamentally, classical test theory enables researchers to use observable information (e.g., scores on questionnaire items) to garner insights into variables (e.g., an individual's self-perceived ability or satisfaction) that cannot be directly observed. Thus, the procedural approach associated with classical test theory (DeVellis, 2006)—which can also be traced back to Spearman (1904a; 1904b), Guttman (1945), Cronbach (1951), and Nunnally (1967)—guided our methods and analyses.

Self-Efficacy Theory

This study focused on behaviors, characteristics, and techniques associated with effective teaching, largely rooted in teachers' belief in their ability to create desired outcomes (Tschannen-Moran & Hoy, 2001) because "teachers' efficacy beliefs also relate to their behavior in the classroom" (p. 783). Hence, the development of variables or test items was guided by Bandura's theory of self-efficacy (Bandura, 1986). Self-efficacy is believed to influence thought patterns and emotions that drive actions (Bandura, 1986; 1993; 1997). Although teacher efficacy may be difficult to measure (Tschannen-Moran & Hoy, 2001), efficacy studies include, but are not limited to, references of characteristics, beliefs, behaviors, knowledge or competence in specific content areas, and techniques demonstrated by efficacious teachers (Allinder, 1994; Bandura, 1986; 1993; 1997; Berman, McLaughlin, Bass, Pauly & Zellman, 1977; Tschannen-Moran and Hoy, 2001). Such characteristics, beliefs, behaviors, knowledge, and techniques are often referenced when effective teaching is described and/or are listed as components of a framework of teaching.

Purpose and Objectives

Theory cannot be accurately tested until constructs are clearly identified and operationalized (Gorsuch, 1983). In some cases, theory is not explicit regarding the constructs actually needed; instead they may refer only to an area of interest (Gorsuch, 1983). In such cases, the area itself should

be analyzed for appropriate constructs before the research proceeds (Gorsuch, 1983). This task is often accomplished through factor-analytic and psychometric analyses (Field, 2009). The purpose of this study was to identify and describe items (behaviors, characteristics, and techniques) associated with effective teaching in agricultural education to develop a model of effective teaching through factor-analytic and psychometric analyses. The results of this study may lead to self-assessment and observational instruments for use in future studies. The following objectives guided this study:

1. Assess the factor-analytic and psychometric properties of effective teaching, based on the perceptions of secondary agriculture teachers.
2. Using the construct outcomes from research objective one, describe secondary agriculture teachers' self-perceived performance of items associated with effective teaching.

Method

Design

This study is the quantitative strand of a larger sequential mixed method study (QUAL → QUAN), as defined by Morse (2003). In sequential mixed designs, "…mixing occurs across chronological phases (QUAL, QUAN) of the study; questions or procedures of one strand emerge from or depend on the previous strand…" (Teddlie & Tashakkori, 2008, p.151). Mixed method developmental studies in the QUAL → QUAN configuration often identify statements or themes through qualitative analysis, followed by statistical analyses (Teddlie & Tashakkori, 2008).

Scale Development

Developing measurement scales can be approached multiple ways, often based on the desired unit of analysis (Newton & Rudestam, 1999). We approached this study from a whole test (sum of the items) perspective guided by classical test theory (DeVellis, 2006); we followed the specific guidelines outlined by DeVellis (2012). Drawing on our review of the literature, much of the empirical and theoretical research noted characteristics, behaviors, and techniques of teaching as indicators of effective teaching, which served as the general starting point for our sequence of inquiry and led to the quantitative analyses (QUAL → QUAN).

We began the process of scale development with a qualitative strand because DeVellis (2012) noted the "pool of items should be rich source from which a scale can emerge" (p. 84). Although DeVellis (2012) suggested researchers should begin by creating their own pool or list of items after reviewing the literature, we believed drawing from a current practitioner base would create a richer list of items. Thus, the initial qualitative strand yielded 142 unique items identified by 67 in-service agriculture teachers and 51 extension agents, who were asked to describe the characteristics, behaviors, and techniques of teaching related to effective teaching in formal and non-formal settings (McKim, Lawver, Enns, Smith, & Aschenbrener, 2013). DeVellis (2012) noted, generally, the larger the pool, the better; thus, we included items from formal and non-formal agricultural educators to ensure a rich pool of items reflecting characteristics, behaviors, and techniques of teaching used in agricultural education.

While creating the initial list of items, it was also important to consider the most appropriate response format (DeVellis, 2012). We considered Thurstone (1928),

Guttman (1950), and Likert (1932) scales. The Thurstone (1928) scale was not well-suited for this study, because the Thurston's format most commonly requires items to be "precalibrated with respect to their sensitivity to specific levels of the phenomenon" (DeVellis, 2012, p. 86). The Guttman (1950) scale was also not well-suited for this study, because Guttman's format is commonly used to establish a hierarchical pattern of responses (DeVellis, 2012). We opted to use a Likert (1932) format, *Strongly Disagree* to *Strongly Agree*, because our intent was to develop a scale with equally weighted items. The scale items serve as "imperfect indicators of a common phenomenon that can be combined by simple summation into an acceptably reliable scale" (DeVellis, 2012, p. 86). Hence, a five-point sliding scale (1 = *Strongly Disagree* to 5 = *Strongly Agree*) was used.

Bipolar anchors were used based on the recommendations of Lam and Klockars (1982), "The researcher interested in obtaining an interval scale may thus be able to eliminate the effort of labeling all points on the scale in favor of labeling only the endpoints" (p. 321). Additionally, the sliding scale allowed respondents to indicate their level of agreement between anchor points, which provided a more finite response.

Assessing the quality of the 142 items in the initial pool before constructing the instrument was important to ensure item clarity and avoiding unnecessary wordiness (DeVellis, 2012). Overall reading-level was assessed based on the recommendations of DeVellis (2012) and Fry (1977), using the readability review function in Microsoft Word and yielded a Flesch-Kincaid grade level of 8.4, which was near the ideal of 8.0 or less. Additionally, we provided a description of the study, the desired outcomes, and a list of the 142 items to a panel of 10 experts in the fields of formal and non-formal education, curriculum and instruction, and evaluation to evaluate the items' clarity and conciseness, and the relevance of the items to the desired outcomes of the study.

Instrumentation

After integrating the expert panel's feedback, we developed a three-section web-based survey instrument following the recommendations of Dillman, Smyth, and Christian (2009) and administered it using Qualtrics. The first section of the survey instrument asked secondary agriculture teachers how many years they had been an educator, how many hours they taught each week (not including preparation time), and how many hours per week they spent preparing to teach. The second section of the survey instrument included 142 items related to effective teaching, as identified in the qualitative strand of the larger sequential mixed method study. The third section asked teachers to indicate their gender, year of birth, highest level of education completed, number of hours worked in a typical week, and number of hours worked with youth development activities in a typical week. Only data collected in sections 1 and 2 were used for this study.

Content validity of the instrument was assessed in the qualitative strand of the larger sequential mixed method study (Lawver et al., 2013). Prior to data collection, five in-service teachers and the same panel of 10 experts was asked to assess face validity of the survey instrument. Because an outcome of this study was to establish a valid and reliable instrument, both were assessed in objective 1 of this study.

Although DeVellis (2012) noted the advantages of beginning with a rich and expansive pool items, researchers have also noted the concern that respondents will seldom complete a lengthy survey

instrument, resulting in item-response bias (Dillman, Sinclair, & Clark, 1993; Galesic & Bosnjak, 2009). To minimize item-response bias, the 142 items included in the second section were presented in random order to each respondent using the randomize function in the Qualtrics software. Additionally, data collected in the first section provided a basis of comparison between secondary agriculture teachers who started the questionnaire, but did not finish (n = 220), and those who completed the entire questionnaire (n = 1,248). Hours typically dedicated to teaching each week (not including preparation time) and hours per week typically dedicated to preparing to teach served as the dependent variables.

A multivariate analysis of variance (MANOVA) was used to compare the variables of interest. A MANOVA is the appropriate analysis when

> …multiple independent and/or dependent variables and the measured variables are likely to be dependent on each other (i.e., to correlate)…. Thus, multivariate analysis allows for the examination of two variables while simultaneously controlling for the influence of the other variables on each of them (Newton & Rudestam, 1999, p. 137).

Box's test of equality of covariance was not significant (p = .19), indicating that the assumption of equality of covariance was not violated (Field, 2009). The result of the MANOVA was interpreted using Wilks' lambda (Λ). There was not a significant effect of item-response bias on the dependent variables Λ = .999, $F(2, 1465)$ = .536, p = .585, η_p^2 = .001.

Sampling and Subject Characteristics

Nunnally (1967) noted the importance of distinguishing between "…statistics concerning the sampling of people and statistics concerning the sampling of items (test items). After measures are developed and then employed in empirical investigations, it is important to employ inferential statistics concerning the sampling of people" (Nunnally, 1967, p. 9). Hence, this study used factor analytic procedures to empirically investigate the behaviors, characteristics, and techniques associated with effective teaching in formal settings for use in future hypothesis-testing studies.

Therefore, this study was exploratory in nature. The focus was placed on the development of psychological measures—the generality of findings to populations of test items—rather than the ability to infer the results to a population. Consequently, the objectives of this study were not inferential in nature. Nonetheless, it was important to obtain enough responses to satisfy sampling adequacy; the sample must be sufficiently large to eliminate subject variance as a concern (DeVellis, 2012; Nunnally, 1967). Kass and Tinsley (1979), Field (2009), and Tabachnick and Fidell (2013) recommended obtaining 5 to 10 respondents per item to reach an adequate number of cases for factor analysis. Thus, we conservatively set our minimum number of responses at 1,420 (10 respondents per item).

To maximize response rate, the data collection schedule suggested by Dillman et al. (2009) was followed. Teacher educators and/or state FFA advisors in each state were contacted, requesting a list of names and e-mail contacts of agriculture teachers in their respective states. Twenty-two states provided lists; whereas, 15 lists were secured from state websites. Teacher educators from two states responded that they were not willing or able to share the information. Data were collected from current agriculture teachers representing 37 states between September and November

2011. The accuracy of the lists obtained and the inclusiveness of the lists were unknown; therefore, it was not reasonably possible to access an accurate national frame of agriculture teachers or determine the extent of frame error. Moreover, because the purpose of this study was focused on instrument development and assessing internal validity of the instrument, the 1,631 agriculture teachers who provided useable responses were considered the population for this study; thus, all findings are restricted to that population and cannot be inferred beyond.

After five points of attempted contact, 1,631 responses were received. A summary of this study's participants (N = 1,631), including number of agriculture teachers per state and years of teaching experience (see Table 1).

Table 1

Characteristics of Secondary Agriculture Teachers (N = 1,631; μ [a] = 14.59; σ = 10.53)

		Yrs. Exper.[a]				*Yrs. Exper.*[a]	
State	*n*	*M*	*SD*	State	*n*	*M*	*SD*
Alaska	14	12.40	10.50	Nebraska	80	16.37	10.68
Arizona	31	13.43	10.99	Nevada	11	13.60	9.73
Arkansas	53	14.53	11.10	New Hampshire	7	16.40	14.76
California	210	13.27	9.55	New Jersey	11	13.90	10.87
Colorado	44	11.44	7.60	North Carolina	83	13.66	11.93
Connecticut	18	14.19	10.88	North Dakota	24	17.91	10.85
Delaware	25	13.36	8.47	Ohio	121	14.65	10.26
Florida	27	19.07	11.88	Oklahoma	27	15.67	12.11
Georgia	62	10.48	8.46	Oregon	45	14.33	9.89
Hawaii	3	9.67	10.97	Pennsylvania	59	15.95	11.65
Idaho	33	15.76	10.13	South Carolina	18	13.29	11.18
Illinois	63	14.11	10.38	South Dakota	42	15.10	11.17
Indiana	40	12.86	11.66	Texas	195	16.59	11.03
Iowa	30	18.13	12.09	Utah	67	11.80	9.55
Maine	2	27.00	5.66	Vermont	6	22.83	16.46
Maryland	21	19.06	13.13	West Virginia	18	13.38	8.24
Michigan	17	13.65	8.91	Wisconsin	35	15.14	9.09
Minnesota	45	15.34	8.74	Wyoming	20	16.32	10.49
Montana	24	12.80	9.83	**Total**	**1,631**	**14.59**	**10.53**

Note. [a]Mean years of teaching experience.

Results

We analyzed the data using SPSS® version 20.0. Respondents who completed less than 50% of the instrument and who completed fewer than 50% of the items composing any factor were eliminated, per the suggestion of Kamakura and Wedel (2000), resulting in 1,366 useable responses.

The purpose of research objective 1 was to assess the factor-analytic and psychometric properties of the items associated with effective teaching, based on the perceptions of secondary agriculture teachers. The 142 items identified in the initial qualitative strand of the larger sequential mixed method study were included in the principal component analysis

using a varimax rotation. We used varimax rotation because we approached this study from a whole test perspective and were guided by classical test theory (DeVellis, 2006). The focus of classical test theory is placed on building scales with the intent of interpreting the sum of the items, rather than an individual item basis (DeVellis, 2006). It is, however, important to note the classical test theory approach has more restrictions than other latent trait measurement models, e.g., confirmatory factor analysis.

Coefficients with an absolute value less than .45 were suppressed to eliminate double-loadings (Field, 2009). Bartlett's test of sphericity was significant ($p < .001$), and Kaiser-Meyer-Olkin's (KMO) measure of sampling adequacy was .98—values above .90 are considered to be *superb* (Field, 2009). After removing components of less than three items and components with Cronbach's alpha coefficients less than .80 (Field, 2009), the remaining 50 items composed the 10-component solution that accounted for 68.99% of the total variance. The 10 components were then treated as independent constructs and served as the dependent variables for the study. Eigenvalues, percentages of variance, cumulative percentages, and Cronbach's alpha coefficients for each construct are reported (see Table 2). Construct loadings from the principal component analysis of the items are reported (see Table 3).

Table 2

Number of Items, Eigenvalues, Percentages of Variance, Cumulative Percentages for Constructs, and Estimates of Reliability

Construct	Items	Eigenvalue	% of variance	Cumulative %	*n*	Cronbach's α
1	12	7.18	14.08	14.08	1290	.93
2	8	5.47	10.73	24.80	1325	.91
3	6	3.50	6.86	31.67	1320	.83
4	5	3.24	6.36	38.02	1374	.86
5	4	3.07	6.01	44.03	1369	.88
6	3	2.63	5.15	49.19	1369	.92
7	3	2.59	5.09	54.27	1367	.90
8	3	2.55	5.00	59.27	1369	.88
9	3	2.51	4.92	64.19	1368	.88
10	3	2.45	4.80	68.99	1375	.86

Field (2009) noted that individual items should measure the same underlying dimension. In this case, the underlying dimensions are behaviors, characteristics, or techniques associated with effective teaching. Intercorrelations should range between "about .30" to no higher than .80 (Field, 2009, p. 648). "If any variables have lots of correlations below .30 then consider excluding them" (Field, 2009, p. 648). Intercorrelations greater than .80 could indicate issues related to multicolinearity; thus, those items should be removed as well.

All 50 items included in the 10 constructs revealed associated correlation scores greater than .30 and less than .80 (see Table 4). Additionally, all constructs should correlate, as they each measure different aspects of the same thing. One bivariate correlation score of .29 existed between constructs 5 and 9. It was determined that one low correlation among 45 acceptable bivariate correlations was not sufficient

cause to remove the construct. The associated constructs were then named through a collaborative process, utilizing experts from the previously established panel.

Table 3

Bivariate Correlations Between Constructs

Construct	1	2	3	4	5	6	7	8	9	10
1	—									
2	.47	—								
3	.55	.63	—							
4	.56	.56	.54	—						
5	.44	.51	.45	.47	—					
6	.39	.54	.42	.44	.38	—				
7	.41	.55	.53	.52	.39	.34	—			
8	.45	.47	.47	.60	.36	.38	.49	—		
9	.44	.38	.45	.52	.29	.35	.40	.53	—	
10	.53	.61	.56	.58	.43	.42	.48	.49	.42	—

Table 4

Construct Loadings from Principal Component Analysis with Varimax Rotation

Item	Loading
Construct 1: Planning & Organizing the Learning Environment	
I keep lessons organized to help learners learn information	.78
I provide clear objectives for each lesson	.76
I keep lessons organized to help learners retain information	.76
I use objectives to organize lessons	.75
I present clear objectives	.70
I follow instructional plans (e.g., lesson or workshop plans)	.69
I establish goals that include desired outcomes	.68
I establish a scope for curriculum	.66
I establish a daily routine	.66
I create a timeline for curriculum – amount of time for each component	.66
I provide a clear process for notes	.59
I define expectations for learning	.54
Construct 2: Respect & Rapport	
I show an apparent interest in learners' lives	.81
I am concerned about learners' well-being	.81
I am compassionate	.77
I care about learners	.74
I give attention to all learners	.66
I care for learners beyond the classroom	.59
I show compassion toward learners	.57
I am concerned about learners' success	.53

Item	Loading
Construct 3: Professional & Ethical Conduct	
I have integrity	.81
I am trustworthy	.77
I am honorable	.63
I dress appropriately	.60
I honor the individuality of each learner	.48
Construct 4: Instructional Flexibility	
I use experiential learning	.73
I appeal to a variety of learning styles	.67
I take advantage of opportunities to learn	.67
I provide a variety of opportunities to learn	.62
I encourage learner inquiry	.62
Construct 5: Collegiality	
I collaborate with colleagues	.81
I consider advice from colleagues	.76
I share resources with colleagues	.77
I consider constructive criticism from colleagues	.74
Construct 6: Commitment & Desire to Teach	
I enjoy teaching	.85
I love to teach	.84
I want to teach	.83
Construct 7: Student Engagement	
I allow learners to ask questions	.77
I encourage learners to ask questions	.76
I encourage active participation	.76
Construct 8: Subject Matter Meaning	
I make real-life connections to the subject matter	.74
I help learners understand application of the material in the real-world	.70
I provide learners with an opportunity to apply subject matter in a practical way	.68
Construct 9: Knowledge & Experience	
I have experience with the topic	.84
I am knowledgeable of the topic	.81
I know how to apply topics to the real-world	.70
Construct 10: Learner Accommodations	
I teach material that matches the learners' ability	.80
I teach at the learners' level	.80
I pay attention to learners' concerns	.53
I connect with learners	.51

The purpose of research objective 2 was to describe secondary agriculture teachers' self-perceived ability to perform the items associated with effective teaching. Ability scores of the 1,631 secondary agriculture teachers in this study are

proposed as multi-state benchmarks for comparing ability levels in future studies of effective teaching. Findings of this research objective are not intended for inference to a larger population. Therefore, summated mean and standard deviation for each construct were reported as μ and σ (see Table 5).

Table 5

Proposed Benchmark Scores for Comparison in Studies of Agriculture Teachers' Ability Levels

Construct	μ	σ
Planning & Organizing the Learning Environment	4.12	0.57
Respect & Rapport	4.60	0.43
Professional & Ethical Conduct	4.70	0.36
Instructional Flexibility	4.41	0.48
Collegiality	4.37	0.57
Commitment & Desire to Teach	4.58	0.57
Student Engagement	4.72	0.39
Subject Matter Meaning	4.56	0.47
Knowledge & Experience	4.54	0.49
Learner Accommodations	4.30	0.51

Note. 1 = *Strongly Disagree*, 5 = *Strongly Agree*

Discussion

As a result of this study, the 142 items (characteristics, behaviors, and techniques of teaching) associated with effective teaching in agricultural education were reduced through factor-analytical procedures to 50 items, representing 10 constructs. Thus, 10 agriculture teacher effectiveness constructs or latent variables were generated through psychometric evaluation. Earlier studies focusing on agriculture teacher effectiveness were primarily based upon existing effectiveness research, often rooted in elementary and secondary education. The 10 constructs, representing 50 items, identified in this study include planning and organizing the learning environment and preparing clear objectives, instructional plans, and curriculum; developing respect and rapport with students; professional and ethical conduct and integrity, honor, and trust; the ability to use a variety of learning styles and approaches to learning; instructional flexibility; the relevance of collegiality and commitment to teach; attention to student engagement, and real-life connections to the subject matter; the importance of personal content knowledge and experience; and the ability to accommodate learners; may serve as a comparison for future needs assessments and evaluation of effective teaching in agricultural education teachers.

It is important to reiterate we approached this study from a whole test perspective to build scales with the intent of interpreting the sum of the items, rather than an individual item basis. We did not investigate the relationship among the constructs (*latent variables*) nor the relationship or relationships among the individual items. Consequently, further investigations using other approaches to latent trait measurement, including confirmatory factor analysis and item response theory, would be warranted.

Investigating the professional characteristics of the most self-efficacious agriculture teachers, using the metrics presented in this study, may be advantageous; however, it was beyond the

scope of this study. Therefore, future studies should investigate the relationships between effective teaching and teachers' experience (Huberman, 1989), level of education, and amount of time preparing to teach or lesson planning (Ball, Knobloch, & Hoop, 2007).

With respect for CTE, similar studies should be replicated in other CTE areas in order to substantiate effective teaching across CTE content areas. Comparisons of effective teaching characteristics among CTE content areas may provide valuable insight into the teaching effectiveness of various CTE programs and may substantiate similarities. Comparisons of effective teaching characteristics among CTE content areas may also provide teacher educators, pre-service teachers, and stakeholders in CTE with a measure of teacher effectiveness that goes beyond student achievement and combines teacher practice. Procedures for establishing accurate state and national directories of CTE teachers should be developed in order to allow for data acquisition to happen more readily and research to accurately be generalized to larger, national populations. Such a directory would allow researchers to select valid simple-random samples of CTE teachers, which is necessary to empirically investigate many of the ongoing and emerging issues in education. Additional studies of regional or national scope are needed to validate the findings of this study.

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Authors

Rebecca G. Lawver is an Associate Professor in the School of Applied Sciences, Technology and Education at Utah State University, 1498 North 800 East, Logan, UT 84321, (435) 797-1254

Billy R. McKim is an Assistant Professor in the Department of Agricultural Leadership, Education, and Communications at Texas A&M University, 231 Agriculture and Life Sciences Building, TAMU 2116, College Station, TX, 77843, (979) 845-0794.

Amy R. Smith is an Assistant Professor in the Division of Applied Economics and Agricultural Education at the University of Minnesota, 146 C Ruttan Hall, 1994 Buford Ave. St. Paul, MN 55108, (612) 624-3010

Mollie S. Aschenbrener is an Associate Professor and Cooridinator of the Ag Ed Masters Program in the College of Agriculture at California State University, Chico, 400 West First Street, Chico, CA 95929,)530) 898-5844

Kellie Enns is an Associate Professor in the Department of Agricultural and Resource Economics at Colorado State University, B334 Clark Bldg., Fort Collins, CO 80523, (970) 491-6325

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