Developing an Instrument to Measure the Utilization of Principles of Teaching and Learning During Class Sessions*

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The purpose of this study was to develop an instrument, the Principles of Teaching and Learning Assessment (PTLA) to measure the frequency of use of principles of teaching and learning (Newcomb, McCracken, Warmbrod, & Whittington, 2004) during class sessions. The following research objectives guided the study: operationalize the principles of teaching and learning by developing concrete classroom observation criteria for each principle; establish face and content validity of the PTLA as measured using qualitative data from a panel of experts; establish reliability of the PTLA as measured through analysis of test–retest data; and write foundational premises for developing the PTLA. Grounded in Piaget's Theory of Cognitive Development (1961), the study was further guided by a conceptual framework for studying cognitive levels of teaching and learning (Ewing and Whittington, 2007). An instrument for measuring the use of principles of teaching and learning during class sessions is needed for documenting teaching effectiveness. The PTLA will be used to facilitate data collection regarding professor behaviors and their relationship to student variables in teaching environments.

Introduction

America has been committed to higher education for 370 years, beginning when America's first college trained Puritan ministers in the Massachusetts Bay Colony (Lucus, 1994). According to the United States Department of Education (USDE, 2006), higher education in the United States is one of the nation's greatest success stories:

Whether America's colleges and universities are measured by their sheer number and variety, by the increasingly open access so many citizens enjoy to their campuses, by their crucial role in advancing the frontiers of knowledge through research discoveries, or by the new forms of teaching and learning that they have pioneered to meet students' changing needs, these postsecondary institutions have accomplished much of which they and the nation can be proud. (p. ix)

However, an outcome of the Commission on the Future of Higher Education (USDE, 2006), was the reiteration of concerns regarding the quality of teaching and learning in U.S. colleges and universities. Heightened after the mid–1970s (Rice, 2006) and fueled by findings from several commission reports in the 1980s, the quality of undergraduate education, and the subsequent call for instructional improvement (Paulsen & Feldman, 1995) have been reoccurring national themes. In their report, CFHE stated:

It is imperative that the nation give urgent attention to improving its system of higher education. The future of our country's colleges and universities is threatened by global competitive pressures, powerful technological developments, restraints on public finance, and serious structural limitations that cry–out for reform. (p. ix)

However, researchers have stated that the same instructional methods are still used to teach

today's students that were used to teach students from the early 1900s, despite the differences in students (Boggs, 1995). Given that the class of 2007 was born in 1990, the same year as the 15th birthday of the personal computer, and the same year that the World Wide Web was proposed, today's freshmen class has never known a world without the Internet (Pew Internet and American Life Report, 2007). Therefore, there is justification for the "disturbing feeling that our colleges are not as effective as they need to be" (Boggs, p. 24).

As Bess (1998) noted, stakeholders in higher education want to see quality from their institution. "A critical purpose of postsecondary education is to prepare students for their future professional lives" (Thompson, Licklider, & Jungst, 2003, p. 133). However, "Many traditional instructional approaches respond ineffectively to the learning needs and life situations of today's college students" (Weimer, 2003, p. 49). Therefore, professors, in this accountability–riddled era, must strive to deliver course content using a variety of methodologies, and at the appropriate cognitive level (Ewing & Whittington, 2009) to meet the needs of the 21st century learner.

In 2001, Kuh wrote, "Sooner or later, colleges and universities are either going to document what students are learning, or some external entity will impose its own approach" (p. 12). Policymakers, parents, and students are demanding solid evidence of student learning results (USDE, 2006). Therefore, institutions must examine that which they are currently doing to make certain they are meeting the needs of their communities of learners including, ". . . a more intense reexamination of the tried and true methods of instruction . . ." (Bess, 1998, p. 3).

Principles of Teaching and Learning

Rice (2006) stated, "The search for best practices in university teaching has been an elusive one" (p. 20). As early as 1907, evidence exists to indicate that researchers were searching for best practices. The 1907 Journal of Education, April issue, contains article excerpts presenting a list of books related to the *principles* and practice of *teaching* in the U.S. (Books on Principles and Practice of Teaching, 1907).

Since 1907, much has been published related to principles of teaching and learning (Chickering & Gamson, 1987; Guskin, 1994; McKeachie, 2002). In agricultural education, Stewart (1950) addressed principles of learning in his book, *Methods of Good Teaching.* Phipps and Osborne (1988) addressed teaching principles in the *Handbook on Agricultural Education* (1988). Newcomb, McCracken, Warmbrod, and Whittington (2004) addressed principles of teaching and learning in *Methods of Teaching Agriculture.* Others within agricultural education have addressed principles of teaching and learning (Crunkilton & Krebs, 1982; Hammonds, 1950).

Although a review of literature does not reveal one accepted set of principles for teaching and learning in education, Ball and Knobloch (2005) found that the most frequently required reading in preservice agricultural education methods courses was *Methods of Teaching Agriculture* (Newcomb, et al., 2004). Therefore, the 16 principles of teaching and learning identified by Newcomb et al. were adopted for this study.

Classroom Observation Instruments

Regarding measuring teaching behaviors, Dunkin and Biddle (1974) stated:

> First, we must provide ourselves access to examples of teaching so that we may examine them. Second, it is necessary to develop an instrument for making judgments concerning some aspect of teaching. Third, we must judge (or code) examples of teaching in terms of the instrument we have developed. (p. 57)

Fraser (1998) stated, "Classroom environment instruments can be used as a source of process criteria in the evaluation of educational innovations" (p. 21) and suggested several methods for studying classroom environments: using students' and teachers' perceptions, application of naturalistic inquiry techniques, ethnography, case study or interpretative research, and external observer's direct observation and systematic coding of classroom communication and events.

According to Martin (1977), classroom observation instruments are an organized, objective system for analyzing teacher and

student behavior in class sessions. Martin suggests several forms of classroom observation instruments including category observation instruments, rating schemes, and sign observation systems. Researchers tend to use category observation instruments to record classroom behaviors in the form of tallies, checks, or other marks, into predefined categories; information is yielded regarding behaviors that occurred and how frequently they are occurring during the observation (Martin). Dunkin and Biddle (1974) stated, "categorical observation provides more data and appears to be more flexible than sign observations" (p. 71). Consequently, the categorical observation style instrument was adopted for the PTLA study.

Theoretical Foundation

Jean Piaget spent the last 60 years of his life working in developmental psychology and refining his theory of cognitive and affective development (Wadsworth, 2004). Piaget's Theory of Cognitive Development (1961) serves as the theoretical foundation for the PTLA study (see Table 1).

Piaget is criticized for including the word *stage* in his theory (Wadsworth, 2004). Piaget did not believe, however, that individuals advance one distinct step at a time through the stages, nor that progress was automatic. In fact, Piaget suggested that cognitive development be viewed as a continuum involving the interaction of four influences: maturation, active experience, social interaction, and a general progression of equilibrium (Piaget, 1961).

Wadsworth stated, "Movement within and between stages of development is a function of these factors and their interaction" (p. 28).

Woolfolk (2007) added, "Some students remain at the concrete operational stage throughout their school years, even throughout life. However, new experiences, usually those that take place in school, eventually present most students with problems they cannot solve using concrete operations" (p. 35). Piaget advocated that teachers have powerful impact upon the active experience and social interaction influences because teachers control class session behaviors and environments (Wadsworth, 2004).

Conceptual Framework

The PTLA study is a continuation of a line of inquiry, *Improving the Cognitive Capacity of Students by Fully Engaging Professors in the Teaching and Learning Process*, that began in 1988 (Whittington & Newcomb, 1990). In Figure 1, the conceptual framework used to guide the ongoing line of inquiry is shown (Ewing & Whittington, 2007).

Developing the PTLA is critical to furthering the understanding of *content delivery* (see Figure 1), a variable that, together with *classroom environment*, effects students' ability to *think*, *engage*, and *retain* content. The PTLA will be used to measure professor use of the principles of teaching and learning, such that potential relationships can be studied between professor class session behaviors and student cognition during class sessions.

Table 1
Piaget's Stages of Cognitive Development (Wadsworth, 2004)

Stage	Age Range	Description
Sensorimotor intelligence	0–2 years	Cognitive development is observed as schemata are developed. Behavior is primarily sensory and motor.
Preoperational thought	2–7 years	Language development and other forms of representation with rapid conceptual development. Reasoning dominated by perception.
Concrete Operations	7–11 years	Ability developed to apply logical thought to concrete problems in the present.
Formal Operations	11–15 years or older	Greatest level of development. Capable of applying logical reasoning to all classes of problems.

Purpose and Objectives

The purpose of the study was to develop an instrument, the Principles of Teaching and Learning Assessment (PTLA), to measure the frequency of use of the principles of teaching and learning (Newcomb, et al., 2004) by professors during class sessions. The following research objectives guided the study:

1. To operationalize principles of teaching and learning (Newcomb, et al.) by developing

2. concrete classroom observation criteria for each principle.
3. To establish face and content validity of the PTLA as measured using qualitative data from a panel of experts (Ary, Jacobs, & Razavieh, 2002).
4. To establish reliability of the PTLA as measured through analysis of test–retest data (Ary et al.).
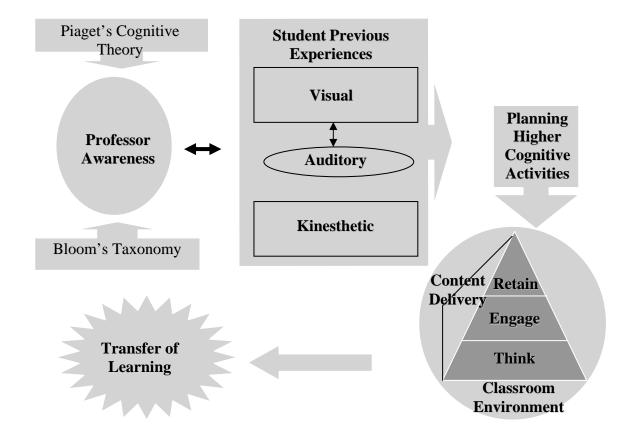5. To write foundational premises for developing the PTLA.

Figure 1. A conceptual framework for studying cognitive levels of teaching and learning (Ewing & Whittington, 2007).

Methods and Results

Newcomb at al. (2004, p. 27–43) organized 16 principles of teaching and learning into five constructs: organization and structure of subject matter, motivation, reward and reinforcement, techniques of teaching, and transfer of learning. Behaviors in which the 16 principles of teaching and learning are evidenced through teacher practice can be found in a table in the textbook titled, *How Teachers Put Into Practice the Principles of Teaching and Learning* (Newcomb et al., p. 45) that formed the basis for operationalizing the indicators for the PTLA. The constructs, principles, and *example* indicators from the PTLA can be seen in Table 2.

Table 2
Constructs, Principles of Teaching and Learning, and Example Indicators

Principle

I. Organization and Structure of Subject Matter
 1   When the subject matter to be learned possesses meaning, organization, and structure that is clear to students, learning proceeds more rapidly and is retained longer.
       a. Instructor utilizes visual organizational techniques.
 2   Readiness is a prerequisite for learning.   Subject matter and learning experiences must be provided that begins where the learner is.
       a. Instructor utilizes information about students' interests to determine readiness.

II. Motivation
 3   Students must be motivated to learn.   Learning activities should be provided that take into account the wants, needs, interests, and aspirations of students.
       a. Instructor demonstrates by comments that he/she is aware of the aspirations and/or experiences of students.
 4   Students are motivated through their involvement in setting goals and planning learning activities.
       a. Instructor acknowledges the contributions of students to learning goals and activities.
 5   Success is a strong motivating force.
       a. Instructor provides opportunities to students to indicate that they have successfully met the objectives.
 6   Students are motivated when they attempt tasks that fall in a range of challenge such that success is perceived to be possible but not certain.
       a. Instructor asks questions at varying levels of difficulty during class session.

III. Rewards & Reinforcement
 7   When students have knowledge of their learning progress, performance will be superior to what it would have been without such knowledge.
       a. Instructor conducts questioning during discussion to monitor student comprehension.
 8   Behaviors that are reinforced (rewarded) are more likely to be learned.
       a. Instructor provides verbal affirmation of student demonstration of comprehension.
 9   To be most effective, reward (reinforcement) must follow as immediately as possible the desired behavior and be clearly connected with that behavior by the student
       a. Instructor demonstrates desired behavior immediately followed by opportunity for student demonstration of comprehension.

IV. Techniques of Teaching
 10   Directed Learning is more effective than undirected learning.
       a. Instructor is on–task in delivering content relevant to the class session objectives.
 11   To maximize learning, students should "inquire into" rather than "be instructed in" the subject matter. Problem–oriented approaches to teaching improve learning.
       a. Instructor uses technique(s) in class session to encourage student inquiry.
 12   Students learn what they practice.
       a. Instructor supervises opportunities for students to apply content during class sessions.
 13   Supervised practice that is most effective occurs in a functional educational experience external to the classroom.
       a. Instructor provides opportunities for students to practice class content in environments external to the classroom

Table 2 (cont.)
Constructs, Principles of Teaching and Learning, and Example Indicators

Principle

V. Transfer of Learning

14   Learning is more likely to be used (transferred) if it is learned in a situation as much like that in which it is to be used as possible and immediately preceding the time when it is needed.
  a. Instructor uses examples to apply class content to learner–familiar situations.

15   You learn better when information is provided in a summary, formula, or rule.
  a. Instructor delivers content such that students, through comments, questions, and/or examples, see the broad implications and/or applications.

16   Teachers must teach materials so that students can use what is learned in a real life situation.
  a. Instructor uses examples from previous instruction and/or real world where the concepts and principles are applicable.

Note. Constructs identified by Roman numerals. Principles identified by Arabic numerals. Example indicators identified by lower case letters.

Category Observation Instrument Development

 There are four structural components of a category observation instrument as identified by Martin (1977): (a) a set of operationally defined categories of behavior; (b) a set of rules and priorities for observation and coding; (c) a standardized recording form; and (d) a series of instructions for organizing and analyzing the observational data. Martin cited the first two components as "absolutely necessary" (p. 43) and indicated that the final pair may be omitted despite their ability to increase the utility of the instrument. In addition, Martin called for a sound category observation instrument to have the following five characteristics: objective, relevant, parsimonious, efficient, reliable, and valid. Martin's instrument development schema was strictly followed throughout the development of the PTLA.

Establishing Validity
 Construct validity.
 Researchers assumed that construct validity was determined by Newcomb et al. (2004) when five constructs were used to categorize the 16 principles of teaching and learning. Therefore, construct validity was not addressed and the pre–existing constructs were used (see Table 2).

 Content validity.
 Validity was established using a panel of experts (Ary et al., 2002). The panel of experts consisted of the senior authors of *Methods of Teaching Agriculture*: . L.H. Newcomb, Senior Associate Dean for Academic Programs, The

Ohio State University; . J. Robert Warmbrod, Distinguished Professor Emeritus, The Ohio State University, and . J. David McCracken, Professor Emeritus, The Ohio State University.

 The panel of experts was solicited via email on August 28, 2007; all replied within one week. Feedback from the panel of experts suggested that the researchers emphasize more specific and observable behaviors. Dr. Warmbrod specifically offered the comment, "generally the items comprising the instrument pertain to the constructs/principles with the qualification of the need for more specific teaching behaviors rather than a more general statement."

 Dr. McCracken commented, "You will not find every principle in use every six minutes in the typical class situations. The important thing is that the students see the application of the principles over time." Dr. McCracken's comment was in line with the researchers' goal to determine the frequency of use of the indicators of the principles of teaching and learning over the course of the class session.

 Dr. Newcomb expressed concern that some indicators listed multiple items for analysis. The researchers' rectified his concern by removing multiple item indicators, or by adding the phrase "and/or" to allow the observer to select the indicator if *any* of the listed behaviors were observed. Again, note that the purpose of the instrument is to measure *the principle that the indicators represent* rather than measure the *individual indicators*. Thus the indicator an observer selects is intended to collectively reflect the principles themselves across the class session.

Dr. Newcomb also expressed concern for coding the discourse in indicator A of Principle Two, which at that time read, "Instructor utilizes information about students' interests and aspirations to determine readiness." To address his concern, the researchers made the decision to focus on instructor *behavior* during class sessions, which encompasses discourse, but encompasses other classroom behaviors as well. Additionally, Dr. Newcomb, in Principle Four commented that instructors' use of student presentations or small groups should be included. However, the researchers determined that *student presentations* are categorized in the techniques of teaching construct, and therefore would be accounted for in Principle Eleven.

Face validity.

"Face validity is determined from the point of view of the person being measured or the person whose behavior is being observed and recorded" (.J. Robert Warmbrod, personal communication, August 28, 2007). Therefore, the researchers determined that the panel of experts utilized for content validity held the necessary expertise in college teaching to establish face validity for an instrument for college classroom assessment.

Establishing Reliability

Reliability for the PTLA was established using test–retest (Ary et al., 2002). To establish inter– and intra–rater reliability, the researchers watched a videotaped class session from a previously obtained data set (Ewing & Whittington, 2007) and recorded the frequency of use of the indicators for each of the principles of teaching and learning.

Intra–rater reliability.

The intra–rater reliability for the PTLA was established by one researcher watching a randomly selected videotaped class session and recording the frequency of use of the indicators for each of the principles of teaching and learning as teaching was observed. One week later the same videotape was re–assessed by the same researcher. *A priori*, a 90% confidence band was established as acceptable for each *principle*, not each individual *indicator* within the principle. For example, the researcher could record the use of indicator "A" (an indicator categorized under Principle One) two times

during the first observation, then record indicator "A" once and indicator "B" (also an indicator categorized under Principle One) once during the second observation and still be reliable for Principle One. Likewise, the researcher could record ten frequencies of the use of indicators for Principle One during the first observation, then record nine or eleven frequencies of the use of indictors for Principle One during the second observation and still be reliable for Principle One. As can be seen in Table 3, the acceptable reliability (90%) was achieved in three trials. The intra–rater reliability for researcher one was $r_{1\ week}$ 82.3%, $r_{2\ week}$ 88.2%, $r_{3\ week}$ 97.7%.

Inter–rater reliability.

Another researcher, familiar with principles of teaching and learning, completed an analysis of the randomly sampled videotape used by the researcher to determine intra–rater reliability. To establish inter–rater reliability, test–retest was used (Ary et al., 2002). A priori, a 90% confidence band was established as acceptable. The inter–rater reliability for the frequency of use of the indicators for each principle of teaching and learning was established by each researcher examining the same randomly selected videotaped class sessions until the acceptable rate (90%) was achieved. As can be seen in Table 3, the acceptable reliability (90%) was achieved in two trials ($r_{1\ week}$ 80.6%, $r_{2\ weeks}$ 93.3%, $r_{3\ weeks}$ 97.7%).

Foundational Premises for Developing the PTLA

The development of the PTLA to measure the utilization of the principles of teaching and learning (Newcomb et al., 2004) during class sessions involved foundational decision–making by the researchers including: (a) capturing instructor classroom behavior, (b) describing the relationship between indicators and principles, (c) organizing and structuring the instrument, and (d) assuming instructor content competency.

Capturing Instructor Classroom Behavior

The principles of teaching and learning (Newcomb, et al., 2004) were originally conceptualized in the textbook with the holistic secondary agricultural education program in mind; classroom/laboratory instruction, supervised agricultural experience, and

career/technical student organization (FFA) components were covered collectively by the principles of teaching and learning. Thus, some of the indicators were written originally to be actualized in environments other than a class session. Specifically, ten of the original indicators were identified as being worded such that the indicator was difficult to ascertain during a class session, and consequently were deleted (without affecting the original intent of the principle). An example of a deleted indicator from Principle Two (the indicator would likely have occurred outside of the classroom environment) was: "Instructor obtain information about student's aptitude for learning."

Initial meetings of the researchers focused on operationalizing indicators that could be recorded through observed classroom instructor behavior. The first step to accomplish this was to rewrite all original indicators as complete, action–oriented sentences where the action was being taken (thereby could be observed) by the instructor. An example from Principle One was that instead of the indicator reading, "Units of instruction are titled to indicate application and use of subject matter," the indicator was changed to read, "Instructor utilizes visual organization techniques."

Additionally, the PTLA was not created to assess student behavior in the classroom, but rather to focus on the instructor's classroom behavior. An example of editing for focus on instructor behavior as opposed to student behavior is evident in Principle One which contains an indicator that originally read, "Instructor explains key points in a manner that students attain." The indicator was edited by deleting the phrase, "in a manner that students attain," as that phrase indicated student performance, not instructor performance.

Describing the Relationship Between Indicators and Principles

The next decision made by the researchers was that indicators must be viewed only in relation to the principle under which they are categorized. Indicators themselves would not be analyzed for use, but rather used to capture utilization and frequency of the principle in which it is embedded. Each indicator needed to stand alone, and needed to reflect the essence and spirit of the original principle of teaching and learning. An example of editing that occurred due to the decision of the researchers to view the indicator in relation only to its principle included changing an indicator in Principle Two from, "Instructor utilizes information about interests and aspirations," to, "Instructor utilizes information about interests and aspirations to determine readiness." Another example was in Principle Ten. The researchers deleted, "Instructor encourages students to work hard," because it did not clearly connect to Principle Ten.

Another editing example occurred after the second reliability trial. Principle Four was originally written as a "problem solving approach" principle related to student–centeredness. Researchers determined that they had incorrectly captured student verbal response to questions regarding student comprehension and student contribution under Principle Four. In reality, student verbal response to questions regarding student comprehension and student contribution should have been categorized under Principle Seven which was written to address knowledge of learning progress.

Table 3
Reliability Trial Results

Principle of Teaching and Learning	Researcher 1 Initial Observation			Researcher 1 Follow–Up Observations			Researcher 2 Initial Observations			Intra–Rater Reliability			Inter–rate Reliability		
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
1	14	8	6	15	8	6	12	7	6	.933	1.00	1.00	.857	.875	1.00
2	3	0	0	1	0	1	3	1	1	.333	1.00	.000	1.00	.000	.000
3	12	7	6	14	6	6	15	7	6	.857	.857	1.00	.800	1.00	1.00
4	10	1	0	9	2	1	13	0	0	.900	.500	.000	.769	.000	1.00
5	0	0	1	1	1	1	1	0	0	.000	.000	1.00	.000	1.00	.000
6	2	1	2	3	1	2	1	2	0	.666	1.00	1.00	.500	.500	.000
7	8	7	5	8	6	6	9	6	6	1.00	.857	.833	.889	.857	.833
8	6	4	5	8	4	5	8	6	6	.750	1.00	.833	.750	.667	.833
9	0	0	0	0	0	0	0	1	1	1.00	1.00	1.00	1.00	.000	.000
10	14	8	6	17	8	6	13	7	6	.824	1.00	1.00	.929	.875	1.00
11	8	5	6	11	6	4	9	1	6	.727	.833	.667	.888	.200	1.00
12	3	1	0	3	1	1	2	1	0	1.00	1.00	.000	.667	1.00	1.00
13	0	0	0	0	0	0	0	0	1	1.00	1.00	1.00	1.00	1.00	.000
14	4	0	0	1	1	0	7	1	0	.250	.000	1.00	.571	.000	1.00
15	2	0	0	1	0	0	3	1	0	.500	1.00	1.00	.667	.000	1.00
16	0	3	4	4	7	4	2	1	5	.000	.429	1.00	.000	.333	.800
Total	79	45	42	96	51	43	98	42	43	.823	.882	.977	.806	.933	.977

Organizing and Structuring the Instrument

Instrument design and format were determined to be critical for providing organizational structure that allowed for ease of discussion between researchers and users. The instrument was formatted to have one construct per page, identified by Roman numerals, with principles identified by Arabic numerals, and indicators identified by lower case letters.

Each indicator was evaluated for its unique distinction from other indicators. If indicators were similar to each other in purpose and utility, the principle under which it was categorized was revisited to bring clarity to the indicator; rewording the indicator followed accordingly. An example of clarifying and rewording four original indicators from Principle Four into one indicator follows: "Instructor repeats, modifies, or rephrases student comments," "Instructor compares and contrasts comments," "Instructor summarizes student comments," and, "Instructor asks students to describe experiences" were re–written as follows: "Instructor utilizes student contributions in classroom instruction."

Assessing Instructor Content Competency

The researchers assumed that instructors of classes were competent experts in their content areas, thus, the PTLA was designed to measure utilization of the principles of teaching and learning (Newcomb, et al., 2004) in instructors' classroom behaviors, not content expertise. The researchers assumed that instructors were teaching relevant content and understood logical sequencing of concepts within subject matter.

Recommendations for Use

In addition to being used for its intended purpose, to measure the use of principles of teaching and learning during class sessions, the PTLA could also be used during agricultural education methods courses to introduce and apply the principles of teaching and learning (Newcomb, et al., 2004) in lectures and labs. Students could use the PTLA to analyze the presence of the principles of teaching and learning during video–captured class sessions. Additionally, the PTLA could be used in the analysis of pre–service students' completed units of instruction; assessing the presence of the principles of teaching and learning in the planning phase of teaching.

The PTLA could also be used as an additional data collection point in peer review processes. Professors could video–capture their class session and provide the recording and the PLTA to a peer for assessment at the peer reviewer's convenience.

The PTLA should continue to be field–tested with various audiences including secondary learning environments. Researchers have advocated that measuring the use of principles of teaching and learning during class sessions is needed for documenting teaching effectiveness and its relationship to student cognition (; Bowman & Whittington, 1994; Ewing & Whittington, 2007; Lopez & Whittington, 2002; McCormick & Whittington, 2000; Whittington & Newcomb, 1990, 1993). College, secondary, and elementary learning environments will all benefit from measuring the use of principles of teaching and learning during class sessions, and modifying class session behaviors for enhanced learning.

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