A Study of Best Practices in PLATO® Learning Online Solutions

Prepared by Marzano Research Laboratory
for
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Executive Summary

Basic Description Of The Evaluation Study

Marzano Research Laboratory (MRL) is an education research firm dedicated to improving public education. From its vision statement, MRL seeks "to continuously develop tools that translate high-quality education research into practical applications educators can put to use." Through its research efforts, MRL effectively provides analytic support and conducts action, evaluation, and assessment research projects to specifically support the improvement of education policy and practice. Working with state departments of education, districts, schools, and corporate entities, MRL's research extends support to a broad range of education practitioners.

During the 2010–2011 academic year, MRL was retained by PLATO Learning, Inc., to evaluate the relationship between student learning and effective teacher pedagogical practices with respect to the use of PLATO Learning's online solutions in three instructional settings—pure virtual, blended, and classroom/lab. For the purpose of this evaluation study, the pure virtual setting included students who completed all of their PLATO coursework outside of a traditional classroom. The blended setting included students who completed some of their PLATO coursework in a traditional classroom and some of their PLATO coursework online. Finally, the classroom/lab setting included students who completed all of their PLATO coursework in a traditional classroom or school computer lab.

PLATO coursework is taken by students for one of four purposes—original credit, credit recovery, intervention, and Advanced Placement (AP). For the purpose of this evaluation study, original credit was defined as coursework for students taking an entire class for the first time. Credit recovery was defined as coursework for students repeating an entire class. Intervention was defined as coursework for students working on some of their assignments. AP was defined as coursework for students seeking to obtain college credit for courses taken in high school. As a relatively new offering in PLATO Learning's online solutions, AP was not considered in this report.

The instructional architecture of PLATO Learning's solutions includes courses that are organized into meaningful units based on an effective instructional sequence. Each unit includes a pretest followed by multiple instructional modules that include tutorials, activities (including application exercises, offline activities, and discussion activities), and a module mastery test. A posttest culminates each unit within a PLATO course. The final activity in each course is an end-of-semester test.

As its primary focus, the evaluation study attempted to answer the following questions through a correlation analysis of student achievement scores (standardized into z-score format for comparison across content areas), as well as student responses to survey items concerning teacher pedagogical practices:

- Evaluation Question 1: What is the relationship between students' academic achievement and teacher pedagogical practices in a pure virtual setting implementation of PLATO Learning's online solutions?

- Evaluation Question 2: What is the relationship between students' academic achievement and teacher pedagogical practices in a blended setting implementation of PLATO Learning's online solutions?

- Evaluation Question 3: What is the relationship between students' academic achievement and teacher pedagogical practices in a classroom/lab setting implementation of PLATO Learning's online solutions?

For the correlation analyses, student responses to survey items were correlated with students' average achievement scores within four academic content areas—English language arts, mathematics, science, and social studies. Two different scores were standardized into z-score format—the End-of-Semester (EOS) test and Unit 1 (U1) posttest scores. It should be noted that students who take courses for the purpose of intervention do not take the EOS test. Therefore, U1 posttest scores were also analyzed in order to include student test scores taken for that purpose. In all, 15,416 EOS test scores and 19,488 U1 posttest scores were considered valid scores for analysis and were standardized into z-score format.

To establish whether student and teacher perceptions of teacher pedagogical practice were consistent across instructional settings (pure virtual, blended, classroom/lab) and course purposes (original credit, credit recovery, intervention), comparisons were made between the aggregate student and teacher responses to survey items for each of the following design questions from the Marzano Instructional Model (for a detailed discussion of strategies related to the design questions and their effectiveness in the classroom, see Marzano, 2007):

- Teacher pedagogical practice involving routine events

    - o Design Question 1: What will I do to establish and communicate learning goals, track student progress, and celebrate success?

    - o Design Question 6: What will I do to establish and maintain classroom rules and procedures?

- Teacher pedagogical practice enacted on the spot

    - o Design Question 5: What will I do to engage students?

    - o Design Question 7: What will I do to recognize and acknowledge adherence or lack of adherence to classroom rules and procedures?

    - o Design Question 8: What will I do to establish and maintain effective relationships with students?

    - o Design Question 9: What will I do to communicate high expectations for all students?

Because PLATO Learning's online solutions deliver the instructional content to students (as opposed to direct instruction by teachers), the following design questions were not addressed in the student and teacher surveys:

- Teacher pedagogical practice involving content
    - o Design Question 2: What will I do to help students effectively interact with new knowledge?
    - o Design Question 3: What will I do to help students practice and deepen their understanding of new knowledge?
    - o Design Question 4: What will I do to help students generate and test hypotheses about new knowledge?
- Unit and lesson design
    - o Design Question 10: What will I do to develop effective lessons organized into a cohesive unit?

However, system variables collected within the PLATO Learning Environment (PLE) were examined to determine the extent to which various system tools were used and their influence on student academic achievement.

Summary Of Results

To understand best practices in PLATO Learning's online solutions within each of the three instructional settings—pure virtual, blended, classroom/lab—this evaluation study collected data from two sources: survey data from teachers and students and PLE system data (including student achievement scores).

Teacher Pedagogical Practice Involving Routine Events

It is fairly common for teachers to expect their students to follow certain routines on a consistent basis. As such, Design Questions 1 and 6 are classified as routine events that typically occur in a classroom every day (see Marzano, Frontier, & Livingston, 2011).

Teacher Survey Data

In order to address teacher pedagogical practice involving routine events, teachers were asked to respond to the following survey items (using a 4-point scale, 0–never, 1–sometimes, 2–frequently, 3–always):

- Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?)
    - o Item 4 (I ask my students to set goals for their work.)
    - o Item 17 (I ask my students to keep track of their own learning progress.)
    - o Item 19 (I talk individually with students regarding their progress.)
    - o Item 21 (I celebrate students when they do well on PLATO assignments.)

- Design Question 6 (What will I do to establish and maintain classroom rules and procedures?)
    - Item 6 (I provide an orientation prior to students beginning the online course or assignment to communicate the rules, procedures, and my expectations.)
    - Item 7 (I review the rules and procedures with my students.)

Of 144 teachers surveyed, the percentage who responded "frequently" or "always" to items related to pedagogical practice involving routine events ranged from 69.4% (Item 4) to 86.8% (Item 19). A reasonable inference can be made that a majority of the teachers surveyed perceive a frequent implementation of the six instructional strategies involving routine events in PLATO Learning's online solutions (for a discussion of these strategies and their potential effectiveness in the classroom, see Marzano, 2007).

Significant differences ($p < .05$) were found between teachers' self-perceptions of how often pedagogical practices involving routine events were implemented within the three instructional settings in PLATO Learning's online solutions. When survey responses were compared for each instructional setting, teachers in the classroom/lab setting indicated more frequent implementation of instructional strategies involving routine events than teachers in the pure virtual setting for both design questions. A reasonable inference can be made that teachers implemented the instructional strategies involving routine events more often in the classroom/lab setting than in the pure virtual setting. Therefore, further examination may be warranted to determine if there are any potential barriers to the implementation of these strategies in the pure virtual setting.

No significant differences ($p < .05$) were found between teachers' self-perceptions of how often pedagogical practices involving routine events were implemented within the three course purposes in PLATO Learning's online solutions. A reasonable inference can be made that teachers' self-perceived implementation of teaching strategies involving routine events seems to be consistent across PLATO coursework taken by students for the purpose of original credit, credit recovery, and intervention.

Student Survey Data

To address student perceptions of teacher pedagogical practice involving routine events, students were asked to respond to the following survey items (using a 4-point scale, 0–never, 1–sometimes, 2–frequently, 3–always):

- Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?)
    - Item 5 (My teacher encourages me to set goals for my work.)
    - Item 6 (I have a clear understanding of the goal or objective in each assignment.)
    - Item 13 (I keep track of my own learning progress.)

- o Item 14 (I communicate with my teacher about my progress.)
- o Item 16 (My teacher provides encouragement or positive feedback when I do well on my online course or assignments.)

• Design Question 6 (What will I do to establish and maintain classroom rules and procedures?)

- o Item 9 (My teacher clearly communicates rules, procedures, and expectations for this course or assignment.)
- o Item 10 (My teacher reviews the rules and procedures for this course or assignment while I am working on it.)
- o Item 11 (I have a clear understanding of the rules and procedures for this course or assignment.)
- o Item 12 (I have all the materials and resources I need to complete my course or assignment.)

Of more than 1,600 students surveyed, the percentage who responded "frequently" or "always" to items related to teacher pedagogical practice involving routine events ranged from 55.3% (Item 14) to 85.3% (Item 12). The percentage of students was greater than 70% for Items 5, 6, 9, 11, 12, and 13. A reasonable inference can be made that with the exception of Items 10, 14, and 16, a majority of the students surveyed perceive a frequent implementation of the instructional strategies listed pertaining to teacher pedagogical practice involving routine events in PLATO Learning's online solutions (for a discussion of these strategies and their potential effectiveness in the classroom, see Marzano, 2007).

Significant differences ($p < .05$) were found between students' perceptions of how often pedagogical practices involving routine events were implemented by their teachers within the three instructional settings in PLATO Learning's online solutions. More specifically, when survey responses were compared for each instructional setting, students taking PLATO coursework in the classroom/lab setting indicated that their teachers implemented instructional strategies pertaining to Design Question 6 (What will I do to establish and maintain classroom rules and procedures?) more often than students in the blended setting. A reasonable inference can be made that with the exception of Design Question 6, students' perceptions of the frequency of implementation of teaching strategies involving routine events seems to be consistent across PLATO coursework taken in the pure virtual, blended, and classroom/lab settings.

Significant differences ($p < .05$) were found between students' perceptions of how often pedagogical practices involving routine events were implemented by their teachers within the three course purposes in PLATO Learning's online solutions. When survey responses were compared for each course purpose, students taking PLATO coursework for the purpose of original credit indicated that their teachers implemented instructional strategies pertaining to Design Question 1 (What will I do to establish and communicate learning goals, track

student progress, and celebrate success?) more often than students taking courses for credit recovery. A reasonable inference can be made that with the exception of Design Question 1, students' perceptions of the frequency of implementation of teaching strategies seems to be consistent across PLATO coursework taken for the purpose of original credit, credit recovery, and intervention.

Student Survey and Achievement Correlations

In the pure virtual setting, significant positive relationships ($p < .05$) ranging from .11 to .12 were found between students' mean z-scores and survey responses to Item 11 (I have a clear understanding of the rules and procedures for this course or assignment), Item 12 (I have all the materials and resources I need to complete my course or assignment), and Item 16 (My teacher provides encouragement or positive feedback when I do well on my online courses or assignments). A reasonable inference can be made that these three instructional strategies are related to student academic achievement for PLATO coursework taken in a pure virtual setting.

In the blended setting, a significant positive relationship ($p < .05$) of .16 was found between students' mean z-scores and survey responses to Item 11 (I have a clear understanding of the rules and procedures for this course or assignment). In addition, a positive relationship of .15, which approached significance, was found between students' mean z-scores and survey responses to Item 16 (My teacher provides encouragement or positive feedback when I do well on my online course or assignments). A reasonable inference can be made that these two instructional strategies are related to student academic achievement for PLATO coursework taken in a blended setting.

Finally, in the classroom/lab setting, significant positive relationships ($p < .05$) ranging from .16 to .23 were found between students' mean z-scores and survey responses to Item 6 (I have a clear understanding of the goal or objective in each assignment), Item 11 (I have a clear understanding of the rules and procedures for this course or assignment), Item 12 (I have all the materials and resources I need to complete my course or assignment), and Item 13 (I keep track of my own learning progress). Additionally, a positive relationship of .15, which approached significance, was found between students' mean z-scores and survey responses to Item 16 (My teacher provides encouragement or positive feedback when I do well on my online course or assignments). A reasonable inference can be made that these five instructional strategies are related to student academic achievement for PLATO coursework taken in a classroom/lab setting.

PLE System Data

Once teachers have logged in to PLE, they can provide feedback to students, communicate learning goals and expectations, establish rules and procedures, track student progress, and customize instructional content. As they do with any online instructional solution, teachers log in to PLE to be able to use the features of the system. A session is the period of time from when a teacher logs in until he or she logs out. The total number of sessions per teacher provides a

picture of how often teachers use PLE to engage with a course or with a class of students. For each session, PLE keeps track of how long each teacher is logged in to the system. It should be noted that if teachers do not actively log out of the system, their session ends after one hour of inactivity in PLE.

A significant positive relationship ($p < .05$) of .26 was found between student EOS test z-scores (averaged by teacher) and the total amount of time each teacher was logged in to PLE across all classes. A significant positive relationship ($p < .05$) of .24 was found between student EOS test z-scores (averaged by teacher) and the total number of times each teacher logged in to PLE across all classes. Additionally, a significant positive relationship ($p < .05$) of .16 was found between student EOS test z-scores (averaged by teacher) and the average amount of time each teacher was logged in to PLE per session. Taken at face value, these findings suggest that a positive linear relationship was found between student achievement scores and the amount of time teachers were logged in to PLE—the total amount of time logged in to the system, the number of sessions, and the amount of time per session. A reasonable inference can be made that as the amount of time teachers spend logged in to PLE increases, student achievement scores also increase.

A significant positive relationship ($p < .05$) of .14 was found between student U1 posttest z-scores (averaged by teacher) and the total amount of time each teacher was logged in to PLE across all classes. A significant positive relationship ($p < .05$) of .13 was also found between student U1 posttest z-scores (averaged by teacher) and the total number of times each teacher was logged in to PLE across all classes. However, no significant relationship ($p < .05$) was found between student EOS test z-scores (averaged by teacher) and the average amount of time each teacher was logged in to PLE per session. Taken at face value, these findings provide additional evidence of a positive linear relationship between student achievement scores and the amount of time teachers were logged in to PLE—both the number of sessions and the total amount of time logged in to the system.

PLE includes a messaging feature that is essentially an email system. It allows teachers to communicate with students, and vice-versa. This feature allows teachers to communicate classroom rules and procedures, to set out learning goals and expectations, and to celebrate student success. Teachers can send messages to individual students, to a class, or to other teachers. Students can send messages to teachers. It should be noted that students cannot send messages to each other using the internal PLE messaging feature. Student messages are those sent by an individual student, and teacher messages are those sent by individual teachers.

A significant negative relationship ($p < .05$) of -.17 was found between students' mean EOS test z-scores and the average number of messages sent by students using the PLE messaging feature across all of their classes. In addition, a significant negative relationship ($p < .05$) of -.12 was found between students' mean U1 posttest z-scores and the average number of messages sent by students using the PLE messaging feature across all of their classes. However, no significant relationship ($p < .05$) was found between student

z-scores (averaged by teacher) and the average number of messages sent by teachers using the PLE messaging feature across all of their classes. Taken at face value, these findings suggest that a negative linear relationship was found between student achievement scores and the average number of messages sent by students using the PLE messaging feature across all of their classes. A reasonable inference can be made that students with higher achievement scores were the students who sent fewer messages using the PLE messaging feature. Conversely, students with lower achievement scores were the students who sent more messages. This might suggest that students with higher achievement scores had fewer questions for their teachers.

It should be noted that out of 6,299 students with valid EOS test z-scores, 4,147 students (65.8%) did not send any messages using the PLE messaging feature. Student responses to Item 8 (When I have questions about my work on PLATO assignments, I ask my questions) indicate that a large percentage of students meet with their teacher face-to-face (78.4%) compared with a small percentage of students who send email (10.7%). Similar patterns of responses were found for other items on the student survey (see appendix E). Because of the high percentage of students who did not use the PLE messaging feature, further examination may be warranted to ascertain the true correlation between student achievement and use of the messaging feature. The correlations reported here, although statistically significant, might be isolated to the specific sample that was analyzed.

Teacher Pedagogical Practice Enacted On The Spot

Within the classroom, teachers often need to be prepared to use a specific strategy with little or no notice even though they have not necessarily planned for its use within a given lesson. For example, strategies designed to help maintain student engagement might be employed when students show signs of becoming disinterested in the lesson. As such, Design Questions 5, 7, 8, and 9 are classified as events that typically occur whenever the need arises (see Marzano et al., 2011).

Teacher Survey Data

To address teacher pedagogical practice enacted on the spot, teachers were asked to respond to the following survey items (using a 4-point scale, 0–never, 1–sometimes, 2–frequently, 3–always):

- Design Question 5 (What will I do to engage students?)
    - o Item 4 (I monitor students carefully in order to keep students on task and focused.)
- Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?)
    - o Item 9 (There are clear consequences when a student “breaks the rules.”)
    - o Item 10 (I publicly acknowledge/celebrate when a student adheres to rules/procedures.)

- Design Question 8 (What will I do to establish and maintain effective relationships with students?)
    - Item 11 (Students are able to ask me questions about their work during this class.)
    - Item 32 (I make a conscious effort to get to know the students in this class on a personal level.)
    - Item 33 (I recognize and acknowledge students outside this classroom.)
    - Item 34 (I know each student's name in this class.)
- Design Question 9 (What will I do to communicate high expectations for all students?)
    - Item 35 (I ask students questions about their learning in this class.)
    - Item 36 (Students understand that they are able to ask questions during this class.)
    - Item 37 (I ask students questions about how they are doing with their work in this class.)
    - Item 39 (I treat all students equally in this class.)

Of 144 teachers surveyed, the percentage who responded "frequently" or "always" to items related to pedagogical practice enacted on the spot ranged from 60.1% (Item 10) to 98.6% (Item 36). A reasonable inference can be made that a majority of the teachers surveyed perceive a frequent implementation of the 11 instructional strategies listed involving pedagogical practices enacted on the spot in PLATO Learning's online solutions (for a discussion of these strategies and their potential effectiveness in the classroom, see Marzano, 2007).

Significant differences ($p < .05$) were found between teachers' self-perceptions of how often pedagogical practices enacted on the spot were implemented within the three instructional settings in PLATO Learning's online solutions. When survey responses were compared for each instructional setting, teachers in the classroom/lab setting indicated more frequent implementation of instructional strategies enacted on the spot than teachers in the pure virtual setting for all four design questions. A reasonable inference can be made that teachers implemented the instructional strategies enacted on the spot more often in the classroom/lab setting than in the pure virtual setting. Therefore, further examination may be warranted to determine if there are any potential barriers to the implementation of these strategies in the pure virtual setting.

Significant differences ($p < .05$) were found between teachers' self-perceptions of how often pedagogical practices enacted on the spot were implemented within the three course purposes in PLATO Learning's online solutions. When survey responses were compared for each course purpose, teachers who teach PLATO coursework for the purpose of credit recovery and intervention indicated that they implemented instructional strategies pertaining to Design Question 9 (What will I do to communicate high expectations for all students?) more often than teachers who teach PLATO coursework for the

purpose of original credit. A reasonable inference can be made that with the exception of Design Question 9, teachers' self-perceived implementation of pedagogical practices enacted on the spot seems to be consistent across PLATO coursework taken by students for the purpose of original credit, credit recovery, and intervention.

Student Survey Data

To address student perceptions of teacher pedagogical practice enacted on the spot, students were asked to respond to the following survey items (using a 4-point scale, 0–never, 1–sometimes, 2–frequently, 3–always):

- Design Question 5 (What will I do to engage students?)
    - o Item 18 (The pace of the online lessons works for me in this class.)
    - o Item 19 (I feel challenged and engaged using the computer to help me learn.)
    - o Item 20 (My teacher allows me to communicate with other students through email or discussion tools available in the online course or assignment.)
    - o Item 21 (My teacher helps me stay on task and focused while I work on my online course or assignments.)
    - o Item 22 (When I am not focused in this class, my teacher helps me get back to work.)
- Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?)
    - o Item 30 (There are clear consequences when someone gets in trouble in this class.)
    - o Item 31 (When I do something right in this class, my teacher acknowledges it.)
    - o Item 32 (The teacher is paying attention to what I am doing in this class.)
- Design Question 8 (What will I do to establish and maintain effective relationships with students?)
    - o Item 7 (I can ask the teacher any questions I have about my work on my online course or assignment.)
    - o Item 24 (When learning something new in my online course or assignments, I feel that my teacher provides the help I need to understand and practice new knowledge.)
    - o Item 25 (When I send an email regarding questions I have about my online course or assignments, my teacher responds quickly.)

- Item 33 (The teacher in this class makes an effort to get to know a little about me.)
- Item 34 (If I saw the teacher of this class outside this classroom, he or she would recognize me.)
- Item 35 (The teacher in this class remembers my name.)

• Design Question 9 (What will I do to communicate high expectations for all students?)

- Item 27 (My teacher asks me questions about my learning in this class.)
- Item 28 (The teacher explained that I am able to ask questions during this class.)
- Item 36 (My teacher treats all students in this class the same.)
- Item 37 (The teacher asks questions about how I am doing with my work in this class.)

Of more than 1,600 students surveyed the percentage who responded "frequently" or "always" to items related to teacher pedagogical practice enacted on the spot ranged from 28.5% (Item 20) to 87.5% (Item 35). This percentage was greater than 70% for Items 7, 18, 21, 22, 28, 30, 32, 34, 35, and 36. A reasonable inference can be made that with the exception of Items 19, 20, 24, 25, 27, 31, 33, and 37, a majority of the students surveyed perceive a frequent implementation of the instructional strategies pertaining to teacher pedagogical practices enacted on the spot in PLATO Learning's online solutions (for a discussion of these strategies and their potential effectiveness in the classroom, see Marzano, 2007).

No significant differences ($p < .05$) were found between students' perceptions of how often pedagogical practices enacted on the spot were implemented by their teachers within the three instructional settings in PLATO Learning's online solutions. A reasonable inference can be made that students' perceptions of the frequency of implementation of teaching strategies enacted on the spot seems to be consistent across PLATO coursework taken in the pure virtual, blended, and classroom/lab settings.

No significant differences ($p < .05$) were found between students' perceptions of how often pedagogical practices enacted on the spot were implemented by their teachers within the three course purposes in PLATO Learning's online solutions. A reasonable inference can be made that students' perceptions of the frequency of implementation of teaching strategies seems to be consistent across PLATO coursework taken for the purpose of original credit, credit recovery, and intervention.

Student Survey and Achievement Correlations

In the pure virtual setting, significant positive relationships ($p < .05$) ranging from .10 to .12 were found between students' mean z-scores and survey

responses to Item 32 (The teacher is paying attention to what I am doing in this class) and Item 35 (The teacher in this class remembers my name). A reasonable inference can be made that these two instructional strategies are related to student academic achievement for PLATO coursework taken in a pure virtual setting.

In the blended setting, significant positive relationships ($p < .05$) ranging from .16 to .19 were found between students' mean z-scores and survey responses to Item 18 (The pace of the online lessons works for me in this class), Item 24 (When learning something new in my online course or assignments, I feel that my teacher provides the help I need to understand and practice new knowledge), and Item 28 (The teacher explains that I am able to ask questions during this class). A reasonable inference can be made that these three instructional strategies are related to student academic achievement for PLATO coursework taken in a blended setting.

Finally, in the classroom/lab setting, significant positive relationships ($p < .05$) ranging from .18 to .24 were found between students' mean z-scores and survey responses to Item 18 (The pace of the online lessons works for me in this class), Item 34 (If I saw the teacher of this class outside this classroom, he or she would recognize me), Item 35 (The teacher in this class remembers my name), and Item 36 (My teacher treats all the students in this class the same). Additionally, a positive relationship of .15, which approached significance, was found between students' mean z-scores and survey responses to Item 19 (I feel challenged and engaged using the computer to help me learn). A reasonable inference can be made that these five instructional strategies are related to student academic achievement for PLATO coursework taken in a classroom/lab setting.

PLE System Data

The design of PLATO courses provides students with a comprehensive instructional experience. Students are presented with a variety of learning activities that begin with the presentation of new knowledge and skills, continue with the opportunity to practice new knowledge and concepts to gain facility and a deeper understanding of the instructional content, and ultimately lead to applying new knowledge and skills in real-world situations. PLE keeps track of student activity by tracking the time between when a student starts an activity and when he or she completes or closes the activity. Individual activity sessions get aggregated together in order to track a student's total time on task. It should be noted that if a student is inactive for more than 15 minutes in an activity session, the system automatically ends the time tracking for that session.

A significant positive relationship ($p < .05$) of .03 was found between students' EOS test z-scores and students' total time on task. Out of 6,299 students with valid EOS test z-scores in the data file, the average time on task per student ranged from 5.70 minutes to 40,155.96 minutes with an overall mean of 4,774.35 minutes. A significant positive relationship ($p < .05$) of .03 was also found between students' U1 posttest z-scores and students' total time on task. Of 8,499 students with valid U1 posttest z-scores in the data file, the average time on task per student ranged from 5.57 minutes to 199,834.62 minutes

with an overall mean of 4,781.87 minutes. Taken at face value, these findings suggest that a very small positive linear relationship was found between student achievement scores and students' total time on task. A reasonable inference can be made that as the amount of time students spend on a specific task increases, student achievement scores also increase. However, the size of the correlations that were found may be too small to be of significant practical value within the context of online learning. Further examination through follow-up studies may be warranted to establish a more reliable correlation between student achievement scores and students' total time on task within PLATO Learning's online solutions.

Teacher Pedagogical Practice Involving Content

As noted earlier, PLATO Learning's online solutions deliver instructional content to students (as opposed to direct instruction by teachers). As such, there were no items presented on the surveys that related to teachers' pedagogical practices involving content.

PLE System Data

PLE has a feature that allows teachers to customize PLATO course content. There are four main ways to customize a course: remove a lesson, change the sequence of lessons, add a PLATO lesson from a different course, or add an external lesson or activity provided by the teacher. Two of these variables were considered in this evaluation study: adding a PLATO lesson from a different course and adding an external lesson or activity.

A significant difference ($p < .05$) was found between students' mean z-scores for courses that were customized by teachers versus courses that were not customized. The difference between means favored the customized courses. It should be noted that all of the courses with a valid z-score featured the addition of a PLATO lesson. Therefore, a mean comparison for the use of additional PLATO lessons within customized courses was not possible. For courses that were customized, a significant difference ($p < .05$) was found between students' mean z-scores for courses that featured an external resource provided by the teacher versus courses that did not. The difference between means favored the courses with an external resource. Taken at face value, this finding suggests that students who took PLATO courses that were customized with the addition of an external lesson or activity provided by the teacher scored higher than students who took PLATO courses that were not customized. Further examination may be warranted to determine any additional factors contributing to the difference between group means.

PLATO courses include assessments at the lesson, unit, and semester level. Each unit has a pretest and a posttest. Performance on the pretest allows for highly individualized instruction, as students are exempted from content that they have mastered by virtue of pretest results. Any of these tests can be locked so that a student cannot take the test. Some teachers will lock pretests in order to control the pace a student moves through units, while others lock pretests in order to encourage a student to take every lesson in a unit regardless of prior

knowledge. After each lesson, students take a mastery test. A teacher can control how many tries a student gets on each mastery test before it locks as a way to prevent students from simply guessing their way to a passing score. Once a mastery test is locked, students need to ask the teacher to unlock it to make further attempts at showing mastery of that lesson.

A significant difference ($p < .05$) was found between students' mean z-scores for courses with pretests that were locked versus courses that did not have the pretests locked. The difference between means favored the courses in which the pretests were locked. Taken at face value, this finding suggests that students who took PLATO courses with the pretests locked scored higher than students who took courses with the pretests unlocked. Further examination may be warranted to determine any additional factors contributing to the difference between group means.

A significant difference ($p < .05$) was found between students' mean z-scores for lessons that had the mastery test unlocked by the teacher versus lessons that did not. The difference between means favored the lessons that had the mastery test unlocked by the teacher. Taken at face value, this finding suggests that students who needed to re-take a mastery test scored higher than students who passed the mastery test on the first attempt. Further examination may be warranted to determine any additional factors contributing to the difference between group means.

Conclusion

In The Art and Science of Teaching (2007), Marzano provided a comprehensive framework for effective teaching practices. Based on self-reported data, the teacher survey analyses indicate that the majority of teachers frequently implement many of these practices. However, the teachers in the sample did not perceive the frequency of their implementation of these strategies with the same consistency across the three instructional settings—pure virtual, blended, and classroom/lab. That said, it should be noted that student perceptions of the frequency of their teachers' implementation of the strategies were consistent across the three settings. The correlation analyses between students' z-scores and students' responses to survey items pertaining to teacher pedagogical practices indicate that some of the pedagogical practices—both routine events and those enacted on the spot—exhibited a positive linear relationship with student achievement in each of the three instructional settings. The correlation analyses between students' z-scores and the amount of time teachers were logged in to PLE indicate that a positive linear relationship was found between these two variables. The correlation analyses between students' z-scores and students' time on task within PLE indicate that a very small positive linear relationship was found between these two variables. However, the size of the correlations that were found may be too small to be of significant practical value within the context of online learning. Further examination through follow-up studies may be warranted to establish a more reliable correlation between student achievement scores and students' total time on task within PLE. The correlation analyses between students' z-scores and the average number of messages students sent using the PLE messaging feature indicate that a negative

linear relationship was found between these two variables. However, given the large percentage of students in the sample who did not use the feature, the correlations reported may not be representative of the true correlations between the variables. Finally, the comparison of students' mean z-scores for courses that were customized by teachers versus courses that were not customized indicates that, on average, students who took PLATO courses that were customized by adding an external lesson or activity provided by the teacher scored higher than students who took PLATO courses that were not customized. Taken at face value, these findings suggest that the role of the teacher within an online learning environment is very important. Given the positive effects on student achievement reported by Marzano (2007) for the strategies included in his framework, further examination of their use is warranted to determine potential barriers to implementation within each instructional setting and to provide additional support for best practices in PLATO Learning's online solutions.

I. Introduction

Marzano Research Laboratory (MRL) is an education research firm dedicated to improving public education. From its vision statement, MRL seeks "to continuously develop tools that translate high-quality education research into practical applications educators can put to use." Through its research efforts, MRL effectively provides analytic support and conducts action, evaluation, and assessment research projects to specifically support the improvement of education policy and practice. Working with state departments of education, districts, schools, and corporate entities, MRL's research extends support to a broad range of education practitioners.

During the 2010–2011 academic year, MRL was retained by PLATO Learning, Inc., to evaluate the relationship between student learning and effective teacher pedagogical practices with respect to the use of PLATO Learning's online solutions in three instructional settings: pure virtual, blended, and classroom/lab. For the purpose of this evaluation study, the pure virtual setting was indicated for students who completed all of their PLATO coursework outside of a traditional classroom. The blended setting was indicated for students who completed some of their PLATO coursework in a traditional classroom and some of their PLATO coursework online. Finally, the classroom/lab setting was indicated for students who completed all of their PLATO coursework in a traditional classroom or school computer lab.

PLATO Learning's online solutions have continued to evolve since 1960 when it was first launched as a computer assisted instructional system (Malikowski, 2008) that was funded through a National Science Foundation grant initiative. PLATO's programs continue to adapt to the changing needs of the education sector, specifically the increasing role of technology in the classroom. Course modules and varied instructional settings offered through PLATO allow schools to integrate technology with traditional teaching and learning. Today, PLATO's menu of assessments and programs for kindergarten students to adults includes considerations paramount to adequately teaching the 21st century learner.

Aligning with education policy directives, PLATO teaching and learning solutions aim to reduce drop-out rates and increase graduation rates, offer students greater choices in course content areas, prevent struggling learners from failing courses, and enable more schools to encourage students who excel to gain college credit through AP coursework. In the same way, its instructional settings address access challenges by offering learning in purely virtual learning environments, classrooms or computer labs located in traditional brick-and-mortar institutions, and in a blend of these settings. Additionally, to improve access and increase opportunity for certain learners, the role of the educator is examined to achieve consistently effective outcomes.

II. Program Overview

The Sample

A memorandum of understanding was sent to 376 teachers and 10,855 K–12 student participants at 32 sites across the country. These volunteer participants were also sought out based on enrollment across the four areas of course purpose:

Original credit: 91 teachers and 2,710 students
Credit recovery: 149 teachers and 4,703 students
Intervention: 133 teachers and 3,370 students
Advanced Placement: 3 teachers and 72 students (new program)

TOTAL: 376 teachers and 10,855 students

Responses were received from 1,828 students and 141 teacher participants at 23 sites located in 12 states: California, Florida, Iowa, Illinois, Indiana, Massachusetts, Maine, New Hampshire, New York, Ohio, Oklahoma, and Pennsylvania.

Any site for which both student and teacher survey data were not received was excluded from the study (see appendix A for a breakdown of study numbers by participating site). Of the total student sample, the majority of students indicated they applied PLATO Learning's online solutions to more than one course purpose and instructional setting.

Data fields captured by the survey included person-level identifier variables for both students and teachers as well as the PLATO course or title and name of assignment pursued. At the school level, the name of the school and instructor were also captured. (For the complete surveys administered to teachers and students, see appendices B and C.)

Measuring achievement

The survey also captured data related to student achievement. Within PLATO, pre- and posttests are administered to students in each course at a unit level. Semester-long courses contain approximately five to ten units each. Each unit

assessment may vary in the number of questions posed to students, falling within the range of 30 to 50 possible questions. Additionally, students are able to test out of certain lessons within units, thus exempting them from completing portions of units. Given this, it should be understood that a student will either master a unit's lessons by scoring an 80% or higher on lesson tests or by successfully completing the pretest.

Separate from the pre-and posttests administered through PLATO Learning's online solutions is an End-of-Semester (EOS) test. The EOS test is an additional assessment issued to students at the completion of each semester's courses to measure cumulative learning from all units within each course. Interestingly, End-of-Semester tests are not required of all students and are administered at the discretion of the teacher leaders at each implementation site and also based upon the course purpose (i.e., students who enroll in PLATO Learning's online solutions for the purpose of a course intervention do not complete a course in its entirety and therefore do not complete the EOS assessment).

Furthermore, students are also given the option to take the EOS test offline, simply completing the assessment after it has been printed onto a hard copy; some districts administer an assessment of their choosing in lieu of PLATO's EOS test. This flexibility offers teacher leaders at the school and district level opportunities to ensure alignment between PLATO coursework and the course objectives at the school. For example, if a student must retake a course through PLATO after receiving a failing grade at the home school, certain lesson objectives must be fulfilled if the coursework completed with PLATO is to fulfill the school and district requirements. In fact, there is flexibility in constructing the course modules specifically for this purpose. When students complete a unit within PLATO, the course objectives within PLATO are specifically aligned to the requirements—whether for the purpose of graduation, improved standing, or advanced standing.

Instructional Settings

PLATO Learning's online solutions are taken by students in three different environments: the purely virtual, onsite (classroom or lab settings), and blended learning environments. All three instructional settings involve a teacher leader who supports students' work by encouraging students to set goals, engaging with students and encouraging engagement among students and their peers, establishing and maintaining rules and procedures, building relationships, and effectively communicating expectations to students. These constructs were based on the Marzano Instructional Model (see Methodology section). Throughout the study, these constructs served as the theoretical framework against which PLATO Learning's online solutions were measured.

Course-Purpose Fields

To examine the consistency of teacher pedagogical practices within the three instructional settings (pure virtual, blended, and classroom/lab), student and teacher perceptions concerning the implementation of those practices were compared across PLATO coursework taken by students for these purposes:

original credit, credit recovery, intervention, and Advanced Placement. Original credit is used by students in good standing within their traditional classroom work to complete additional coursework taken beyond the traditional course offerings. Credit recovery affords students who have not successfully completed a course the opportunity to retake the course and fulfill the school or district level requirement. Credit recovery is a critical tool for districts working to augment graduation rates. Intervention enables students to relearn or supplement their learning in specific units—therefore not requiring completion of an entire unit—with the aim of preventing students from falling behind. Finally, Advanced Placement, the newest of PLATO's course-purpose models, provides students with established mastery in content areas the opportunity to earn college level credits. One critical advantage of Advanced Placement is that it provides access to students whose schools or districts may not otherwise offer an Advanced Placement program.

Within the context of meeting students' individual learning needs, PLATO Learning's online solutions offer students the opportunity to enroll in a wide range of content areas. Below is a full list of PLATO Courses titles:

Table 1. List of PLATO Courses

Course Topics Studied	
Algebra	English Literature
Anatomy And Physiology	Free Enterprise
Art Appreciation And History	French
British Literature	Ogt/Act Prep
Business Math	Reading
Computer Applications Technology	Research Tools And Skills 2010
Consumer Math/Money Management	Space Science
Creative Writing	Study Skills
Ecology	Visual & Performing Arts
ELA	World Affairs

III. Methodology

Study Design

The study employed a posttest-only design with nonequivalent groups, which is common in education research settings. The groups are the students registered to complete PLATO coursework in the four course-purpose areas. Students were measured on one dependent variable, also referred to as the outcome variable, here represented by student knowledge. Student knowledge was captured as the scores on End-of-Semester tests taken within PLATO Learning's online solutions. To capture student knowledge from PLATO coursework taken for intervention, the Unit 1 posttest scores were considered an additional dependent variable. The independent or predictor variables were student perceptions of teacher pedagogical practices within each of the three instructional settings.

Research Questions

The purpose of this research program was to evaluate effective pedagogical practices vis-à-vis PLATO Learning's online solutions, taking into consideration the instructional setting in which students completed their coursework. The research sought to isolate some best practices in online teaching and learning by exploring the practices, perceptions, and student learning outcomes for a study sample enrolled in grades K–12 and also across a broad scope of achievement levels in multiple states. Three evaluation questions were considered in the study:

- Evaluation Question 1: What is the relationship between students' academic achievement and teacher pedagogical practices in a pure virtual setting implementation of PLATO Learning's online solutions?
- Evaluation Question 2: What is the relationship between students' academic achievement and teacher pedagogical practices in a blended setting implementation of PLATO Learning's online solutions?
- Evaluation Question 3: What is the relationship between students' academic achievement and teacher pedagogical practices in a classroom/lab setting implementation of PLATO Learning's online solutions?

Before discussing the pedagogical practices of teacher participants of this study, it is necessary to provide a description of the framework used to guide the analysis that was performed.

The Marzano Instructional Model

The Marzano Instructional Model is based on a number of previous, related works, including *What Works in Schools: Translating Research into Action* (Marzano, 2003a), *Classroom Instruction That Works: Research-Based Strategies for Increasing Student Achievement* (Marzano, Pickering, & Pollock, 2001), *Classroom Management That Works: Research-Based Strategies for Every Teacher* (Marzano, 2003b), *Classroom Assessment and Grading That Work* (Marzano, 2006), *The Art and Science of Teaching: A Comprehensive Framework for Effective Instruction* (Marzano, 2007), and *Effective Supervision: Supporting the Art and Science of Teaching* (Marzano, Frontier, & Livingston, 2011). Each of these works was generated from a synthesis of the research and theory. Thus, the model can be considered an aggregation of the research on those elements that have traditionally been shown to correlate with student academic achievement. The model includes four domains:

Domain 1: Classroom Strategies and Behaviors
Domain 2: Preparing and Planning
Domain 3: Reflecting on Teaching
Domain 4: Collegiality and Professionalism

The four domains include 60 elements: 41 in Domain 1, 8 in Domain 2, 5 in Domain 3, and 6 in Domain 4. The specifics of each domain are outlined below. For a detailed discussion of these elements, see *Effective Supervision: Supporting the Art and Science of Teaching* (Marzano et al., 2011). A complete model of the domains can be found in appendix D.

Research Framework For The Marzano Model

Each of the works cited above, from which the model was developed, report substantial research on the elements they address. For example, The Art and Science of Teaching (Marzano, 2007) includes more than 25 tables reporting the research on the various elements of Domain 1. These tables report the findings from meta-analytic studies and the average effect sizes computed in these studies. In all, more than 5,000 studies (i.e., effect sizes) are covered in the tables representing research over the last five decades. The same can be said for the other titles listed above. Thus, one can say that the model was initially based on thousands of studies that span multiple decades and that these studies were chronicled and cataloged in books that have been widely disseminated in the United States. Specifically, more than 2 million copies of the books cited above have been purchased and disseminated to K–12 educators across the United States.

Experimental/Control Studies

Perhaps one of the more unique aspects of the research on this model is that a growing number of experimental/control studies have been conducted by practicing teachers on the effectiveness of specific strategies in their classrooms. This is unusual in the sense that these studies are designed to establish a direct causal link between elements of the model and student achievement. Studies that use correlation analysis techniques (see next section) can establish a link between elements of a model and student achievement, but causality cannot be easily inferred. Other evaluation models currently used throughout the country have correlational data only regarding the relationship between their elements and student achievement.

To date, more than 300 experimental/control studies have been conducted. These studies involved more than 14,000 students and 300 teachers across 38 schools in 14 districts (see Haystead & Marzano, 2009). The average effect size for strategies addressed in the studies was .42, with some studies reporting effect sizes of 2.00 and higher. An average effect size of .42 is associated with a 16 percentile-point gain in student achievement. Stated differently, on average, when teachers used the classroom strategies and behaviors in the model, their typical student achievement increased by 16 percentile-points. However, even larger gains (i.e., those associated with an effect size of 2.00) can be realized if specific strategies are used in specific ways.

Correlational Studies

As mentioned above, correlational studies are the most common approach to examining the validity of an evaluation model. Such studies have been and continue to be conducted on various elements of the Marzano Instructional Model. For example, such a study was conducted in Oklahoma as part of an examination of elements related to student achievement in K–12 schools (see What Works in Oklahoma Schools: Phase I Report [Marzano Research Laboratory, 2010] and What Works in Oklahoma School: Phase II Report [Marzano Research Laboratory, 2011]). These studies involved 59 schools, 1,117 teachers, and more than 13,000 K–12 students. Collectively, the

reports indicate positive relationships with various elements of the Marzano Instructional Model across the domains. Specific emphasis was placed on Domain 1, particularly in the Phase II report. Using state mathematics and reading test data, 96% of the 82 correlations (i.e., 41 correlations for mathematics and 41 for reading) were found to be positive, with some as high as .40 and greater. A .40 correlation translates to an effect size (i.e., standardized mean difference) of .87, which is associated with a 31 percentile-point gain in student achievement. These studies also aggregated data across the nine design questions in Domain 1. All correlations were positive for this aggregated data. Seven of those correlations ranged from .33 to .40. These correlations translate into effect sizes of .70 and higher. Relatively large correlations such as these were also reported for the total number of Domain 1 strategies teachers used in school. Specifically, the number of Domain 1 strategies teachers used in school had a .35 correlation with reading proficiency and a .26 correlation with mathematics proficiency.

Technology Studies

Another unique aspect of the research conducted on the model is that its effects have been examined in the context of technology. For example, a two-year study was conducted to determine (in part) the relationship between selected elements from Domain 1 and the effectiveness of interactive whiteboards in enhancing student achievement (see Marzano & Haystead, 2010). In all, 131 experimental/control studies were conducted across grade levels. Selected elements of Domain 1 were correlated with the effect sizes for use of the interactive whiteboards. All correlations for Domain 1 elements were positive, with some as high as .70. This implies that the effectiveness of interactive whiteboards as used in these 131 studies was greatly enhanced by the use of Domain 1 strategies.

In summary, the Marzano Instructional Model was designed using thousands of studies conducted over the past five or more decades and published in books that have been widely used by K–12 educators. In addition, experimental/control studies have been conducted that establish more direct causal linkages with enhanced student achievement than can be made with other types of data analysis. Correlational studies (the more typical approach to examining the viability of a model) have also been conducted, indicating positive correlations between the elements of the model and student mathematics and reading achievement. Finally, the model has been studied as to its effects on the use of technology (i.e., interactive whiteboards) and found to be highly correlated with the effectiveness of that technology.

PLATO Learning Online Solutions And The Marzano Instructional Model

Given the scope of this research study, an abbreviated set of design questions was extracted from Domain 1 of the Marzano Instructional Model, which supports effective pedagogical practice in terms of classroom behaviors and strategies. This abbreviated set of design questions is shown in table 2.

Table 2. Design Questions from the Marzano Model

The Design Questions Defined	
Design Question 1:	What will I do to establish and communicate learning goals, track student progress, and celebrate success?
Design Question 5:	What will I do to engage students?
Design Question 6:	What will I do to establish and maintain classroom rules and procedures?
Design Question 7:	What will I do to recognize and acknowledge adherence or lack of adherence to classroom rules and procedures?
Design Question 8:	What will I do to establish and maintain effective relationships with students?
Design Question 9:	What will I do to communicate high expectations for all students?

The student and teacher surveys were designed to directly align with the six design questions listed in table 2. Because PLATO Learning's online solutions deliver the instructional content to the students (as opposed to direct instruction by the teachers), these design questions were not addressed in the student and teacher surveys:

- Design Question 2: What will I do to help students effectively interact with new knowledge?
- Design Question 3: What will I do to help students practice and deepen their understanding of new knowledge?
- Design Question 4: What will I do to help students generate and test hypotheses about new knowledge?
- Design Question 10: What will I do to develop effective lessons organized into a cohesive unit?

IV. Analyses and Findings

For the primary analyses, one dependent variable, students' knowledge of academic content, was examined. The independent, or predictor, variables were student perceptions of teacher pedagogical practices within each of the three instructional settings.

Evaluation Questions

As mentioned previously, three evaluation questions were considered through a correlation analysis of student achievement scores (standardized into z-score format for comparison across content areas) and student survey responses to statements concerning teacher pedagogical practices:

- Evaluation Question 1: What is the relationship between students' academic achievement and teacher pedagogical practices in a pure virtual setting implementation of PLATO Learning's online solutions?
- Evaluation Question 2: What is the relationship between students'

academic achievement and teacher pedagogical practices in a blended setting implementation of PLATO Learning's online solutions?

- Evaluation Question 3: What is the relationship between students' academic achievement and teacher pedagogical practices in a classroom/lab setting implementation of PLATO Learning's online solutions?

IBM SPSS (2010) was the statistical software package used to conduct all data analyses. To establish whether perceptions of teacher pedagogical practice were consistent across the instructional settings and course purposes, comparisons were first made between the average teacher responses and average student responses for each of the design questions examined using the general linear model, specifically, analysis of variance (ANOVA). ANOVA is commonly used to determine whether the mean scores for each category of variable differ beyond what can be attributed to random sampling error. By convention, the threshold for determining a statistically significant difference between group means was set at the standard alpha of .05 (= .05). The null hypothesis (i.e., group means are equal) is tested by the ratio of the group mean square to the residual mean square (F-ratio). When the probability of observing an F-ratio as large (or larger) than the one reported is less than .05 ($p < .05$), the assumption of equal group means is likely false. In other words, there is a 95% probability that a true difference exists between the mean scores of the groups being compared. Stated in different terms, when the null hypothesis is actually true (i.e., group means are equal), an F-ratio larger than the one observed would occur less than 5% of the time across repeated samples. (For a more thorough discussion of statistical significance, see Harlow, Muliak, & Steiger, 1997, and Murphy & Myors, 2004; for a more detailed discussion of ANOVA, see Iversen & Norpoth, 1987).

A one-way ANOVA was first conducted to determine significant group comparisons between students' perceptions of how often their teachers implemented pedagogical practices selected from the Marzano Instructional Model in the three instructional settings (for further detail on the Marzano Instructional Model, see the methodology section and appendix D). A second one-way ANOVA was then conducted to compare students' perceptions of how often their teachers implemented select pedagogical practices in each of three course-purpose areas: original credit, credit recovery, and intervention.

Following the comparisons made between variables based on the student survey results, similar comparisons were then made based on the teachers' survey responses. The first was a one-way ANOVA comparing teachers' own perceived frequency of implementation of selected pedagogical practices in each of the instructional settings. A second one-way ANOVA then allowed for a comparison of teacher's perceived frequency of implementation of their pedagogical practices in each of the course-purpose areas. It should be noted that although teachers were asked to indicate whether they taught PLATO coursework for Advanced Placement, students were not given the choice to select Advanced Placement as one of their reasons for taking courses using PLATO Learning's online solutions; therefore, Advanced Placement was excluded from the second ANOVA.

To establish whether student and teacher perceptions of teacher pedagogical practice were consistent across instructional settings (pure virtual, blended, classroom/lab) and course purposes (original credit, credit recovery, intervention), comparisons were made between the aggregate student and teacher responses to survey items for each of these design questions from the Marzano Instructional Model:

- Teacher pedagogical practice involving routine events
  - o Design Question 1: What will I do to establish and communicate learning goals, track student progress, and celebrate success?
  - o Design Question 6: What will I do to establish and maintain classroom rules and procedures?
- Teacher pedagogical practice enacted on the spot
  - o Design Question 5: What will I do to engage students?
  - o Design Question 7: What will I do to recognize and acknowledge adherence or lack of adherence to classroom rules and procedures?
  - o Design Question 8: What will I do to establish and maintain effective relationships with students?
  - o Design Question 9: What will I do to communicate high expectations for all students?

As mentioned previously, PLATO Learning's online solutions deliver the instructional content to the students (as opposed to direct instruction by the teachers). Therefore, these design questions were not addressed in the student and teacher surveys:

- Teacher pedagogical practice involving content
  - o Design Question 2: What will I do to help students effectively interact with new knowledge?
  - o Design Question 3: What will I do to help students practice and deepen their understanding of new knowledge?
  - o Design Question 4: What will I do to help students generate and test hypotheses about new knowledge?
- Unit and lesson design
  - o Design Question 10: What will I do to develop effective lessons organized into a cohesive unit?

The analyses that followed examined the relationship between student survey responses and student achievement scores within four academic content areas—English language arts, mathematics, science, and social studies. Two different scores were standardized into z-score format—the End-of-Semester (EOS) test and Unit 1 (U1) posttest scores. It should be noted that students who take courses for the purpose of intervention do not take the EOS test.

Therefore, U1 posttest scores were also analyzed in order to include student test scores taken for that purpose. In all, 15,416 EOS test scores and 19,488 U1 posttest scores were considered valid scores for analysis and standardized into z-score format. (For a description of the z-score conversion process, see technical note 1.)

Finally, system variables collected within the PLATO Learning Environment (PLE) were examined to determine the extent to which various system tools were used and their influence on student academic achievement.

Analysis Of Student Perceptions Of Teacher Pedagogical Practices

What is the relationship between student perceptions of pedagogical practice based on instructional setting and course purpose?

Student survey items contained a combination of Likert-scaled items and global questions that were more descriptive in nature and asked the student to tell how a teacher practice, strategy, or behavior was implemented (see appendix B). For example:

Likert-Scaled Questions

My teacher helps me stay on task and focused while I work on my online course or assignments.
(0) Never; (1) Sometimes; (2) Frequently; (3) Always

Global Questions

When I have questions about my work on PLATO assignments, I ask my questions (Select all that apply.)
by sending an email; by meeting with the teacher face-to-face (in person); other (please specify); not applicable

These global "how" questions were posed to gain further information about the manner in which student-teacher interaction occurred in the various implementations of PLATO Learning's online solutions across the various schools and districts in the study sample population. Because multiple responses were allowed on the global questions for each student, this report focused on the single-response Likert-scaled items.

One-Way ANOVA—comparing student perceptions of pedagogical practice across instructional settings

For this analysis, student responses to the following statement were used to group students into one of the three instructional settings:

Which of the following best describe how you take your online course or assignments? (Select all that apply.)
- I do my entire class online; I do not go to a regular classroom.
- I do some of my work in a regular classroom and some of it online.
- I do all of my work in either a regular classroom or in a school computer lab.

Aggregates of student survey response scores were calculated to align with instructional design questions taken from the Marzano Instructional Model (explained in the methodology section and in appendix D). The aggregates are reported in table 3 (survey items can be found in appendix C):

Table 3. Design Questions Aligned with Student Survey Items

Design Questions Aligned with Student Survey Items						
Design Question 1	Item 5	Item 6	Item 13	Item 14	Item 16	
Design Question 5	Item 18	Item 19	Item 20	Item 21	Item 22	
Design Question 6	Item 9	Item 10	Item 11	Item 12		
Design Question 7	Item 30	Item 31	Item 32			
Design Question 8	Item 7	Item 24	Item 25	Item 33	Item 34	Item 35
Design Question 9	Item 27	Item 28	Item 36	Item 37		

Aggregates were calculated in such a way that missing values for the survey question resulted in a missing value for the design questions (i.e., where a blank appeared in the data set, a zero was not inserted because the survey response range was 0 to 3).

Table 4 lists the frequency counts for the survey items listed in table 3. (For a complete list of student survey response counts, see appendix E.)

Table 4. Student Survey Item Frequency Counts and Means

Frequency Counts and Means						
Survey Item	Always (3)	Frequently (2)	Sometimes (1)	Never (0)	No Response	Mean
Item 5: My teacher encourages me to set goals for my work.	744	441	374	112	3	2.09
Item 6: I have a clear understanding of the goal or objective in each assignment.	747	529	356	33	9	2.20
Item 7: I can ask the teacher any questions I have about my work on my online course or assignment.	1,080	255	270	59	10	2.42
Item 9: My teacher clearly communicates rules, procedures, and expectations for this course or assignment.	901	411	288	67	7	2.29
Item 10: My teacher reviews the rules and procedures for this course or assignment while I am working on it.	523	428	495	216	12	1.76
Item 11: I have a clear understanding of the rules and procedures for this course or assignment.	977	442	212	37	6	2.41

Item 12: I have all the materials and resources I need to complete my course or assignment.	1,060	356	211	33	14	2.47
Item 13: I keep track of my own learning progress.	826	499	285	54	10	2.26
Item 14: I communicate with my teacher about my progress.	474	446	542	203	9	1.72
Item 16: My teacher provides encouragement or positive feedback when I do well on my online course or assignments.	745	395	351	170	13	2.03
Item 18: The pace of the online lessons works for me in this class.	865	418	302	80	9	2.24
Item 19: I feel challenged and engaged using the computer to help me learn.	492	474	489	209	10	1.75
Item 20: My teacher allows me to communicate with other students through email or discussion tools available in the online course or assignment.	268	205	387	797	17	0.97
Item 21: My teacher helps me stay on task and focused while I work on my online course or assignments.	777	466	314	105	12	2.15
Item 22: When I am not focused in this class, my teacher helps me get back to work.	802	418	308	134	12	2.14
Item 24: When learning something new in my online course or assignments, I feel that my teacher provides the help I need to understand and practice new knowledge.	657	448	390	162	17	1.97
Item 25: When I send an email regarding questions I have about my online course or assignments, my teacher responds quickly.	511	367	314	446	36	1.58
Item 27: My teacher asks me questions about my learning in this class.	354	402	579	330	9	1.47
Item 28: The teacher explains that I am able to ask questions during this class.	897	385	275	105	12	2.25
Item 30: There are clear consequences when someone gets in trouble in this class.	818	385	357	108	6	2.15
Item 31: When I do something right in this class, my teacher acknowledges it.	606	434	413	213	8	1.86

Item 32: The teacher is paying attention to what I am doing in this class.	802	466	314	81	11	2.20
Item 33: The teacher in this class makes an effort to get to know a little about me.	541	410	467	242	14	1.75
Item 34: If I saw the teacher of this class outside this classroom, he or she would recognize me.	951	291	285	133	14	2.24
Item 35: The teacher in this class remembers my name.	1,250	203	158	49	14	2.60
Item 36: My teacher treats all students in this class the same.	1,087	282	200	92	13	2.42
Item 37: The teacher asks questions about how I am doing with my work in this class.	641	435	408	170	20	1.94

Table 4 (page 32) indicates that out of more than 1,600 students surveyed, the percentage of students who responded "frequently" or "always" to items related to teacher pedagogical practice involving routine events ranged from 55.3% (Item 14) to 85.3% (Item 12). The percentage of students who responded "frequently" or "always" to items related to teacher pedagogical practice enacted on the spot ranged from 28.5% (Item 20) to 87.5% (Item 35). With the exception of Items 10, 14, 16, 19, 20, 24, 25, 27, 31, 33, and 37, the percentage of students was greater than 70%.

Only students who indicated a single instructional setting were included in the analysis. In the ANOVA, instructional setting was considered the factor and aggregate student survey responses for each design question were considered dependent variables. For the purposes of this study, the first choice was labeled pure virtual, the second choice was labeled blended, and the third choice was labeled classroom/lab. Table 5 depicts the descriptive statistics for the teacher survey responses within each instructional setting for each of the design questions.

Table 5. Descriptives—Design Question Student Survey (Instructional Setting)

Descriptives					
Dependent Variable		**N**	**Mean**	**Std. Deviation**	**Maximum**
DQ1	Pure Virtual	799	10.3066	3.25058	15
	Blended	382	10.1754	3.30483	15
	Classroom/ Lab	333	10.5015	3.23723	15
	Total	1,514	10.3164	3.26121	15
DQ5	Pure Virtual	792	9.3409	3.31452	15
	Blended	383	9.0888	3.13107	15
	Classroom/ Lab	331	9.3776	3.26960	15

	Total	1,506	9.2849	3.25880	15
DQ6	Pure Virtual	794	8.9773	2.60845	12
	Blended	387	8.7494	2.55341	12
	Classroom/ Lab	335	9.2567	2.53710	12
	Total	1,516	8.9809	2.58307	12
DQ7	Pure Virtual	800	6.1988	2.37830	9
	Blended	392	6.2628	2.22169	9
	Classroom/ Lab	336	6.2530	2.31123	9
	Total	1,528	6.2271	2.32300	9
DQ8	Pure Virtual	772	12.5712	4.04211	18
	Blended	371	12.4555	4.03566	18
	Classroom/ Lab	323	12.7585	4.00511	18
	Total	1,466	12.5832	4.03097	18
DQ9	Pure Virtual	786	8.1285	2.95487	12
	Blended	381	8.1890	2.95421	12
	Classroom/ Lab	331	8.1601	3.11716	12
	Total	1,498	8.1509	2.98939	12

Individual survey questions were scored on a scale of 0 to 3. As such, aggregate question scores resulted in a final score per design question that was a multiple of the 0 to 3 scale. This can be seen in the rightmost column of table 5.

One of the underlying assumptions of ANOVA is that the variances for each group are equal. The test of homogeneity of variances provides a mechanism to evaluate whether the assumption of equal group variances has been met. Table 6 reports the findings from the homogeneity tests.

Table 6. Test of Homogeneity—Design Question Student Survey (Instructional Setting)

Test of Homogeneity of Variances				
Dependent Variable	**Levene Statistic**	**df1**	**df2**	**Sig.**
DQ1	0.029	2	1,511	0.972
DQ5	0.736	2	1,503	0.479
DQ6	0.003	2	1,513	0.997
DQ7	1.138	2	1,525	0.321
DQ8	0.087	2	1,463	0.917
DQ9	0.349	2	1,495	0.705

Because none of the tests reported in table 5 were statistically significant ($p > .05$), there is a 95% probability that this assumption was not violated in the ANOVAs. In other words, the group variances are likely to be similar. Table 7 lists the ANOVA findings for each design question pertaining to instructional setting.

Table 7. ANOVA—Design Question Student Survey (Instructional Setting)

ANOVA						
Dependent Variable		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
DQ1	Between Groups	19.081	2	9.540	0.897	0.408
	Within Groups	16,072.373	1,511	10.637		
	Total	16,091.454	1,513			
DQ5	Between Groups	20.064	2	10.032	0.945	0.389
	Within Groups	15,962.731	1,503	10.621		
	Total	15,982.795	1,505			
DQ6	Between Groups	46.244	2	23.122	3.477*	0.031
	Within Groups	10,062.202	1,513	6.650		
	Total	10,108.445	1,515			
DQ7	Between Groups	1.366	2	0.683	0.126	0.881
	Within Groups	82,38.832	1,525	5.403		
	Total	8,240.198	1,527			
DQ8	Between Groups	16.085	2	8.043	0.495	0.610
	Within Groups	23,788.262	1,463	16.260		
	Total	23,804.347	1,465			
DQ9	Between Groups	0.975	2	0.487	0.054	0.947
	Within Groups	13,376.929	1,495	8.948		
	Total	13,377.904	1,497			

* - $p < .05$.

Table 7 demonstrates that the mean responses for the aggregate design question scores vary significantly ($p < .05$) only with regard to Design Question 6 (What will I do to establish or maintain classroom rules and procedures?). This indicates that student perceptions of how often teachers implement pedagogical practices associated with Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?), Design Question 5 (What will I do to engage students?), Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?), Design Question 8 (What will I do to

establish and maintain effective relationships with students?), and Design Question 9 (What will I do to communicate high expectations for all students?) were consistent across all instructional settings.

In table 5 (page 34), the mean column shows the numeric validation for these statements:

- Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?): A mean score of 10.32 indicates an average response of 2 (10.32 divided by the total of 5 survey items) to the individual survey questions (corresponding to a label of Frequently), meaning students consistently indicated that teacher pedagogical practices associated with Design Question 1 are frequently applied in all settings of PLATO Learning's online solutions.

- Design Question 5 (What will I do to engage students?): A mean score of 9.29 indicates an average response of 2 (9.29 divided by the total of 5 survey items) to the individual survey questions (corresponding to a label of Frequently), meaning students consistently indicated that teacher pedagogical practices associated with Design Question 5 are frequently applied in all settings of PLATO Learning's online solutions.

- Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?): A mean score of 6.23 indicates an average response of 2 (6.23 divided by the total of 3 survey items) to the individual survey questions (corresponding to a label of Frequently), meaning students consistently indicated that teacher pedagogical practices associated with Design Question 7 are frequently applied in all settings of PLATO Learning's online solutions.

- Design Question 8 (What will I do to establish and maintain effective relationships with students?): A mean score of 12.58 indicates an average response of 2 (12.58 divided by the total of 6 survey items) to the individual survey questions (corresponding to a label of Frequently), meaning students consistently indicated that teacher pedagogical practices associated with Design Question 8 are frequently applied in all settings of PLATO Learning's online solutions.

- Design Question 9 (What will I do to communicate high expectations for all students?): A mean score of 8.20 indicates an average response of 2 (8.20 divided by the total of 4 survey items) to the individual survey questions (corresponding to a label of Frequently), meaning students consistently indicated that teacher pedagogical practices associated with Design Question 9 are frequently applied in all settings of PLATO Learning's online solutions.

Although ANOVA provides a mechanism for determining whether a significant difference between group means was found, it does not provide an indication of the actual differences between the group means. Therefore, post hoc mean comparison tests are often used. Table 8 depicts the findings from the post hoc mean difference tests between each of the instructional settings for the student survey.

Table 8. Mean Difference Test—Design Question Student Survey (Instructional Setting)

Mean Difference Test					
Dependent Variable	**(I) Instructional Setting**	**(J) Instructional Setting**	**Mean Difference (I – J)**	**Std. Error**	**Sig.**
DQ1[a]	Pure Virtual	Blended	0.13124	0.20287	0.794
	Pure Virtual	Classroom/ Lab	-0.19487	0.21273	0.630
	Blended	Classroom/ Lab	-0.32611	0.24452	0.377
DQ5[a]	Pure Virtual	Blended	0.25214	0.20283	0.428
	Pure Virtual	Classroom/ Lab	-0.03673	0.21330	0.984
	Blended	Classroom/ Lab	-0.28887	0.24457	0.465
DQ6[a]	Pure Virtual	Blended	0.22798	0.15988	0.328
	Pure Virtual	Classroom/ Lab	-0.27939	0.16801	0.220
	Blended	Classroom/ Lab	-0.50736*	0.19245	0.023
DQ7[a]	Pure Virtual	Blended	-0.06401	0.14330	0.896
	Pure Virtual	Classroom/ Lab	-0.05423	0.15110	0.931
	Blended	Classroom/ Lab	0.00978	0.17280	0.998
DQ8[a]	Pure Virtual	Blended	0.11572	0.25473	0.893
	Pure Virtual	Classroom/ Lab	-0.18727	0.26721	0.763
	Blended	Classroom/ Lab	-0.30299	0.30687	0.585
DQ9[a]	Pure Virtual	Blended	-0.06048	0.18673	0.944
	Pure Virtual	Classroom/ Lab	-0.03162	0.19600	0.986
	Blended	Classroom/ Lab	0.02886	0.22476	0.991

a. Tukey HSD Mean Difference Test
* - $p < .05$.

Looking at Design Question 6 (What will I do to establish or maintain classroom rules and procedures?) using the mean difference test (Tukey HSD), table 8 shows that mean responses to survey questions addressing the Marzano (2007) teaching strategies pertaining to the establishment of rules and procedures were higher in the classroom/lab setting than in the blended setting. This indicates that establishing rules and procedures was most frequently implemented in the classroom/lab setting, followed by pure virtual environments, and was least frequently implemented in the blended setting.

Type I and Type II Errors

In statistical significance testing, a Type I error occurs when the null hypothesis is erroneously rejected in favor of the alternative hypothesis. For example, if the null hypothesis for a significance test is that group means are equal, a Type I error arises when the significance test indicates that there is variation among group means, when the group means are in fact equal. This can lead to a false acceptance of the alternative hypothesis that group means are not equal. A Type II error occurs when the null hypothesis is not rejected when the alternative hypothesis is true. For example, a Type II error can lead to a false acceptance of the null hypothesis that group means are equal, when in fact they are truly different.

One method often used in social science research to help control for Type I error is the Bonferroni correction method. Using the Bonferroni correction method, each comparison would need a value of $p < .017$ ($= .05 \div 3 = .017$) to be considered statistically significant at the standard alpha of .05. However, it is worth considering that for any set of data, Type I and Type II errors are inversely related. In other words, the lower the risk of one type of error, the higher the risk of committing the other type of error (for a detailed discussion of Type I and Type II errors and the Bonferroni correction, see technical note 2). Therefore, none of the mean comparisons would be considered statistically significant when applying the more conservative Bonferroni correction. However, when taken at face value, the uncorrected findings for Design Question 6 (What will I do to establish or maintain classroom rules and procedures?) suggest a difference between student perceptions with respect to the frequency of teacher pedagogical practices related to establishing rules and procedures in the blended and classroom/lab settings: $F(2,1513) = 3.48$, $p < .05$.

One-Way ANOVA—comparing student perceptions of pedagogical practice across course-purpose areas

For this analysis, student responses to the following statement were used to group students into one of three course purposes:

> ***Which of the following best describe the reason why you are taking an online course or assignments?*** (Select all that apply.)
> • I am using it to take an entire class over.
> • I am using it to take an entire class for the first time.
> • I am using it to work on some of my assignments.

Only students who indicated a single course purpose were included in the analysis. In the ANOVA, course purpose was considered the factor and aggregate student survey responses for each design question were considered dependent variables. For the purposes of this study, the first choice was labeled credit recovery, the second choice was labeled original credit, and the third choice was labeled intervention. As noted earlier, students were not asked to indicate whether they took courses for Advanced Placement. Table 9 provides the

descriptive statistics for student survey responses within each course purpose area for each design question.

Table 9. Descriptives—Design Question Student Survey (Course Purpose)

Descriptives				
Dependent Variable		**N**	**Mean**	**Std. Deviation**
DQ1	Original Credit	378	10.6720	3.23251
	Credit Recovery	692	10.1257	3.20998
	Intervention	298	10.1611	3.41923
	Total	1,368	10.2844	3.26924
DQ5	Original Credit	379	9.4248	3.18919
	Credit Recovery	685	9.1839	3.25316
	Intervention	303	9.0693	3.26609
	Total	1,367	9.2253	3.23874
DQ6	Original Credit	373	9.0697	2.53798
	Credit Recovery	689	8.9869	2.53375
	Intervention	305	8.6820	2.88608
	Total	1,367	8.9415	2.61952
DQ7	Original Credit	381	6.2126	2.44399
	Credit Recovery	695	6.2446	2.26756
	Intervention	306	6.1438	2.32849
	Total	1,382	6.2135	2.32949
DQ8	Original Credit	369	10.0054	3.69120
	Credit Recovery	673	10.2734	3.53168
	Intervention	294	10.0306	3.52888
	Total	1,336	10.1460	3.57546
DQ9	Original Credit	376	8.1250	3.02396
	Credit Recovery	686	8.0948	2.94991
	Intervention	296	8.2500	2.99802
	Total	1,358	8.1370	2.97948

As demonstrated in table 9, the average response to the majority of survey questions addressing teaching strategies was “frequently,” indicating consistent implementation of the strategies overall. Table 10 lists the results of the homogeneity tests for this analysis.

Table 10. Test of Homogeneity—Design Question Student Survey (Course Purpose)

Test of Homogeneity of Variances				
Dependent Variable	Levene Statistic	df1	df2	Sig.
DQ1	0.595	2	1,365	0.552
DQ5	0.145	2	1,364	0.865
DQ6	3.927*	2	1,364	0.020
DQ7	1.248	2	1,379	0.287
DQ8	0.816	2	1,326	0.443
DQ9	0.536	2	1,355	0.585

* - $p < .05$.

Table 10 shows that the homogeneity of variance test for Design Question 6 (What will I do to establish or maintain classroom rules and procedures?) was statistically significant ($p < .05$), suggesting that the variances of the groups were significantly different. Although the ANOVA F-test is considered robust against violations of the assumption of homogeneity, the Games-Howell post hoc test was employed to take into account the unequal group variances. Tables 11 and 12 depict the ANOVA findings and post hoc analyses for the comparison of student survey responses between course-purpose areas.

Table 11. ANOVA—Design Question Student Survey (Course Purpose)

ANOVA						
Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.
DQ1	Between Groups	78.732	2	39.366	3.698*	0.025
	Within Groups	14,531.653	1,365	10.646		
	Total	14,610.385	1,367			
DQ5	Between Groups	23.629	2	11.815	1.127	0.324
	Within Groups	14,304.975	1,364	10.488		
	Total	14,328.604	1,366			
DQ6	Between Groups	28.097	2	14.049	2.050	0.129
	Within Groups	9,345.221	1,364	6.851		
	Total	9,373.318	1,366			
DQ7	Between Groups	2.160	2	1.080	0.199	0.820
	Within Groups	7,491.870	1,379	5.433		
	Total	7,494.030	1,381			
DQ8	Between Groups	51.726	2	25.863	1.575	0.207

	Within Groups	21,767.768	1,326	16.416		
	Total	21,819.494	1,328			
DQ9	Between Groups	5.058	2	2.529	0.285	0.752
	Within Groups	12,041.466	1,355	8.887		
	Total	12,046.524	1,357			

* - p < .05.

Table 12. Mean Difference Test—Design Question Student Survey (Course Purpose)

Mean Difference Test					
Dependent Variable	**(I) Instructional Setting**	**(J) Instructional Setting**	**Mean Difference (I – J)**	**Std. Error**	**Sig.**
DQ1[a]	Original Credit	Credit Recovery	0.54624*	0.20868	0.024
	Original Credit	Intervention	0.51088	0.25276	0.107
	Credit Recovery	Intervention	-0.03535	0.22607	0.987
DQ5[a]	Original Credit	Credit Recovery	0.24086	0.20732	0.476
	Original Credit	Intervention	0.35550	0.24957	0.329
	Credit Recovery	Intervention	0.11463	0.22343	0.865
DQ6[b]	Original Credit	Credit Recovery	0.08277	0.16305	0.868
	Original Credit	Intervention	0.38774	0.21114	0.159
	Credit Recovery	Intervention	0.30497	0.19138	0.249
DQ7[a]	Original Credit	Credit Recovery	-0.03201	0.14858	0.975
	Original Credit	Intervention	0.06881	0.17892	0.922
	Credit Recovery	Intervention	0.10081	0.15991	0.803
DQ8[a]	Original Credit	Credit Recovery	-0.31912	0.26359	0.447
	Original Credit	Intervention	0.14102	0.31751	0.897
	Credit Recovery	Intervention	0.46014	0.28344	0.236
DQ9[a]	Original Credit	Credit Recovery	0.03025	0.19128	0.986
	Original Credit	Intervention	-0.12500	0.23164	0.852
	Credit Recovery	Intervention	-0.15525	0.20731	0.734

[a.] Tukey HSD Mean Difference Test. [b.] Games-Howell Mean Difference Test

* - p < .05.

Using the mean difference test (Tukey HSD), table 12 indicates that mean responses to survey questions addressing the Marzano (2007) teaching strategies pertaining to Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?) was higher in the original credit group than in the credit recovery group. This suggests that instructional strategies related to establishing and communicating learning goals, tracking student progress, and celebrating success were most often implemented in the courses taken for original credit, followed by courses taken for intervention, and were implemented least often in courses taken for credit recovery.

Adjusting for Type I Error

Using the Bonferroni correction method, each comparison would need a value of $p < .017$ ($= .05 \div 3 = .017$) to be considered statistically significant at the standard alpha of .05. Therefore, none of the mean comparisons would be considered statistically significant when applying the more conservative Bonferroni correction. However, when taken at face value, the uncorrected findings for Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?) suggest a difference between student perceptions with respect to establishing and communicating learning goals, tracking student progress, and celebrating success within courses taken for original credit and credit recovery, $F(2,1365) = 3.70$, $p < .05$.

Analysis Of Teacher Perceptions Of Pedagogical Practices

What is the relationship between teacher self-perceptions of pedagogical practices vis-à-vis instructional setting and course purpose?

Teacher survey items contained a combination of both Likert-scaled items and global "how" questions that were more descriptive in nature, such as:

> **Likert-Scaled Questions**
> ***I ask my students to set goals for their work.***
> (0) Never; (1) Sometimes; (2) Frequently; (3) Always
>
> **Global Questions**
> ***I ask my students to set goals for their work via (Select all that apply.)***
> face-to-face discussion; virtual communication such as email or messages; other (please specify); not applicable

As was the case with the student survey analysis, only the Likert-scaled items were considered in the ANOVAs.

One-Way ANOVA—comparing teacher perceptions of pedagogical practice across instructional settings

For this analysis, teacher responses to the following statement were used to group teachers into one of the three instructional settings:

Which of these describe the instructional setting(s) you use to implement PLATO Learning solutions? (Select all that apply.)

- All learning is virtual with no face-to-face class time (pure virtual).
- Instruction is both virtual and in a classroom setting (blended).
- All instruction is in a traditional classroom or lab setting (classroom/lab).

Aggregates of teacher survey response scores were calculated to align with instructional design questions taken from the Marzano Instructional Model (see appendix D). The aggregates are reported in table 13 (survey items can be found in appendix C).

Table 13. Design Questions Aligned with Teacher Survey Items

Design Questions Aligned with Teacher Survey Items				
Design Question 1	**Item 4**	**Item 17**	**Item 19**	**Item 21**
Design Question 5	Item 30			
Design Question 6	Item 6	Item 7		
Design Question 7	Item 9	Item10		
Design Question 8	Item 11	Item 32	Item 33	Item 34
Design Question 9	Item 35	Item 36	Item 37	Item 39

Again, aggregates were calculated in such a way that missing values for a survey question resulted in a missing value for the design questions (i.e., where a blank appeared in the data set, a zero was not inserted because the survey response range was 0 to 3).

Table 14 lists the frequency counts for the survey items listed in table 13. (For a complete list of teacher survey response counts, see appendix F.)

Table 14. Teacher Survey Item Frequency Counts and Means

Frequency Counts and Means						
Survey Item	Always (3)	Frequently (2)	Sometimes (1)	Never (0)	No Response	Mean
Item 4: I ask my students to set goals for their work.	47	53	40	4	0	1.99
Item 6: I provide an orientation prior to students beginning the online course or assignment to communicate the rules, procedures, and my expectations.	89	18	29	8	0	2.31
Item 7: I review the rules and procedures with my students.	64	42	33	5	0	2.15
Item 9: There are clear consequences when a student breaks the rules.	74	36	28	5	1	2.25
Item 10: I publicly acknowledge and celebrate when a student adheres to rules and procedures.	39	47	41	16	1	1.76

Item 11: Students are able to ask me questions about their work during this class.	120	14	9	0	1	2.78
Item 17: I ask my students to keep track of their own learning progress.	65	46	26	7	0	2.17
Item 19: I talk individually with students regarding their progress.	49	76	19	0	0	2.21
Item 21: I celebrate students when they do well on PLATO assignments.	69	47	24	4	0	2.26
Item 30: I monitor students carefully in order to keep students on task and focused.	82	51	10	0	1	2.50
Item 32: I make a conscious effort to get to know the students in this class on a personal level.	89	36	17	2	0	2.47
Item 33: I recognize and acknowledge students outside this classroom.	82	40	19	3	0	2.40
Item 34: I know each student's name in this class.	125	12	6	1	0	2.81
Item 35: I ask students questions about their learning in this class.	64	56	23	0	1	2.29
Item 36: Students understand that they are able to ask questions during this class.	131	10	2	0	1	2.90
Item 37: I ask students questions about how they are doing with their work in this class.	79	56	9	0	0	2.49
Item 39: I treat all students equally in this class.	121	18	4	1	0	2.80

Table 14 shows that of 144 teachers surveyed, the percentage of teachers who responded "frequently" or "always" to items related to pedagogical practice involving routine events ranged from 69.4% (Item 4) to 86.8% (Item 19). The percentage of teachers who responded "frequently" or "always" to items related to pedagogical practice enacted on the spot ranged from 60.1% (Item 10) to 98.6% (Item 36). With the exception of Items 4 and 10, the percentage of teachers was greater than 70%.

As was the case for the analysis of student surveys, only teachers who indicated a single instructional setting were included in the analysis. In the ANOVA, instructional setting was considered the factor and aggregate teacher survey responses for each design question were considered dependent variables. Tables 15 through 18 provide the descriptive statistics, homogeneity tests, ANOVA findings, and post hoc tests for this analysis.

Table 15. Descriptives—Design Question Teacher Survey (Instructional Setting)

Descriptives					
Dependent Variable		**N**	**Mean**	**Std. Deviation**	**Maximum**
DQ1	Pure Virtual	42	7.6905	2.21401	12.00
	Blended	40	8.3250	2.08028	12.00
	Classroom/ Lab	45	9.8000	1.90215	12.00
	Total	127	8.6378	2.23844	12.00
DQ5	Pure Virtual	41	2.2927	0.71568	3.00
	Blended	40	2.4250	0.63599	3.00
	Classroom/ Lab	45	2.7111	0.50553	3.00
	Total	126	2.4841	0.64167	3.00
DQ6	Pure Virtual	42	3.5952	1.76773	6.00
	Blended	40	4.4250	1.53402	6.00
	Classroom/ Lab	45	5.0889	1.14460	6.00
	Total	127	4.3858	1.60874	6.00
DQ7	Pure Virtual	42	3.3095	1.86741	6.00
	Blended	40	4.0250	1.47609	6.00
	Classroom/ Lab	44	4.5682	1.30112	6.00
	Total	126	3.9762	1.63690	6.00
DQ8	Pure Virtual	42	9.4524	2.45150	12.00
	Blended	40	10.6250	1.33373	12.00
	Classroom/ Lab	44	11.0909	1.21652	12.00
	Total	126	10.3968	1.87650	12.00
DQ9	Pure Virtual	42	9.9286	1.48805	12.00
	Blended	40	10.0750	1.24833	12.00
	Classroom/ Lab	44	11.2273	1.03122	12.00
	Total	126	10.4286	1.38811	12.00

Table 16. Test of Homogeneity—Design Question Teacher Survey (Instructional Setting)

Test of Homogeneity of Variances				
Dependent Variable	**Levene Statistic**	**df1**	**df2**	**Sig.**
DQ1	0.109	2	124	0.897
DQ5	5.475**	2	123	0.005
DQ6	5.506**	2	124	0.005
DQ7	4.859**	2	123	0.009
DQ8	15.081***	2	123	0.000
DQ9	1.302	2	123	0.276

** - p < .01, *** - p < .001.

Table 17. ANOVA—Design Question Teacher Survey (Instructional Setting)

ANOVA						
Dependent Variable		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
DQ1	Between Groups	102.387	2	51.194	12.001***	0.000
	Within Groups	528.951	124	4.266		
	Total	631.339	126			
DQ5	Between Groups	3.961	2	1.981	5.128**	0.007
	Within Groups	47.507	123	0.386		
	Total	51.468	125			
DQ6	Between Groups	48.556	2	24.278	10.847***	0.000
	Within Groups	277.538	124	2.238		
	Total	326.094	126			
DQ7	Between Groups	34.182	2	17.091	6.990**	0.001
	Within Groups	300.747	123	2.445		
	Total	334.929	125			
DQ8	Between Groups	60.743	2	30.371	9.846***	0.000
	Within Groups	379.416	123	3.085		
	Total	440.159	125			
DQ9	Between Groups	43.569	2	21.785	13.582***	0.000
	Within Groups	197.288	123	1.604		
	Total	240.857	125	51.194		

** - p < .01, *** - p < .001.

Table 18. Mean Difference Test—Design Question Teacher Survey (Instructional Setting)

Mean Difference Test					
Dependent Variable	(I) Instructional Setting	(J) Instructional Setting	Mean Difference (I – J)	Std. Error	Sig.
DQ1[a]	Pure Virtual	Blended	-0.63452	0.45630	0.349
	Pure Virtual	Classroom/ Lab	-2.10952***	0.44312	0.000
	Blended	Classroom/ Lab	-1.47500**	0.44882	0.004
DQ5[a]	Pure Virtual	Blended	-0.13232	0.15035	0.654
	Pure Virtual	Classroom/ Lab	-0.41843**	0.13480	0.008
	Blended	Classroom/ Lab	-0.28611	0.12566	0.065
DQ6[b]	Pure Virtual	Blended	-0.82976	0.36501	0.066
	Pure Virtual	Classroom/ Lab	-1.49365***	0.32174	0.000
	Blended	Classroom/ Lab	-0.66389	0.29655	0.072
DQ7[a]	Pure Virtual	Blended	-0.71548	0.37081	0.137
	Pure Virtual	Classroom/ Lab	-1.25866**	0.34858	0.002
	Blended	Classroom/ Lab	-0.54318	0.30487	0.182
DQ8[a]	Pure Virtual	Blended	-1.17262*	0.43309	0.023
	Pure Virtual	Classroom/ Lab	-1.63853**	0.42039	0.001
	Blended	Classroom/ Lab	-0.46591	0.27947	0.224
DQ9[a]	Pure Virtual	Blended	-0.14643	0.27980	0.860
	Pure Virtual	Classroom/ Lab	-1.29870***	0.27321	0.000
	Blended	Classroom/ Lab	-1.15227***	0.27668	0.000

[a.] Tukey HSD Mean Difference Test. [b.] Games-Howell Mean Difference Test
* - $p < .05$.

As shown in table 16 (page 47), the homogeneity of variance tests were statistically significant ($p < .01$) for four of the six instructional design questions. To accommodate the unequal group variances, the Games-Howell post hoc test was used for Design Questions 5, 6, 7, and 8.

Tables 15 (page 46) and 17 (page 47) demonstrate that mean responses for the aggregate instructional design question scores vary significantly with all design questions ($p < .01$). This indicates that the frequency of implementation of pedagogical practice with respect to Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?), Design Question 5 (What will I do to engage students?),

Design Question 6 (What will I do to establish or maintain classroom rules and procedures?), Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?), Design Question 8 (What will I do to establish and maintain effective relationships with students?), and Design Question 9 (What will I do to communicate high expectations for all students?) occur differently between the groups and across the instructional settings according to teacher perceptions captured in the survey. As previously mentioned, ANOVA is fairly robust to violations to homogeneity of variance. A reasonable inference can be made that there were significant differences between teacher perceptions of their implementation of pedagogical practice within each of the three instructional settings.

The mean difference tests (Tukey HSD for Design Questions 1 and 9 and Games-Howell for Design Questions 5, 6, 7, and 8) reported in table 18 (page 48) indicate that teachers in the classroom/lab setting rated the frequency of their implementation of pedagogical practices higher than teachers in the pure virtual and blended instructional settings.

Adjusting for Type I Error

Again, using the Bonferroni correction method, each comparison would need a value of $p < .017$ ($= .05 \div 3 = .017$) to be considered statistically significant at the standard alpha of .05. For each instructional design question, the comparison of means between the pure virtual and classroom/lab settings meets the adjusted criterion. Therefore, the adjustment for Type I error suggests that a significant difference was found between the frequency of implementation of pedagogical practice in the pure virtual and classroom/lab settings. The comparison of means between the blended and classroom/lab settings only meets the adjusted criterion for Design Questions 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?) and 9 (What will I do to communicate high expectations for all students?). As such, with the exception of Design Questions 1 and 9, no significant difference was found between the frequency of implementation of pedagogical practice in the blended and classroom/lab settings. Finally, none of the comparisons of means between the pure virtual and blended settings meet the adjusted criterion. However, taken at face value, the uncorrected findings suggest that a significant difference may exist between the teachers' perceived frequency of implementation for Design Question 8 (What will I do to establish and maintain effective relationships with students?) in the pure virtual and blended settings.

One-Way ANOVA—comparing teacher perceptions of pedagogical practice across course-purpose areas

For this analysis, teacher responses to the following statement were used to group teachers into one of four course purposes:

> ***What student population(s) are you specifically addressing with PLATO Learning solutions?*** (Select all that apply.)
> • Original/first-time credit
> • Credit recovery
> • Intervention
> • Advanced Placement (AP)

As previously noted, Advanced Placement was excluded from the analysis because the student survey listed only original credit, credit recovery, and intervention as choices. Tables 19 through 22 list the descriptive statistics, homogeneity tests, ANOVA findings, and post hoc tests for this analysis.

Table 19. Descriptives—Design Question Teacher Survey (Course Purpose)

Descriptives					
Dependent Variable		**N**	**Mean**	**Std. Deviation**	**Maximum**
DQ1	Original Credit	9	8.0000	2.23607	12.00
	Credit Recovery	39	9.1538	2.36797	12.00
	Intervention	18	7.5000	2.89523	12.00
	Total	66	8.5455	2.57910	12.00
DQ5	Original Credit	9	2.6667	0.50000	3.00
	Credit Recovery	39	2.5897	0.63734	3.00
	Intervention	18	2.3889	0.60768	3.00
	Total	66	2.5455	0.61223	3.00
DQ6	Original Credit	9	3.5556	2.18581	6.00
	Credit Recovery	39	4.7949	1.45420	6.00
	Intervention	18	4.1667	1.79050	6.00
	Total	66	4.4545	1.69326	6.00
DQ7	Original Credit	9	3.0000	1.80278	6.00
	Credit Recovery	38	3.9211	1.53132	6.00
	Intervention	18	4.1667	1.79050	6.00
	Total	65	3.8615	1.65715	6.00
DQ8	Original Credit	9	8.1111	3.17980	12.00
	Credit Recovery	38	10.7632	1.54979	12.00
	Intervention	18	10.3333	1.84710	12.00
	Total	65	10.2769	2.08797	12.00
DQ9	Original Credit	9	8.8889	1.76383	11.00
	Credit Recovery	39	10.7949	1.28103	12.00
	Intervention	18	10.6111	1.28973	12.00
	Total	66	10.4848	1.48057	12.00

Table 20. Test of Homogeneity—Design Question Teacher Survey (Course Purpose)

Test of Homogeneity of Variances				
Dependent Variable	**Levene Statistic**	**df1**	**df2**	**Sig.**
DQ1	1.489	2	63	0.233
DQ5	0.509	2	63	0.604
DQ6	2.240	2	63	0.115
DQ7	0.439	2	62	0.647
DQ8	7.042**	2	62	0.002
DQ9	1.255	2	63	0.292

** - p < .01.

Table 21. ANOVA—Design Question Teacher Survey (Course Purpose)

ANOVA						
Dependent Variable		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
DQ1	Between Groups	36.787	2	18.393	2.929	0.061
	Within Groups	395.577	63	6.279		
	Total	432.364	65			
DQ5	Between Groups	0.650	2	0.325	0.863	0.427
	Within Groups	23.714	63	0.376		
	Total	24.364	65			
DQ6	Between Groups	13.282	2	6.641	2.417	0.097
	Within Groups	173.081	63	2.747		
	Total	186.364	65			
DQ7	Between Groups	8.491	2	4.245	1.574	0.215
	Within Groups	167.263	62	2.698		
	Total	175.754	64			
DQ8	Between Groups	51.258	2	25.629	6.977**	0.002
	Within Groups	227.757	62	3.674		
	Total	279.015	64			
DQ9	Between Groups	26.959	2	13.48o	7.351**	0.001
	Within Groups	115.526	63	1.834		
	Total	142.485	65			

** - p < .01.

Table 22. Mean Difference Test—Design Question Teacher Survey (Course Purpose)

Mean Difference Test					
Dependent Variable	**(I) Instructional Setting**	**(J) Instructional Setting**	**Mean Difference (I – J)**	**Std. Error**	**Sig.**
DQ1[a]	Original Credit	Credit Recovery	-1.15385	0.92664	0.431
	Original Credit	Intervention	0.50000	1.02299	0.877
	Credit Recovery	Intervention	1.65385	0.71403	0.061
DQ5[a]	Original Credit	Credit Recovery	0.07692	0.22688	0.939
	Original Credit	Intervention	0.27778	0.25047	0.512
	Credit Recovery	Intervention	0.20085	0.17482	0.488
DQ6[b]	Original Credit	Credit Recovery	-1.23932	0.61295	0.115
	Original Credit	Intervention	-0.61111	0.67667	0.640
	Credit Recovery	Intervention	0.62821	0.47231	0.384
DQ7[a]	Original Credit	Credit Recovery	-0.92105	0.60889	0.292
	Original Credit	Intervention	-1.16667	0.67055	0.199
	Credit Recovery	Intervention	-0.24561	0.46997	0.861
DQ8[a]	Original Credit	Credit Recovery	-2.65205	1.08934	0.088
	Original Credit	Intervention	-2.22222	1.14586	0.175
	Credit Recovery	Intervention	0.42982	0.50274	0.672
DQ9[a]	Original Credit	Credit Recovery	-1.90598**	0.50077	0.001
	Original Credit	Intervention	-1.72222**	0.55283	0.008
	Credit Recovery	Intervention	0.18376	0.38587	0.883

[a.] Tukey HSD Mean Difference Test. [b.] Games-Howell Mean Difference Test
* - p < .01.

Table 20 (page 51) shows that the homogeneity of variance test for Design Question 8 (What will I do to establish and maintain effective relationships with students?) was statistically significant (p < .01), suggesting unequal variances between groups. Therefore, the Games-Howell post hoc test was employed for Design Question 8.

Table 21 (page 51) indicates a significant difference (p < .01) between course-purpose groups for Design Questions 8 (What will I do to establish and maintain effective relationships with students?) and 9 (What will I do to communicate high expectations for all students?). These findings suggest that a difference was

found in teachers' reported frequency in their pedagogical practices with respect to Design Questions 8 and 9 between PLATO coursework taken for the three course purposes. The mean difference test (Games-Howell) for Design Question 8 indicates that none of the between-group differences were statistically significant. Again, the Games-Howell test was used because equal variance is not an underlying assumption. The mean difference test (Tukey HSD) for Design Question 9 shows that the differences between original credit and credit recovery and between original credit and intervention were significant ($p < .01$).

Adjusting for Type I Error

Again, using the Bonferroni correction method, each comparison would need a value of $p < .017$ ($= .05 \div 3 = .017$) to be considered statistically significant at the standard alpha of .05. After applying the adjusted criterion, the ANOVAs for Design Questions 8 (What will I do to establish and maintain effective relationships with students?) and 9 (What will I do to communicate high expectations for all students?) would be considered significant at the .05 level ($p < .05$). However, when using a post hoc mean comparison test appropriate for unequal variances (see table 22, page 53), the mean comparisons for Design Question 8 were not significant ($p > .05$). The adjustment for Type I error indicates that a significant difference was found for Design Question 9 between the frequency of implementation of pedagogical practice in courses taken for the purpose of original credit and credit recovery. The findings also show that a significant difference was found between the frequency of implementation of pedagogical practice in courses taken for the purpose of original credit and intervention. Therefore, the findings for Design Question 9 (What will I do to communicate high expectations for all students?) suggest a significant difference between the teachers' perceived frequency of implementation between the different course purposes with respect to communicating expectations to students ($F(2,63) = 7.35$, $p < .01$).

Analysis Of Assessment Scores

What is the relationship between teacher pedagogical practice and student achievement in the three instructional settings?

To analyze students' achievement scores across domains (i.e., various academic content areas), the End-of-Semester (EOS) test and Unit 1 (U1) posttest scores were first standardized into z-score format within the academic content areas of English language arts, mathematics, science, and social studies (see technical note 1 for the method used for z-score conversion). In all, 15,416 EOS test scores and 19,488 U1 posttest scores were considered valid scores for analysis and standardized into z-score format.

In educational research, it is often worth considering the relationship between student and teacher perceptions of teacher pedagogical practices and student academic achievement. One mechanism for assessing the relationship is through a correlation analysis of student and teacher survey responses and student test scores. It is important to keep in mind that correlation does not prove causation. Additional evidence is often required to support any claim of a causal influence of one variable on another. However, a generalized causal inference can be supported by a strong correlation between variables. To examine these

relationships, a correlation analysis was employed between the valid z-scores and the student response variables within each of the instructional design questions previously described.

In social science research, a common measure of the linear relationship between two continuous variables is Pearson's product-moment coefficient (Pearson's r), which is based on an assumption of a normal distribution in the variables. A nonparametric alternative suitable to ordinal data is Spearman's rho ( ). Spearman's is considered a special case of Pearson's r in which the data are converted to ranks before calculating the coefficient. Because the survey response variables are ordinal in nature, Spearman's was used.

It should be noted that some of the students had multiple z-scores in the data file. As such, mean z-scores were calculated for each student and placed into one of three instructional settings by filtering on students' survey responses to the question:

> ***Which of the following best describe how you take your online course or assignments?*** (Select all that apply.)
> • I do my entire class online; I do not go to a regular classroom.
> • I do some of my work in a regular classroom and some of it online.
> • I do all of my work in either a regular classroom or in a school computer lab.

As mentioned previously, only students who reported a single instructional setting were included in the analysis. An assumption was made that students' test scores were from PLATO coursework taken in the instructional setting indicated by the survey response.

Correlation Analysis—What is the relationship between teacher pedagogical practice and student achievement in a pure virtual setting?

Table 23 shows the correlations between students' mean standardized achievement scores and their survey responses within the pure virtual setting for Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?).

Table 23. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 1 (Pure Virtual Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 5: My teacher encourages me to set goals for my work.	EOS	0.023	339	0.673
	U1	0.032	394	0.526
Item 6: I have a clear understanding of the goal or objective in each assignment.	EOS	0.058	337	0.291
	U1	0.086	393	0.090
Item 13: I keep track of my own learning progress.	EOS	-0.028	338	0.602
	U1	0.046	394	0.359

Item 14: I communicate with my teacher about my progress.	EOS	-0.023	338	0.671
	U1	0.012	394	0.807
Item 16: My teacher provides encouragement or positive feedback when I do well on my online course or assignments.	EOS	0.065	338	0.231
	U1	0.123*	393	0.014

* - p < .05.

As presented in the student survey, the items in Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?) seek to establish the frequency of implementation of teacher pedagogical practices with respect to establishing and communicating learning goals, tracking student progress, and celebrating student success. Table 23 shows that, in the pure virtual setting, none of the correlations between the students' mean EOS test z-scores and survey responses were significant (p > .05). However, the correlation between the students' mean U1 posttest z-scores and survey responses to Item 16 (My teacher provides encouragement or positive feedback when I do well on my online courses or assignments) was significant (= .12, N = 393, p = .014).

Table 24 lists the correlations between students' mean standardized achievement scores and their survey responses within the pure virtual setting for Design Question 5 (What will I do to engage students?).

Table 24. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 5 (Pure Virtual Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 18: The pace of the online lessons works for me in this class.	EOS	-0.041	339	0.455
	U1	0.038	395	0.447
Item 19: I feel challenged and engaged using the computer to help me learn.	EOS	0.035	339	0.524
	U1	0.034	395	0.505
Item 20: My teacher allows me to communicate with other students through email or discussion tools available in the online course or assignment.	EOS	-0.051	337	0.347
	U1	-0.025	393	0.618
Item 21: My teacher helps me stay on task and focused while I work on my online course or assignments.	EOS	-0.038	336	0.487
	U1	0.028	391	0.579
Item 22: When I am not focused in this class, my teacher helps me get back to work.	EOS	0.017	339	0.761
	U1	0.041	395	0.420

* - p < .05.

As presented in the student survey, the items in Design Question 5 (What will I do to engage students?) seek to establish the frequency of implementation of teacher pedagogical practices and other factors related to student engagement.

Table 24 indicates that, in the pure virtual setting, none of the correlations between the students' mean z-scores and survey responses were significant ($p > .05$).

Table 25 depicts the correlations between students' mean standardized achievement scores and their survey responses within the pure virtual setting for Design Question 6 (What will I do to establish or maintain classroom rules and procedures?).

Table 25. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 6 (Pure Virtual Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 9: My teacher clearly communicates rules, procedures, and expectations for this course or assignment.	EOS	0.011	339	0.846
	U1	0.094	395	0.061
Item 10: My teacher reviews the rules and procedures for this course or assignment while I am working on it.	EOS	0.058	337	0.289
	U1	0.075	394	0.135
Item 11: I have a clear understanding of the rules and procedures for this course or assignment.	EOS	0.083	338	0.127
	U1	0.124*	394	0.014
Item 12: I have all the materials and resources I need to complete my course or assignment.	EOS	0.024	336	0.665
	U1	0.109*	393	0.031

* - $p < .05$.

As presented in the student survey, the items in Design Question 6 (What will I do to establish or maintain classroom rules and procedures?) seek to establish the frequency of implementation of teacher pedagogical practices with respect to establishing or maintaining classroom rules and procedures. Table 25 (page 56) shows that, in the pure virtual setting, none of the correlations between the students' mean EOS test z-scores and survey responses were significant ($p > .05$). However, the correlations between students' mean U1 posttest z-scores and survey responses to Item 11 (I have a clear understanding of the rules and procedures for this course or assignment) and Item 12 (I have all the materials and resources I need to complete my course or assignment) were significant (Item 11: = .12, N = 394, p = .014; Item 12: = .11, N = 393, p = .031).

Table 26 shows the correlations between students' mean standardized achievement scores and their survey responses within the pure virtual setting for Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?).

Table 26. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 7 (Pure Virtual Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 30: There are clear consequences when someone gets in trouble in this class.	EOS	-0.003	339	0.962
	U1	0.015	394	0.764
Item 31: When I do something right in this class, my teacher acknowledges it.	EOS	0.012	337	0.828
	U1	0.059	392	0.247
Item 32: The teacher is paying attention to what I am doing in this class.	EOS	0.027	335	0.618
	U1	0.101*	389	0.047

* - $p < .05$.

As presented in the student survey, the items in Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?) seek to establish the frequency of implementation of teacher pedagogical practices with respect to recognizing and acknowledging adherence and lack of adherence to classroom rules and procedures. Table 26 indicates that, in the pure virtual setting, none of the correlations between the students' mean EOS test z-scores and survey responses were significant ($p > .05$). However, the correlation between students' mean U1 posttest z-scores and survey responses to Item 32 (The teacher is paying attention to what I am doing in this class) was significant (= .10, N = 89, p = .047).

Table 27 displays the correlations between students' mean standardized achievement scores and their survey responses within the pure virtual setting for Design Question 8 (What will I do to establish and maintain effective relationships with students?).

Table 27. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 8 (Pure Virtual Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 7: I can ask the teacher any questions I have about my work on my online course or assignment.	EOS	0.027	338	0.622
	U1	0.059	394	0.245
Item 24: When learning something new in my online course or assignments, I feel that my teacher provides the help I need to understand and practice new knowledge.	EOS	0.076	335	0.166
	U1	0.061	391	0.227
Item 25: When I send an email regarding questions I have about my online course or assignments, my teacher responds quickly.	EOS	-0.046	335	0.402
	U1	0.009	389	0.852

Item 33: The teacher in this class makes an effort to get to know a little about me.	EOS	0.043	335	0.430
	U1	0.019	390	0.706
Item 34: If I saw the teacher of this class outside this classroom, he or she would recognize me.	EOS	0.016	336	0.775
	U1	0.031	391	0.538
Item 35: The teacher in this class remembers my name.	EOS	0.018	336	0.743
	U1	0.122*	390	0.015

* - $p < .05$.

As presented in the student survey, the items in Design Question 8 (What will I do to establish and maintain effective relationships with students?) seek to establish the frequency of implementation of teacher pedagogical practices with respect to establishing and maintaining effective relationships with students. Table 27 shows that, in the pure virtual setting, none of the correlations between the students' mean EOS test z-scores and survey responses were significant ($p > .05$). However, the correlation between students' mean U1 z-scores and survey responses to Item 35 (The teacher in this class remembers my name) was significant (= .12, N = 390, p = .015).

Table 28 lists the correlations between students' mean standardized achievement scores and their survey responses within the pure virtual setting for Design Question 9 (What will I do to communicate high expectations for all students?).

Table 28. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 9 (Pure Virtual Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 27: My teacher asks me questions about my learning in this class.	EOS	-0.004	339	0.946
	U1	0.014	394	0.787
Item 28: The teacher explains that I am able to ask questions during this class.	EOS	0.047	338	0.385
	U1	0.039	392	0.437
Item 36: My teacher treats all students in this class the same.	EOS	0.018	336	0.745
	U1	0.007	390	0.895
Item 37: The teacher asks questions about how I am doing with my work in this class.	EOS	-0.005	333	0.923
	U1	-0.003	388	0.956

* - $p < .05$.

As presented in the student survey, the items in Design Question 9 (What will I do to communicate high expectations for all students?) seek to establish the frequency of implementation of teacher pedagogical practices with respect to communicating high expectations for all students. Table 28 (page 58) indicates that, in the pure virtual setting, none of the correlations between the students' mean z-scores and survey responses were significant ($p > .05$).

Correlation Analysis—What is the relationship between teacher pedagogical practice and student achievement in a blended setting?

Table 29 lists the correlations between students' mean standardized achievement scores and their survey responses within the blended setting for Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?).

Table 29. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 1 (Blended Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 5: My teacher encourages me to set goals for my work.	EOS	-0.039	125	0.666
	U1	0.100	166	0.199
Item 6: I have a clear understanding of the goal or objective in each assignment.	EOS	0.109	124	0.229
	U1	0.082	165	0.297
Item 13: I keep track of my own learning progress.	EOS	0.077	124	0.394
	U1	0.138	165	0.077
Item 14: I communicate with my teacher about my progress.	EOS	-0.075	124	0.410
	U1	-0.048	165	0.542
Item 16: My teacher provides encouragement or positive feedback when I do well on my online course or assignments.	EOS	-0.013	124	0.889
	U1	0.152	165	0.051

* - $p < .05$.

Table 29 shows that, in the blended setting, none of the correlations between the students' mean z-scores and student responses to survey items from Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?) were significant ($p > .05$). However, It is worth noting that the correlation between the students' mean U1 posttest z-scores and survey responses to Item 16 (My teacher provides encouragement or positive feedback when I do well on my online course or assignments) approaches significance at the standard alpha of .05 (= .15, N = 165, p = .051).

Table 30 displays the correlations between students' mean standardized achievement scores and their survey responses within the blended setting for Design Question 5 (What will I do to engage students?).

Table 30. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 5 (Blended Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 18: The pace of the online lessons works for me in this class.	EOS	-0.036	125	0.688
	U1	0.188*	166	0.015
Item 19: I feel challenged and engaged using the computer to help me learn.	EOS	-0.179*	125	0.046
	U1	-0.093	166	0.233
Item 20: My teacher allows me to communicate with other students through email or discussion tools available in the online course or assignment.	EOS	-0.128	123	0.160
	U1	0.022	165	0.778
Item 21: My teacher helps me stay on task and focused while I work on my online course or assignments.	EOS	-0.163	124	0.070
	U1	0.001	164	0.993
Item 22: When I am not focused in this class, my teacher helps me get back to work.	EOS	0.030	125	0.740
	U1	0.076	165	0.334

* - $p < .05$.

Table 30 indicates that, in the blended setting, one of the correlations between the students' mean EOS test z-scores and student responses on survey items from Design Question 5 (What will I do to engage students?) was significant (Item 19 [I feel challenged and engaged using the computer to help me learn]: = -.18, N = 125, p = .015). Also, the correlation between students' mean U1 posttest z-scores and survey responses to Item 18 (The pace of the online lessons works for me in this class) was significant (= .19, N = 166, p = .015).

Table 31 depicts the correlations between students' mean standardized achievement scores and their survey responses within the blended setting for Design Question 6 (What will I do to establish or maintain classroom rules and procedures?).

Table 31. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 6 (Blended Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 9: My teacher clearly communicates rules, procedures, and expectations for this course or assignment.	EOS	-0.065	124	0.472
	U1	0.045	165	0.563
Item 10: My teacher reviews the rules and procedures for this course or assignment while I am working on it.	EOS	-0.199*	125	0.026
	U1	-0.042	166	0.594

Item 11: I have a clear understanding of the rules and procedures for this course or assignment.	EOS	0.152	125	0.090
	U1	0.161*	166	0.038
Item 12: I have all the materials and resources I need to complete my course or assignment.	EOS	-0.069	125	0.442
	U1	0.057	165	0.471
Item 22: When I am not focused in this class, my teacher helps me get back to work.	EOS	0.030	125	0.740
	U1	0.076	165	0.334

* - p < .05.

Table 31 reveals that, in the blended setting, one of the correlations between the students' mean EOS test z-scores and student responses on survey items from Design Question 6 (What will I do to establish or maintain classroom rules and procedures?) was significant (Item 10 [My teacher reviews the rules and procedures for this course or assignment while I am working on it]: = -.20, N = 125, p = .026). Also, the correlation between students' mean U1 posttest z-scores and survey responses to Item 11 (I have a clear understanding of the rules and procedures for this course or assignment) was significant (= .16, N = 166, p = .038).

Table 32 shows the correlations between students' mean standardized achievement scores and their survey responses within the blended setting for Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?).

Table 32. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 7 (Blended Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 30: There are clear consequences when someone gets in trouble in this class.	EOS	0.052	123	0.570
	U1	0.087	164	0.266
Item 31: When I do something right in this class, my teacher acknowledges it.	EOS	-0.104	125	0.247
	U1	0.056	166	0.476
Item 32: The teacher is paying attention to what I am doing in this class.	EOS	-0.104	125	0.247
	U1	0.054	166	0.492

* - p < .05.

Table 32 indicates that, in the blended setting, none of the correlations between the students' mean z-scores and student responses to survey items from Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?) were significant (p > .05).

Table 33 displays the correlations between students' mean standardized achievement scores and their survey responses within the blended setting for Design Question 8 (What will I do to establish and maintain effective relationships with students?).

Table 33. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 8 (Blended Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 7: I can ask the teacher any questions I have about my work on my online course or assignment.	EOS	-0.063	125	0.487
	U1	0.097	165	0.214
Item 24: When learning something new in my online course or assignments, I feel that my teacher provides the help I need to understand and practice new knowledge.	EOS	-0.067	125	0.459
	U1	0.188*	164	0.016
Item 25: When I send an email regarding questions I have about my online course or assignments, my teacher responds quickly.	EOS	0.077	123	0.396
	U1	0.087	163	0.267
Item 33: The teacher in this class makes an effort to get to know a little about me.	EOS	0.016	124	0.860
	U1	0.099	165	0.205
Item 34: If I saw the teacher of this class outside this classroom, he or she would recognize me.	EOS	-0.058	125	0.522
	U1	0.012	166	0.875
Item 35: The teacher in this class remembers my name.	EOS	-0.019	125	0.831
	U1	0.060	166	0.441

* - $p < .05$.

Table 33 shows that, in the blended setting, none of the correlations between the students' mean EOS test z-scores and student responses to survey items from Design Question 8 (What will I do to establish and maintain effective relationships with students?) were significant ($p > .05$). However, the correlation between students' mean U1 posttest z-scores and survey responses to Item 24 (When learning something new in my online course or assignments, I feel that my teacher provides the help I need to understand and practice new knowledge) was significant (= .19, N = 164, p = .016).

Table 34 lists the correlations between students' mean standardized achievement scores and their survey responses within the blended setting for Design Question 9 (What will I do to communicate high expectations for all students?).

Table 34. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 9 (Blended Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 27: My teacher asks me questions about my learning in this class.	EOS	-0.157	124	0.081
	U1	0.046	164	0.557
Item 28: The teacher explains that I am able to ask questions during this class.	EOS	0.081	125	0.367
	U1	0.164*	165	0.036

Item 36: My teacher treats all students in this class the same.	EOS	0.017	125	0.849
	U1	0.020	165	0.803
Item 37: The teacher asks questions about how I am doing with my work in this class.	EOS	-0.084	123	0.353
	U1	0.050	164	0.523

* - p < .05.

Table 34 indicates that, in the blended setting, none of the correlations between the students' mean EOS test z-scores and student responses to survey items from Design Question 9 (What will I do to communicate high expectations for all students?) were significant (p > .05). However, the correlation between students' mean U1 posttest z-scores and survey responses to Item 28 (The teacher explains that I am able to ask questions during this class) was significant (= .16, N = 165, p = .036).

Correlation Analysis—What is the relationship between teacher pedagogical practice and student achievement in a classroom/lab setting?

Table 35 shows the correlations between students' mean standardized achievement scores and their survey responses within the classroom/lab setting for Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?).

Table 35. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 1 (Classroom/Lab Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 5: My teacher encourages me to set goals for my work.	EOS	-0.171	130	0.051
	U1	-0.038	159	0.633
Item 6: I have a clear understanding of the goal or objective in each assignment.	EOS	0.056	130	0.527
	U1	0.158*	159	0.047
Item 13: I keep track of my own learning progress.	EOS	0.229**	128	0.009
	U1	0.154	157	0.054
Item 14: I communicate with my teacher about my progress.	EOS	-0.071	129	0.423
	U1	0.067	158	0.401
Item 16: My teacher provides encouragement or positive feedback when I do well on my online course or assignments.	EOS	0.081	130	0.359
	U1	0.152	159	0.056

* - p < .05.

Table 35 reveals that, in the classroom/lab setting, one of the correlations between the students' mean EOS test z-scores and student responses to survey items from Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?) was significant

(Item 13 [I keep track of my own learning progress]: = .23, N = 128, p = .009). Also, the correlation between students' mean U1 posttest z-scores and survey responses to Item 6 (I have a clear understanding of the goal or objective in each assignment) was significant (= .16, N = 159, p = .047). It is worth noting that the correlation between students' mean EOS test z-scores and survey responses to Item 5 (My teacher encourages me to set goals for my work) approached significance at the .05 level (= -.17, N = 130, p = .051). The correlations between students' mean U1 posttest z-scores and survey responses to Item 13 (I keep track of my own learning progress) and Item 16 (My teacher provides encouragement or positive feedback when I do well on my online course or assignments) also approached statistical significance (Item 13: = .15, N = 157, p = .054; Item 16: = .15, N = 159, p = .056).

Table 36 displays the correlations between students' mean standardized achievement scores and their survey responses within the classroom/lab setting for Design Question 5 (What will I do to engage students?).

Table 36. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 5 (Classroom/Lab Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 18: The pace of the online lessons works for me in this class.	EOS	0.053	129	0.552
	U1	0.181*	156	0.023
Item 19: I feel challenged and engaged using the computer to help me learn.	EOS	0.026	128	0.774
	U1	0.152	156	0.059
Item 20: My teacher allows me to communicate with other students through email or discussion tools available in the online course or assignment.	EOS	-0.050	129	0.572
	U1	-0.009	157	0.907
Item 21: My teacher helps me stay on task and focused while I work on my online course or assignments.	EOS	0.003	130	0.976
	U1	0.081	159	0.310
Item 22: When I am not focused in this class, my teacher helps me get back to work.	EOS	0.121	130	0.170
	U1	0.096	158	0.229

* - p < .05.

Table 36 indicates that, in the classroom/lab setting, none of the correlations between the students' mean EOS test z-scores and student responses on survey items from Design Question 5 (What will I do to engage students?) were significant (p > .05). However, the correlation between students' mean U1 posttest z-scores and survey responses to Item 18 (The pace of the online lessons works for me in this class) was significant (= .18, N = 156, p = .023). Also, it is worth noting that the correlation between students' mean U1 posttest z-scores and survey responses to Item 19 (I feel challenged and engaged using the computer to help me learn) approached significance at the standard alpha of .05 (= .15, N = 156, p = .059).

Table 37 shows the correlations between students' mean standardized achievement scores and their survey responses within the classroom/lab setting for Design Question 6 (What will I do to establish or maintain classroom rules and procedures?).

Table 37. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 6 (Classroom/Lab Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 9: My teacher clearly communicates rules, procedures, and expectations for this course or assignment.	EOS	-0.043	129	0.632
	U1	0.074	159	0.355
Item 10: My teacher reviews the rules and procedures for this course or assignment while I am working on it.	EOS	-0.053	130	0.549
	U1	0.059	159	0.463
Item 11: I have a clear understanding of the rules and procedures for this course or assignment.	EOS	0.089	130	0.316
	U1	0.204*	159	0.010
Item 12: I have all the materials and resources I need to complete my course or assignment.	EOS	0.066	130	0.453
	U1	0.178*	159	0.025
Item 22: When I am not focused in this class, my teacher helps me get back to work.	EOS	0.121	130	0.170
	U1	0.096	158	0.229

* - $p < .05$.

Table 37 shows that, in the classroom/lab setting, none of the correlations between the students' mean EOS test z-scores and student responses on survey items from Design Question 6 (What will I do to establish or maintain classroom rules and procedures?) were significant ($p > .05$). However, the correlations between students' mean U1 posttest z-scores and survey responses to Item 11 (I have a clear understanding of the rules and procedures for this course or assignment) and Item 12 (I have all the materials and resources I need to complete my course or assignment) were significant (Item 11: = .20, N = 159, p = .010; Item 12: = .18, N = 159, p = .025).

Table 38 depicts the correlations between students' mean standardized achievement scores and their survey responses within the classroom/lab setting for Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?).

Table 38. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 7 (Classroom/Lab Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 30: There are clear consequences when someone gets in trouble in this class.	EOS	0.065	129	0.463
	U1	0.144	158	0.071
Item 31: When I do something right in this class, my teacher acknowledges it.	EOS	0.063	130	0.474
	U1	0.188*	159	0.018
Item 32: The teacher is paying attention to what I am doing in this class.	EOS	0.046	130	0.600
	U1	0.123	159	0.124

* - p < .05.

Table 38 reveals that, in the classroom/lab setting, none of the correlations between the students' mean EOS test z-scores and student responses to survey items from Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?) were significant (p > .05). However, the correlation between students' mean U1 posttest z-scores and survey responses to Item 31 (When I do something right in this class, my teacher acknowledges it) was significant (= .19, N = 159, p = .018).

Table 39 lists the correlations between students' mean standardized achievement scores and their survey responses within the classroom/lab setting for Design Question 8 (What will I do to establish and maintain effective relationships with students?).

Table 39. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 8 (Classroom/Lab Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 7: I can ask the teacher any questions I have about my work on my online course or assignment.	EOS	-0.035	128	0.698
	U1	0.106	157	0.186
Item 24: When learning something new in my online course or assignments, I feel that my teacher provides the help I need to understand and practice new knowledge.	EOS	-0.011	129	0.901
	U1	0.061	158	0.449
Item 25: When I send an email regarding questions I have about my online course or assignments, my teacher responds quickly.	EOS	0.011	130	0.905
	U1	0.141	158	0.076
Item 33: The teacher in this class makes an effort to get to know a little about me.	EOS	-0.105	129	0.237
	U1	0.122	157	0.129
Item 34: If I saw the teacher of this class outside this classroom, he or she would recognize me.	EOS	-0.039	128	0.663
	U1	0.182*	157	0.023
Item 35: The teacher in this class remembers my name.	EOS	0.049	129	0.580
	U1	0.182*	158	0.022

* - p < .05.

Table 39 indicates that, in the classroom/lab setting, none of the correlations between the students' mean EOS test z-scores and student responses to survey items from Design Question 8 (What will I do to establish and maintain effective relationships with students?) were significant ($p > .05$). However, the correlations between students' mean U1 posttest z-scores and survey responses to Item 34 (If I saw the teacher of this class outside this classroom, he or she would recognize me) and Item 35 (The teacher in this class remembers my name) were significant (Item 34: = .18, N = 157, p = .023; Item 35: = .18, N = 158, p = .022).

Table 40 displays the correlations between students' mean standardized achievement scores and their survey responses within the classroom/lab setting for Design Question 9 (What will I do to communicate high expectations for all students?).

Table 40. Correlation—Student Mean Standardized Achievement Scores and Survey Responses for Design Question 9 (Classroom/Lab Setting)

Correlation				
Survey Item	Mean Z-Score	Spearman's *p*	N	Sig.
Item 27: My teacher asks me questions about my learning in this class.	EOS	-0.026	130	0.766
	U1	0.104	159	0.193
Item 28: The teacher explains that I am able to ask questions during this class.	EOS	-0.097	128	0.275
	U1	0.064	157	0.426
Item 36: My teacher treats all students in this class the same.	EOS	0.041	129	0.648
	U1	0.244**	158	0.002
Item 37: The teacher asks questions about how I am doing with my work in this class.	EOS	-0.066	128	0.462
	U1	0.026	157	0.743

* - $p < .05$.

Table 40 shows that, in the classroom/lab setting, none of the correlations between the students' mean EOS test z-scores and student responses to survey items from Design Question 9 (What will I do to communicate high expectations for all students?) were significant ($p > .05$). However, the correlation between students' mean U1 posttest z-scores and survey responses to Item 36 (My teacher treats all the students in this class the same) was significant (= .24, N = 158, p = .002).

Analysis Of PLATO Learning Environment System Variables

System variables collected within the PLATO Learning Environment (PLE) were examined to determine the extent to which various system tools were used and their influence on student academic achievement.

Teachers' Time On System

Once teachers have logged in to PLE, they can provide feedback to students, communicate learning goals and expectations, establish rules and procedures, track student progress, and customize instructional content. As with any online instructional solution, teachers log in to PLE to use the features of the system. A session is the period of time from when a teacher logs in until he or she logs out. The total number of sessions per teacher provides a picture of how often teachers use PLE to engage with a course or class of students. For each session, the PLE system keeps track of how long each teacher was logged in to the system. Note that if teachers do not actively log out of the system, their sessions end after one hour of inactivity in PLE.

Table 41 shows the descriptive statistics for the PLE system variables related to teachers' time on system for courses with valid EOS test and U1 posttest z-scores. Although the PLE system records the time in seconds in the variables, the values were converted to minutes for ease of discussion.

Table 41. Descriptives—Teachers' Time on System

Correlation						
PLE System Variable	Z-Score	N	Mean	Std. Deviation	Minimum	Maximum
The total amount of time (in minutes) teachers were logged in to the system	EOS	281	6,055.5057	6,770.95977	0.00	31,869.80
	U1	332	5,353.2707	6,499.38692	0.00	31,869.80
The number of times teachers were logged in to the system	EOS	281	89.9100	88.42000	0.00	778.00
	U1	332	80.8193	85.48909	0.00	778.00
The average amount of time (in minutes) the teachers were logged in to the system per session	EOS	281	58.1952	34.66069	0.00	218.12
	U1	332	55.3582	34.03761	0.00	218.12

* - $p < .05$.

Table 41 indicates that the total amount of time teachers were logged in to the PLE system across all classes for the courses with valid EOS test z-scores ranged from 0.00 minutes to 31,869.80 minutes, with an overall mean of 6,055.51 minutes. The number of times teachers were logged in to the PLE system across all classes for the courses with valid EOS test z-scores ranged from 0.00 sessions to 778.00 sessions, with an overall mean of 89.91 sessions. The average amount of time teachers were logged in to the PLE system per session across all classes for the courses with valid EOS test z-scores ranged from 0.00 minutes to 218.12 minutes, with an overall mean of 58.20 minutes. Similar patterns were observed for the courses with valid U1 z-scores. Taken at face value, these findings indicate that on the average, teachers spent more than 80 hours logged in to the PLE system across all of their classes. In addition, the overall average time teachers were logged in to the PLE system was close to one hour per session across all of their classes.

Table 42 displays the findings from a correlation analysis between the PLE

system variables related to teachers' time on system and students' mean z-scores (averaged by teacher).

Table 42. Correlation—Student Mean Standardized Achievement Scores and Teachers' Time on System

Correlation				
PLE System Variable	Mean Z-Score	Pearson's r	N	Sig.
The total amount of time (in minutes) teachers were logged in to the system	EOS	0.255**	281	0.000
	U1	0.135*	332	0.014
The number of times teachers were logged in to the system	EOS	0.238**	281	0.000
	U1	0.126*	332	0.022
The average amount of time (in seconds) the teachers were logged in to the system per session	EOS	0.156**	281	0.009
	U1	0.039	332	0.481

* - $p < .05$, ** - $p < .01$.

Table 42 reveals that all of the correlations between students' EOS test z-scores (averaged by teacher) and the PLE system variables related to teachers' time on system were statistically significant ($p < .01$). Additionally, the correlations between students' U1 posttest z-scores (averaged by teacher) and both the total amount of time (in minutes) that teachers were logged in to the system across all classes and the number of times teachers were logged in to the system across all classes were significant ($p < .05$).

Students' Time On Task

The design of PLATO courses provides students with a comprehensive instructional experience. Students are presented with a variety of learning activities that begin with the presentation of new knowledge and skills, followed by the ability to practice new knowledge and concepts to gain facility and a deeper understanding of the instructional content and by the opportunity to apply new knowledge and skills in real-world situations. PLE keeps track of student activity by tracking the time between when a student starts an activity and when the student completes or closes the activity. Individual activity sessions are aggregated to track the total time on task for a student. It should be noted that if a student is inactive for more than 15 minutes in an activity session, the system automatically ends the time tracking for that session.

Table 43 shows the descriptive statistics for the PLE system variable related to students' average time on task for courses with valid EOS test and U1 posttest z-scores. Although the PLE system records the time in seconds in the variables, the values were converted into minutes for ease of discussion.

Table 43. Descriptives—Students' Time on Task

Correlation						
PLE System Variable	Z-Score	N	Mean	Std. Deviation	Minimum	Maximum
Students' average time on task (in minutes)	EOS	6,299	4,774.3482	3,961.13175	5.70	40,155.96
	U1	8,499	4,781.8668	4,570.82397	5.57	199,834.62

Table 43 indicates that the students' average time on task for the courses with valid EOS test z-scores ranged from 5.70 minutes to 40,155.96 minutes with an overall mean of 4,774.35 minutes. The students' average time on task for the courses with valid U1 posttest z-scores ranged from 5.57 minutes to 199,834.62 minutes with an overall mean of 4,781.87 minutes. Taken at face value, these findings indicate that students averaged more than 79 hours across all activity sessions within PLE.

Table 44 lists the findings from a correlation analysis between the PLE system variable related to students' time on task and students' mean z-scores.

Table 44. Correlation—Student Mean Standardized Achievement Scores and Students' Time on Task

Correlation				
PLE System Variable	Mean Z-Score	Pearson's r	N	Sig.
Students' average time on task (in minutes)	EOS	0.027*	6,299	0.033
	U1	0.025*	8,499	0.021

* - $p < .05$, ** - $p < .01$.

Table 44 reveals that all of the correlations between students' mean z-scores and the PLE system variable related to students' time on task were statistically significant ($p < .05$).

PLE Messaging Feature

PLE includes a messaging feature that is essentially an email system that allows teachers to communicate with students, and vice versa. This feature allows teachers to communicate classroom rules and procedures, share learning goals and expectations, and celebrate student success. Teachers have the ability to send messages to individual students, a class, or other teachers, while students can send messages to teachers. It should be noted that students cannot send messages to each other using the internal PLE messaging feature. Student messages are those sent by individual students, and teacher messages are those sent by individual teachers.

Table 45 lists the descriptive statistics for the PLE system variables related to the PLE messaging feature for courses with valid EOS test and U1 posttest z-scores. It should be noted that students and teachers who did not use the messaging feature were excluded from the analyses.

Table 45. Descriptives—PLE Messaging Feature

Correlation						
PLE System Variable	Z-Score	N	Mean	Std. Deviation	Minimum	Maximum
The average number of messages sent by students across all of their classes	EOS	2,152	3.9317	6.31203	0.07	83.00
	U1	2,634	3.9784	5.87427	0.07	83.00
The average number of messages sent by teachers across all of their classes	EOS	187	15.2868	48.82883	0.01	502.00
	U1	209	15.2761	46.74494	0.01	502.00

Table 45 shows that for the courses with valid EOS test z-scores, the average number of messages sent by students using the PLE messaging feature across all of their classes ranged from 0.07 messages to 83.00 messages, with an overall mean of 3.93 messages. The average number of messages sent by teachers across all of their classes ranged from 0.01 messages to 502.00 messages, with an overall mean of 15.29 messages. For the courses with valid U1 posttest z-scores, the average number of messages sent by students using the PLE messaging feature across all of their classes ranged from 0.07 messages to 83.00 messages, with an overall mean of 3.98 messages. The average number of messages sent by teachers across all of their classes ranged from 0.01 messages to 502.00 messages, with an overall mean of 15.28 messages. Taken at face value, these findings indicate that, on average, students sent about 4 messages and teachers sent about 15 messages using the PLE messaging feature across all of their classes. Again, these descriptives reflect the average number of messages sent by students and teachers across their respective classes. Students and teachers who did not send any messages using the PLE messaging feature were excluded from the analyses.

Table 46 displays the findings from a correlation analysis between the PLE system variables related to the PLE messaging feature and students' mean z-scores (averaged by student and by teacher).

Table 46. Correlation—Student Mean Standardized Achievement Scores and PLE Messaging Feature

Correlation				
PLE System Variable	Mean Z-Score	Pearson's r	N	Sig.
The average number of messages sent by students across all of their classes	EOS	-0.166***	2,152	0.000
	U1	-0.123***	2,634	0.000
The average number of messages sent by teachers across all of their classes	EOS	0.061	187	0.406
	U1	0.034	209	0.626

*** - $p < .001$.

Table 46 displays the correlations between students' EOS test z-scores (averaged by student and by teacher) and the PLE system variables related to the PLE messaging feature. Significant negative correlations ($p < .001$) were found students' mean z-scores and the average number of messages sent by students

across all of their classes. However, none of the correlations between students' mean z-scores (averaged by teacher) and the average number of messages sent by teachers across all of their classes were significant ($p > .05$).

Course Custom

PLE has a feature that allows teachers to customize the course content provided by PLATO. There are four main ways to customize a course: removing a lesson, changing the sequence of lessons, adding a PLATO lesson from a different course, and adding an external lesson provided by the teacher. Two PLE system variables were considered in this evaluation study: the addition of a PLATO lesson and the addition of an external lesson or activity.

Table 45 provides the descriptive statistics and comparison of means for the PLE system variables related to course customization with valid EOS test and U1 posttest z-scores.

Table 47. Comparison of Means—Course Customization

Desciptives							
PLE System Variable		N	Mean Z-Score	Std. Deviation	t	df	Sig.
Course customization (valid EOS z-score)	Yes	7,226	0.174	0.97171	20.611***	15,269a	0.000
	No	8,190	-0.154	0.99933			
Course customization (valid U1 z-score)	Yes	8,701	0.176	0.97575	22.361***	18,778a	0.000
	No	10,787	-0.142	0.99673			
Addition of PLATO resource (valid EOS z-score)	Yes	7,226	0.174	0.97171	--	--	--
	No	--	--	--			
Addition of PLATO resource (valid U1 z-score)	Yes	8,701	0.176	0.97575	--	--	--
	No	--	--	--			
Addition of external resource (valid EOS z-score)	Yes	953	0.446	0.80886	10.809***	1,421a	0.000
	No	6,273	0.133	0.98762			
Addition of external resource (valid U1 z-score)	Yes	1,269	0.413	0.78674	11.161***	2,036a	0.000
	No	7,432	0.135	0.99888			

a. Equal variances between groups not assumed, adjusted degrees of freedom used in the analysis.

*** - $p < .001$.

Table 47 shows that a significant difference ($p < .001$) was found between students' mean z-scores for courses that were customized by teachers versus courses that were not customized. The difference between means favored the customized courses. It should be noted that all of the courses with a valid z-score featured the addition of a PLATO lesson. Therefore, a mean comparison for the use of additional PLATO lessons within customized courses was not possible. For courses that were customized, a significant difference ($p < .001$) was found between students' mean z-scores for courses that featured an external resource provided by the teacher versus courses that did not. The difference between

means favored the courses with an external resource.

Test Locking Feature

PLATO courses include assessments at the lesson, unit, and semester level. Each unit has a pretest and a posttest. Performance on the pretest allows for highly individualized instruction, as students are exempted from content that they have mastered by virtue of pretest results. Any of these tests can be locked so that a student cannot take the test. Some teachers will lock pretests to control the pace at which a student moves through units, while others lock pretests to encourage a student to take every lesson in a unit regardless of prior knowledge. After each lesson, students take a mastery test. To prevent students from simply guessing their way to a passing score, teachers can control how many tries a student gets on each mastery test before it locks. Once a mastery test is locked, students need to ask the teacher to unlock it to make further attempts at showing mastery of that lesson.

Table 48 displays the descriptive statistics and comparison of means for the PLE system variables related to the test locking feature with valid EOS test and U1 posttest z-scores.

Table 48. Comparison of Means—Test Locking Feature

Desciptives							
PLE System Variable		N	Mean Z-Score	Std. Deviation	t	df	Sig.
Pretest locking (valid EOS z-score)	Yes	5,318	0.087	0.93034	8.121***	11,823a	0.000
	No	10,098	-0.046	1.03175			
Pretest locking (valid U1 z-score)	Yes	6,591	0.096	0.93452	9.875***	14,443a	0.000
	No	12,897	-0.049	1.02835			
Mastery test locking (valid EOS z-score)	Yes	7,942	0.059	0.95563	7.560***	15,092a	0.000
	No	7,474	-0.063	1.04128			
Mastery test locking (valid U1 z-score)	Yes	9,861	0.050	0.98019	7.103***	19,414a	0.000
	No	9,627	-0.051	1.01722			

a. Equal variances between groups not assumed, adjusted degrees of freedom used in the analysis.

*** - $p < .001$.

Table 48 indicates that a significant difference ($p < .001$) was found between students' mean z-scores for courses with a locked pretest and courses that did not have the pretest locked. The difference between means favored the courses in which the pretest was locked. Also, a significant difference ($p < .001$) was found between students' mean z-scores for lessons that had the mastery test unlocked by the teacher versus lessons that did not. The difference between means favored the lessons that had the mastery test unlocked by the teacher.

V. Summary And Interpretation

As its primary focus, the evaluation study sought to answer these questions:

- Evaluation Question 1: What is the relationship between students' academic achievement and teacher pedagogical practices in a pure virtual setting implementation of PLATO Learning's online solutions?

- Evaluation Question 2: What is the relationship between students' academic achievement and teacher pedagogical practices in a blended setting implementation of PLATO Learning's online solutions?

- Evaluation Question 3: What is the relationship between students' academic achievement and teacher pedagogical practices in a classroom/lab setting implementation of PLATO Learning's online solutions?

To establish whether student and teacher perceptions of teacher pedagogical practice were consistent across instructional settings (pure virtual, blended, classroom/lab) and course purposes (original credit, credit recovery, intervention), the study made comparisons between the aggregate student and teacher responses to survey items for each of these design questions from the Marzano Instructional Model:

- Teacher pedagogical practice involving routine events
    - o Design Question 1: What will I do to establish and communicate learning goals, track student progress, and celebrate success?
    - o Design Question 6: What will I do to establish and maintain classroom rules and procedures?
- Teacher pedagogical practice enacted on the spot
    - o Design Question 5: What will I do to engage students?
    - o Design Question 7: What will I do to recognize and acknowledge adherence or lack of adherence to classroom rules and procedures?
    - o Design Question 8: What will I do to establish and maintain effective relationships with students?
    - o Design Question 9: What will I do to communicate high expectations for all students?

The survey findings can be summarized by these statements:

- None of the mean comparisons between instructional settings on the student survey would be considered statistically significant when applying the more conservative Bonferroni correction, $p < .017$ ($= .05 \div 3 = .017$). However, when taken at face value, the uncorrected findings for Design Question 6 (What will I do to establish or maintain classroom rules and procedures?) suggest a difference between student perceptions with respect to the frequency of teacher pedagogical practices related to establishing rules and procedures in the blended and classroom/lab settings, which favors the classroom/lab setting: $F(2,1513) = 3.48$, $p = .031$.

A reasonable inference can be made that, with the exception of Design Question 6, the frequency of implementation of teaching strategies involving both routine events and those enacted on the spot seems to be consistent across PLATO coursework taken in the pure virtual, blended, and classroom/lab settings.

- None of the mean comparisons between course purposes on the student survey would be considered statistically significant when applying the more conservative Bonferroni correction, $p < .017$ ($= .05 \div 3 = .017$). However, when taken at face value, the uncorrected findings for Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?) suggest a difference between student perceptions with respect to the frequency of teacher pedagogical practices related to establishing and communicating learning goals, tracking student progress, and celebrating success within courses taken for original credit and credit recovery: $F(2,1365) = 3.70$, $p = .025$. The mean difference favors courses taken for original credit.

A reasonable inference can be made that, with the exception of Design Question 1, the frequency of implementation of teaching strategies involving both routine events and those enacted on the spot seems to be consistent across PLATO coursework taken for the purposes of original credit, credit recovery, and intervention.

- The Bonferroni adjustment for Type I error suggests that a significant difference ($p < .05$) was found between the frequency of teachers' self-perceived implementation of pedagogical practice across instructional settings for all design questions:
  - Design Question 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?): $F(2,124) = 12.00$, $p = .000$
  - Design Question 5 (What will I do to engage students?): $F(2,123) = 5.13$, $p = .007$
  - Design Question 6 (What will I do to establish or maintain classroom rules and procedures?): $F(2,124) = 10.85$, $p = .000$
  - Design Question 7 (What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?): $F(2,123) = 6.99$, $p = .001$
  - Design Question 8 (What will I do to establish and maintain effective relationships with students?): $F(2,123) = 9.85$, $p = .000$
  - Design Question 9 (What will I do to communicate high expectations for all students?): $F(2,123) = 13.58$, $p = .000$

Post hoc mean comparison tests indicate significant differences ($p < .01$) between the pure virtual and classroom/lab settings for all design questions, which favor the classroom/lab setting. Additionally, significant differences ($p < .01$) between the blended and classroom/lab settings were found for Design Questions 1 (What will I do to establish and communicate learning goals, track student progress, and celebrate success?) and 9 (What will I do to communicate high expectations for all students?), which

also favor the classroom/lab setting. A reasonable inference can be made that teachers perceive their frequency of implementation of teaching strategies involving both routine events and those enacted on the spot differently between the pure virtual and classroom/lab settings. With the exception of Design Questions 1 and 9, the frequency of implementation of teaching strategies involving both routine events and those enacted on the spot seems to be consistent between the blended and classroom/lab settings. Finally, the frequency of implementation of teaching strategies involving both routine events and those enacted on the spot seems to be consistent between the pure virtual and blended settings.

- The Bonferroni adjustment for Type I error indicates that a significant difference ($p < .05$) was found for Design Question 9 (What will I do to communicate high expectations for all students?) between the frequency of teachers' self-perceived implementation of pedagogical practice in courses taken for the purpose of original credit and credit recovery. The mean difference favors courses taken for the purpose of credit recovery. In addition, a significant difference ($p < .01$) was found between the frequency of teachers' self-perceived implementation of pedagogical practice in courses taken for the purpose of original credit and intervention. The mean difference favors courses taken for the purpose of intervention. Therefore, the findings for Design Question 9 suggest a significant difference between the teachers' self-perceived frequency of implementation between the different course purposes with respect to communicating expectations to students: $F(2,63) = 7.35$, $p = .001$.

A reasonable inference can be made that, with the exception of Design Question 9 (What will I do to communicate high expectations for all students?), the frequency of implementation of teaching strategies involving both routine events and those enacted on the spot seems to be consistent across PLATO coursework taken for the purposes of original credit, credit recovery, and intervention.

The correlational findings between student survey responses and students' mean End-of-Semester (EOS) test and Unit 1 (U1) posttest z-scores can be summarized by the following statements:

- In a pure virtual setting, significant relationships were found between mean z-scores and student responses to these survey items:
  - Item 11 (I have a clear understanding of the rules and procedures for this course or assignment) and U1: = .12, N = 394, p = .014
  - Item 12 (I have all the materials and resources I need to complete my course or assignment) and U1: = .11, N = 393, p = .031
  - Item 16 (My teacher provides encouragement or positive feedback when I do well on my online course or assignments) and U1: = .12, N = 393, p = .014
  - Item 32 (The teacher is paying attention to what I am doing in this class) and U1: = .10, N = 389, p = .047
  - Item 35 (The teacher in this class remembers my name) and U1: = .12, N = 390, p = .015

These positive correlations suggest that, in a pure virtual setting, these instructional strategies are likely to have an influence on student academic achievement.

- In a blended setting, significant relationships were found between mean z-scores and student responses to these survey items:
  - Item 11 (I have a clear understanding of the rules and procedures for this course or assignment) and U1: = .16, N = 166, p = .038
  - Item 18 (The pace of the online lessons works for me in this class) and U1: = .19, N = 166, p = .015
  - Item 19 (I feel challenged and engaged using the computer to help me learn) and EOS: = -.18, N = 125, p = .046
  - Item 24 (When learning something new in my online course or assignments, I feel that my teacher provides the help I need to understand and practice new knowledge) and U1: = .19, N = 164, p = .016
  - Item 28 (The teacher explains that I am able to ask questions during this class) and U1: = .16, N = 165, p = .036

The positive correlations for Items 11, 18, 24, and 28 suggest that, in a blended setting, these instructional strategies are likely to have an influence on student academic achievement. It is worth noting that the positive correlation between students' mean U1 posttest z-scores and survey responses to Item 16 (My teacher provides encouragement or positive feedback when I do well on my online course or assignments) approached statistical significance at the standard alpha of .05 (= .15, N = 165, p = .051). Therefore, a reasonable inference can be made that Item 16 is also likely to have an influence on student academic achievement. The negative correlation for Item 19 (I feel challenged and engaged using the computer to help me learn) indicates that students in the sample with higher mean EOS test z-scores rated their teachers at a lower frequency of implementation than students with lower mean EOS test z-scores. However, given the effects of engagement strategies on student achievement (see Marzano, 2007), the negative correlation might be considered an anomaly.

- In a classroom/lab setting, significant relationships were found between mean z-scores and student responses to these survey items:
  - Item 6 (I have a clear understanding of the goal or objective in each assignment) and U1: = .16, N = 159, p = .047
  - Item 11 (I have a clear understanding of the rules and procedures for this course or assignment) and U1: = .20, N = 159, p = .010
  - Item 12 (I have all the materials and resources I need to complete my course or assignment) and U1: = .18, N = 159, p = .025
  - Item 13 (I keep track of my own learning progress) and EOS: = .23, N = 128, p = .009
  - Item 18 (The pace of the online lessons works for me in this class) and U1: = .18, N = 156, p = .023

- Item 34 (If I saw the teacher of this class outside this classroom, he or she would recognize me) and U1: = .18, N = 157, p = .023
- Item 35 (The teacher in this class remembers my name) and U1: = .18, N = 158, p = .022
- Item 36 (My teacher treats all the students in this class the same) and U1: = .24, N = 158, p = .002

These positive correlations suggest that, in a classroom/lab setting, these instructional strategies are likely to have an influence on student academic achievement. It is worth noting that a negative correlation was found between students' mean EOS test z-scores and survey responses to Item 5 (My teacher encourages me to set goals for my work), which approached statistical significance at the standard alpha of .05 (= -.17, N = 130, p = .051). The negative correlation for Item 5 indicates that students in the sample with higher mean EOS test z-scores rated their teachers at a lower frequency of implementation than students with lower mean EOS test z-scores. However, given the effects of goal-setting strategies on student achievement (see Marzano, 2007), the negative correlation might be considered an anomaly. In addition, positive correlations were found between students' mean U1 posttest z-scores and survey responses to Item 13 (I keep track of my own learning progress), Item 16 (My teacher provides encouragement or positive feedback when I do well on my online course or assignments), and Item 19 (I feel challenged and engaged using the computer to help me learn), which also approached significance (Item 13: = .15, N = 157, p = .054; Item 16: = .15, N = 159, p = .056; Item 19: = .15, N = 156, p = .059). Therefore, a reasonable inference can be made that Items 13, 16, and 19 are also likely to have an influence on student academic achievement.

The analyses of the PLATO Learning Environment (PLE) system variables can be summarized by the following statements:

- Significant positive relationships ($p < .05$) were found between students' mean z-scores (averaged by teacher) and these system variables:
  - The total amount of time each teacher was logged in to the PLE across all classes: EOS – r = .26, N = 281, p = .000; U1 – r = .14, N = 332, p = .014
  - The number of times each teacher was logged in to the PLE across all classes: EOS – r = .24, N = 281, p = .000; U1 – r = .13, N = 332, p = .022
  - The average amount of time each teacher was logged in to the PLE per session: EOS – r = .16, N = 281, p = .009

These positive correlations suggest that a positive linear relationship was found between student achievement scores and the amount of time teachers were logged in to the PLE. A reasonable inference can be made that as the amount of time teachers spend logged in to the PLE increases, student achievement scores also increase.

- Significant positive relationships ($p < .05$) were found between students' mean z-scores and students' total time on task (EOS – r = .03, N = 6,200, p = .033; U1 – r = .03, N = 8,499, p = .021).

These positive correlations suggest that a very small positive linear relationship was found between student achievement scores and student's total time on task. A reasonable inference can be made that as the amount of time students spend on a specific task increases, student achievement scores also increase. However, the size of the correlations that were found may be too small to be of significant practical value within the context of online learning. Further examination through follow-up studies may be warranted to establish a more reliable correlation between student achievement scores and student's total time on task within PLATO Learning's online solutions.

- Significant negative relationships ($p < .05$) were found between students' mean z-scores and the average number of messages sent by students using the PLE messaging feature across all of their classes (EOS – $r = -.17$, $N = 2,152$, $p = .000$; U1 – $r = -.12$, $N = 2,634$, $p = .000$).

These negative correlations suggest that a negative linear relationship was found between student achievement scores and the average number of messages sent by students using the PLE messaging feature across all of their classes. Taken at face value, a reasonable inference can be made that students with higher achievement scores were the students who sent fewer messages using the PLE messaging feature. Conversely, students with lower achievement scores were the students who sent more messages. This might suggest that students with higher achievement scores had fewer questions for their teachers. However, it should be noted that out of 6,299 students with valid EOS test z-scores, 4,147 students (65.8%) did not send any messages using the PLE messaging feature. Student responses to Item 8 (When I have questions about my work on PLATO assignments, I ask my questions) indicate that a large percentage of students meet with their teachers face-to-face (78.4%) compared with a small percentage of students who send email (10.7%). Similar patterns of responses were found for other items on the student survey (see appendix E). Because of the high percentage of students who did not use the PLE messaging feature, further examination may be warranted to ascertain the true correlation between student achievement and use of the messaging feature. The correlations reported here, although statistically significant, might be isolated to the specific sample that was analyzed.

- Significant differences ($p < .05$) were found between students' mean z-scores for the following variables:
  - Favoring courses that were customized by teachers: EOS – $t(1,15269) = 20.61$, $p = .000$; U1 – $t(1,18778) = 22.36$, $p = .000$
  - Favoring courses that featured an external lesson or activity provided by teachers: EOS – $t(1,1421) = 10.81$, $p = .000$; U1 – $t(1,2036) = 11.16$, $p = .000$

These findings suggest that students who took PLATO courses that were customized with the addition of an external lesson or activity provided by the teacher scored higher than students who took PLATO courses that were not customized. Further examination may be warranted to determine any additional factors contributing to the difference between group means.

- Significant differences ($p < .05$) were found between students' mean z-scores for these variables:

- Favoring courses in which the pretest was locked: EOS – $t(1,11823) = 8.12$, $p = .000$; U1 – $t(1,14443) = 9.88$, $p = .000$
- Favoring courses in which the mastery test was unlocked by the teacher: EOS – $t(1,15092) = 7.56$, $p = .000$; U1 – $t(1,19414) = 7.10$, $p = .000$

These findings suggest that students who took PLATO courses with the pretest locked scored higher than students who took courses with the pretest unlocked. In addition, students who needed to retake a mastery test scored higher than students who passed the mastery test on the first attempt. Further examination may be warranted to determine any additional factors contributing to the difference between group means.

In The Art and Science of Teaching, Marzano (2007) provided a comprehensive framework for effective teaching practices. The teacher survey analyses indicate that, based on self-reported survey data, the majority of teachers engaged in frequent implementation of many of these practices. However, the teachers in the sample did not perceive the frequency of their implementation of these strategies with the same consistency across the three instructional settings (pure virtual, blended, and classroom/lab). That said, it should be noted that student perceptions of the frequency of their teachers' implementation of the strategies were consistent across the three settings. The correlation analyses between students' z-scores and students' responses to survey items pertaining to teacher pedagogical practices indicate that some of the pedagogical practices—those involving routine events and those enacted on the spot—exhibited a positive linear relationship with student achievement in each of the three instructional settings. The correlation analyses between students' z-scores and the amount of time teachers were logged in to the PLATO Learning Environment indicate that a positive linear relationship was found between these two variables. The correlation analyses between students' z-scores and students' time on task within the PLATO Learning Environment indicate that a very small positive linear relationship was found between these two variables. However, the size of the correlations that were found may be too small to be of significant practical value within the context of online learning. Further examination through follow-up studies may be warranted to establish a more reliable correlation between student achievement scores and student's total time on task within the PLATO Learning Environment. The correlation analyses between students' z-scores and students' average number of messages sent using the PLATO Learning Environment messaging feature indicate that a negative linear relationship was found between these two variables. However, given the large percentage of students in the sample who did not use the feature, the correlations reported may not be representative of the true correlations between the variables. Finally, the comparison of students' mean z-scores for courses that were customized by teachers versus courses that were not customized indicates that, on average, students who took PLATO courses that were customized with the addition of an external lesson or an activity provided by the teacher scored higher than students who took PLATO courses that were not customized. Taken at face value, these findings suggest that the role of the teacher within an online learning environment is very important. Given the positive effects on student achievement reported by Marzano (2007) for the strategies included in his framework, further examination of their use is warranted to determine potential barriers to implementation within each instructional setting and to provide additional support for best practices in PLATO Learning's online solutions.

Technical Notes

Technical Note 1: To analyze students' achievement scores across domains (i.e., various academic content areas), test scores are often standardized into z-score format. For this report, two different scores were standardized into z-score format within the academic content areas of English language arts, mathematics, science, and social studies: the End-of-Semester (EOS) test and Unit 1 (U1) posttest. According to information provided by PLATO, an EOS test score of 0 was an indication that either the student did not take a test or that a score was not reported by the school using the PLATO system (e.g., paper-and-pencil test). Additionally, a missing EOS test score was an indication that the student took the PLATO coursework for the purpose of intervention. To compute the z-scores within each of the four academic content areas, each EOS test score was subtracted by the mean of valid EOS test scores in each content area and then divided by the standard deviation of the distribution of the valid EOS test scores in each content area. In other words, four separate distributions of valid EOS test scores were created, one distribution for each content area. Because the EOS test score did not include student scores resulting from intervention, U1 posttest scores were also standardized into z-score format within each of the four academic content areas to provide a mechanism for analyzing student test scores taken for that purpose. It should be noted that out of 32,540 posttest scores, 12,181 (37.4%) were recorded as 0. Therefore, only posttest scores greater than 0 were used to determine the distribution of valid scores. Altogether, 15,416 EOS test scores and 19,488 U1 posttest scores were considered valid scores for analysis within the four academic content areas and standardized into z-score format.

Technical Note 2: When conducting multiple comparisons, research is most robust when the researcher can claim that he or she is at least 95% confident that the results occurred because of an effect. However, being at least 95% confident of a particular claim leaves a small chance that the researcher is not altogether accurate in making any such claim. Mistakes that occur to this end will fall into one of two categories, Type I error or Type II error.

A Type I error occurs when the null hypothesis is erroneously rejected—when researchers find that there is variation among means of the populations being compared when these means are actually equal. Researchers traditionally rely on Fisher's (1934) criterion to gauge the size of this error. It is measured as the Greek symbol alpha, and set (largely in the behavioral sciences) at the probability being less than .05 ($p < .05$), meaning that one is certain that there exists less than a five percent chance of error in any claim or, as mentioned above, that one is 95% confident the results occurred as claimed and because of some effect of treatment administered during the research study.

A Type II error—a false negative, if you will—occurs when the researcher claims there is no effect on the population being studied when in fact there truly is an effect. The optimal scenario for both types of errors is that the probability of making such an error is very small. While a Type I error is measured at the alpha ( ) level, a Type II error is measured at the beta ( ) level. The balance between the two is delicate: "As the probability of making a Type I error decreases, the probability of making a Type II error increases" (Field, 2009, p. 56).

Several methods can be used to control for the significance of comparisons such that

the p < .05 level is maintained. With Type I errors, the simplest and most frequently used method in the behavioral sciences is the Bonferroni correction method. With this, the alpha value is divided by the number of comparisons. Hence, with regard to this research study, where there were three group comparisons (pure virtual, blended, and classroom/lab), dividing .05 by 3 yields .017, which is the new criterion used for the level of significance. As mentioned earlier, this conservative approach to controlling for Type I error in essence increases the likelihood that a Type II error is committed due to the reduction of statistical power.

As statistical power increases, the probability of committing a Type II error decreases. For all but medical research studies, power is typically gauged against a benchmark of .80. This number is derived from an accepted trade-off between committing a Type II error or a Type I error. (For a more detailed discussion, see Cohen, 1992.)

Appendices

Appendix A: Study Numbers

Participating Sites/Implementations	PLATO Data	Teacher Survey	# of Teachers	Student Survey	# of Students
Aurora West (IL)	Yes	Yes	8	Yes	77
Binghamton HS (NY)	Yes	No	0	No	0
Brooklyn City SD (OH)	Yes	Yes	6	Yes	3
Canton City Schools, Timken Sr. HS (OH)	Yes	No	0	Yes	37
Circleville City SD (OH)	Yes	Yes	2	Yes	9
Conneaut Area City Schools, Conneaut Digital Academy (OH)	Yes	Yes	3	Yes	26
Curwensville (PA)	Yes	Yes	7	Yes	15
Fargo Public Schools (ND)	Yes	No	0	No	0
Harrison County SD (MS)	Yes	No	0	No	0
Kenosha Unified SD (WI)	Yes	No	0	No	0
Lafayette Parish School System (LA)	Yes	No	0	No	0
Lakewood City Schools (OH)	Yes	Yes	7	Yes	60
Lewiston HS (ME)	Yes	Yes	7	Yes	39
Logan High School (OH)	Yes	Yes	1	Yes	2
Lucia Mar USD (CA)	Yes	No	0	No	0
Osceola County (FL)	Yes	Yes	16	Yes	651
Oswego City SD (NY)	Yes	Yes	4	Yes	36
Raymond SD (NH)	Yes	Yes	3	Yes	6
Red Creek Central School (NY)	Yes	Yes	7	Yes	16
Revere Public Schools (MA)	Yes	Yes	2	Yes	53
Rock Island/Milan SD, Rock Island HS (IL)	Yes	Yes	4	Yes	24

San Dieguito Union High School District (CA)	Yes	Yes	1	Yes	21
San Joaquin County Office of Ed. Alternative Program (CA)	Yes	Yes	5	Yes	54
Schenectady City SD (NY)	Yes	Yes	4	Yes	200
School City of Hammond (IN)	Yes	Yes	12	Yes	139
St. Louis Park Schools (MN)	Yes	No	0	No	0
TRECA (Marion, OH)	Yes	Yes	13	Yes	97
Tulare Joint Union High School District (CA)	Yes	No	0	No	0
Tyrone Area SD (PA)	Yes	Yes	6	Yes	3
Waterloo Community Schools (IA)	Yes	Yes	18	Yes	166
Wooster City SD (OH)	Yes	Yes	4	Yes	58
Yukon Alt. School (OK)	Yes	Yes	4	Yes	16

Appendix B: Student Survey

Online Learning Student Survey

Instructions: On the following pages are questions about your experience taking a course or doing assignments online for school. The entire survey should take approximately 15–20 minutes for you to complete.

As you respond to each question, think about the course or assignments that you are doing online and respond to each question as it best applies to you when you are working on your online class or assignments.

Most of the questions you will see are multiple choice, but some of them will allow you to select more than one response. These questions will include specific directions that will let you "Select all that apply." For some questions, you will be able to provide a response that best applies to you by using your keyboard to type in your answer.

Please respond to each question as it best applies to you only for your online course or assignments.

Your answers will not be shared with anyone. If you have a question as you respond to the survey, please ask your teacher for assistance.

What is the name of your teacher for the class that you are taking an online course or assignments?

First name _____
Last name _____

Please enter your name and the school where you are taking online courses or assignments.

Your name will not be used in this study, and your responses to this survey will not be shared with anyone.

First name _____
Last name _____
School _____

Which of the following best describe the reason why you are taking an online course or assignments? (Select all that apply.)

I am using it to take an entire class over.
I am using it to take an entire class for the first time.
I am using it to work on some of my assignments.

Which of the following best describe how you take your online course or assignments? (Select all that apply.)

I do my entire class online; I do not go to a regular classroom.
I do some of my work in a regular classroom and some of it online.
I do all of my work in either a regular classroom or in a school computer lab.

My teacher encourages me to set goals for my work.

Never
Sometimes
Frequently
Always

I have a clear understanding of the goal or objective in each assignment.

Never
Sometimes
Frequently
Always

I can ask the teacher any questions I have about my work on my online course or assignment.

Never
Sometimes
Frequently
Always

When I have questions about my work on PLATO assignments, I ask my questions (Select all that apply.)

by sending an email
by meeting with the teacher face-to-face (in person)
other (please specify) _____
not applicable

My teacher clearly communicates rules, procedures, and expectations for this course or assignment (for example, how to log on to the online assignment or how to progress through the assignment).

Never
Sometimes
Frequently
Always

My teacher reviews the rules and procedures for this course or assignment while I am working on it.

Never
Sometimes
Frequently
Always

I have a clear understanding of the rules and procedures for this course or assignment.

Never
Sometimes
Frequently
Always

I have all the materials and resources I need to complete my course or assignment.

Never
Sometimes
Frequently
Always

I keep track of my own learning progress.

Never
Sometimes
Frequently
Always

I communicate with my teacher about my progress.

Never
Sometimes
Frequently
Always

I talk with my teacher about my progress on assignments by (Select all that apply.)

meeting with my teacher face-to-face (in person)
using virtual communication such as email or messages
other (please specify) _____
not applicable

My teacher provides encouragement or positive feedback when I do well on my online course or assignments.

Never
Sometimes
Frequently
Always

My teacher allows me to work at my own pace on my online course or assignments.

Never
Sometimes
Frequently
Always

The pace of the online lessons works for me in this class.

Never
Sometimes
Frequently
Always

I feel challenged and engaged using the computer to help me learn.

Never
Sometimes
Frequently
Always

My teacher allows me to communicate with other students through email or discussion tools available in the online course or assignment.

Never
Sometimes
Frequently
Always

My teacher helps me stay on task and focused while I work on my online course or assignments.

Never
Sometimes
Frequently
Always

When I am not focused in this class, my teacher helps me get back to work.

Never
Sometimes
Frequently
Always

My teacher typically helps me get focused and back to work on my online course or assignments by (Select all that apply.)

meeting with me face-to-face (in person)
using virtual communication such as email or messages
other (please specify) _____
not applicable

When learning something new in my online course or assignments, I feel that my teacher provides the help I need to understand and practice new knowledge.

Never
Sometimes
Frequently
Always

When I send an email regarding questions I have about my online course or assignments, my teacher responds quickly.

Never
Sometimes
Frequently
Always

As I am learning something new in this online course or assignment, I feel I am

only learning basic facts
understanding things at a deep level and am able to create new ideas from this knowledge

My teacher asks me questions about my learning in this class.

Never
Sometimes
Frequently
Always

The teacher explains that I am able to ask questions during this class.

Never
Sometimes
Frequently
Always

When learning something new, I feel that the online course or assignment provides the support I need to help me practice and deepen my understanding of new knowledge.

Never
Sometimes
Frequently
Always

There are clear consequences when someone gets in trouble in this class.

Never
Sometimes
Frequently
Always

When I do something right in this class, my teacher acknowledges it.

Never
Sometimes
Frequently
Always

The teacher is paying attention to what I am doing in this class.

Never
Sometimes
Frequently
Always

The teacher in this class makes an effort to get to know a little about me.

Never
Sometimes
Frequently
Always

If I saw the teacher of this class outside this classroom, he or she would recognize me.

Never
Sometimes
Frequently
Always

The teacher in this class remembers my name.

Never
Sometimes
Frequently
Always

My teacher treats all the students in this class the same.

Never
Sometimes
Frequently
Always

The teaher asks questions about how I am doing with my work in this class.

Never
Sometimes
Frequently
Always

If it were up to me, I would rather take a course or an assignment

online
in a regular classroom
some of it online, some of it in a regular classroom
I have no preference.

I think I would do better in a class or on an assignment if I took it

on the computer
in a regular classroom from a teacher
partially on the computer and partially in a classroom from a regular teacher
I would do the same in either situation.

What is the name of the class (or classes) that you are currently taking online or doing assignments online? (Please enter each class separately.)

Name of class _____
Name of class _____
Name of class _____
Name of class _____
Name of class _____
Name of class _____
Name of class _____

Appendix C: Teacher Survey

<u>Online Learning Teacher Survey</u>

As an educator who uses PLATO Learning's online courseware, you have been invited to participate in this study because your school or district was selected among implementations across the country that are using PLATO Learning's online solutions.

Instructions: On the following pages are questions regarding your teaching experience using PLATO Learning's online courses or assignments. The entire survey should take approximately 15–20 minutes to complete. As you respond to each item, think about the PLATO course(s) or assignment(s) that you assign to your students and respond to each question as it best applies to you.

Most of the questions you will see are multiple choice, but some of them will allow you to select more than one response. These questions will include specific directions that will let you "Select all that apply." For some questions, you will be able to provide information that best applies to you by typing in your response.

Again, please respond to each question as it best applies to the PLATO course(s) or assignment(s) you assign to students.

This survey is confidential; the information that you provide will not be shared with anyone. No student, teacher, school, district, or similar identifying information will be used in the study as only aggregated data will be reported.

Your students will also be asked to respond to a survey regarding their experiences using PLATO for courses and assignments. We ask that you and your students complete the survey by Friday, April 29, 2011.

Please provide your name and where you teach using PLATO online courses or assignments. *As a reminder, no identifying information will be used in this study. Data will only be analyzed and reported in aggregate; this information will only be used to assist in keeping your responses separate from other teachers'.*

First name _____
Last name _____
School _____

Which of these describe the instructional setting(s) you use to implement PLATO Learning solutions? (Select all that apply.)

All learning is virtual with no face-to-face class time (pure virtual).
Instruction is both virtual and in a classroom setting (blended).
All instruction is in a traditional classroom or lab setting (classroom/lab).

What student population(s) are you specifically addressing with PLATO Learning solutions? (Select all that apply.)

Original/first-time credit
Advanced Placement (AP*)
Credit recovery
Intervention

I ask my students to set goals for their work.

Never
Sometimes
Frequently
Always

I ask my students to set goals for their work via (Select all that apply.)

face-to-face discussion
virtual communication such as email or messages
other (please specify) _____
not applicable

I provide an orientation prior to students beginning the online course or assignment to communicate the rules, procedures, and my expectations.

Never
Sometimes
Frequently
Always

I review the rules and procedures with my students.

Never
Sometimes
Frequently
Always

I communicate and review rules, procedures, and my expectations to students via (Select all that apply.)

face-to-face discussion
virtual communication such as personal email or messages
other (please specify) _____
not applicable

There are clear consequences when a student breaks the rules.

Never
Sometimes
Frequently
Always

I publicly acknowledge or celebrate when a student adheres to rules and procedures.

Never
Sometimes
Frequently
Always

Students are able to ask me questions about their work during this class.

Never
Sometimes
Frequently
Always

Students are able to ask me questions about their work on PLATO assignments via (Select all that apply.)

face-to-face discussion
virtual communication such as personal email or messages
other (please specify) _____
not applicable

I have regular office hours where my students can contact or visit with me (Select all that apply.)

face-to-face
through virtual communication
other (please specify) _____
not applicable

I interact with my students through virtual communication such as personal email or messages.

Never
Sometimes
Frequently
Always

I allow students to communicate with each other using virtual communication tools such as email or discussions.

Never
Sometimes
Frequently
Always

I monitor students' online interactions with one another.

Never
Sometimes
Frequently
Always

I ask my students to keep track of their own learning progress.

Never
Sometimes
Frequently
Always

I track student learning on specific assignments by using online progress reports (Select the highest level that applies to you.)

Daily
Weekly
Monthly
Only upon completion of their assignments

I rely on some other method to track student progress on PLATO assignments (please specify) _____

I talk individually with students regarding their progress.
Never
Sometimes Never
Frequently
Always
Not applicable

I communicate individually with students regarding their progress on PLATO assignments via (Select all that apply.)

face-to-face discussion
virtual communication such as email or messages
other (please specify) _____
not applicable

I celebrate students when they do well on PLATO assignments.

Never
Sometimes
Frequently
Always

I celebrate students when they do well on PLATO assignments via (Select all that apply.)

face-to-face discussion
virtual communication such as personal email or messages
other (please specify) _____
not applicable

I individualize new learning for my students by (Select all that apply.)

re-sequencing lessons
adding new resources to the course or assignment
using online discussions to interact with students
using the digital drop box to interact with students
other (please specify) _____
not applicable

I manage the pace of learning for my students by

allowing them to work through assignments at their own pace
having all students within a course or assignment work at the same pace
other (please specify) _____

I help students practice and deepen their understanding of new knowledge by (Select all that apply.)

reviewing practice and knowledge-deepening activities that my students submit online (drop box)
reviewing practice and knowledge-deepening activities that my students submit offline (printed)
providing feedback to my students on practice and knowledge-deepening activities
other (please specify) _____
not applicable

I help my students generate and test hypotheses about new knowledge by (Select all that apply.)

using online communication such as discussion, email, or messages to help students generate and test hypotheses about new knowledge
working face-to-face with students to help them generate and test hypotheses about new knowledge
other (please specify) _____
not applicable

If it were up to me, I would rather teach a course or an assignment

in a virtual setting
in a traditional classroom setting
in a blended setting
I have no preference.

I think most students would do better in a class or on an assignment if they took it

in a virtual setting
in a traditional classroom setting
in a blended setting
I don't think the setting has an impact on student learning.

I purposely plan to actively engage learners.

Never
Sometimes
Frequently
Always

I monitor students carefully to keep students on task and focused.

Never
Sometimes
Frequently
Always

I monitor students to keep them on task and focused via (Select all that apply.)

face-to-face discussion
virtual communication such as personal email or messages
other (please specify) _____
not applicable

I make a conscious effort to get to know the students in this class on a personal level.

Never
Sometimes
Frequently
Always

I recognize and acknowledge students outside this classroom.

Never
Sometimes
Frequently
Always

I know each student's name in this class.

Never
Sometimes
Frequently
Always

I ask students questions about their learning in this class.

Never
Sometimes
Frequently
Always

Students understand that they are able to ask questions during this class.

Never
Sometimes
Frequently
Always

I ask students questions about how they are doing with their work in this class.

Never
Sometimes
Frequently
Always

I communicate high expectations to students via (Select all that apply.)

face-to-face discussion
virtual communication such as personal email or messages
other (please specify) _____
not applicable

I treat all students equally in this class.

Never
Sometimes
Frequently
Always

List the class(es) in which you are currently using PLATO courses or assignments. (Please enter each class separately.)

Name of class _____
Name of class _____
Name of class _____
Name of class _____
Name of class _____
Name of class _____
Name of class _____
Name of class _____
Name of class _____
Name of class _____
Additional classes, if applicable _____

Appendix D: Elements Of The Marzano Instructional Model

Domain 1: Classroom Strategies and Behaviors

Routine Segments

Design Question 1: What will I do to establish and communicate learning goals, track student progress, and celebrate success?

- provide clear learning goals and scales (rubrics)
- track student progress
- celebrate success

Design Question 6: What will I do to establish and maintain classroom rules and procedures?

- establish classroom rules and procedures
- organize the physical layout of the classroom

Content Segments

Design Question 2: What will I do to help students effectively interact with new knowledge?

- identify critical information
- organize students to interact with new knowledge
- preview new content
- chunk content into "digestible bites"
- process new information
- elaborate on new information

- record and represent knowledge
- reflect on learning

Design Question 3: What will I do to help students practice and deepen their understanding of new knowledge?

- review content
- organize students to practice and deepen knowledge
- use homework
- examine similarities and differences
- examine errors in reasoning
- practice skills, strategies, and processes
- revise knowledge

Design Question 4: What will I do to help students generate and test hypotheses about new knowledge?

- organize students for cognitively complex tasks
- engage students in cognitively complex tasks involving hypothesis generation and testing
- provide resources and guidance

On-the-Spot Segments

Design Question 5: What will I do to engage students?

- notice when students are not engaged
- use academic games
- manage response rates
- use physical movement
- maintain a lively pace
- demonstrate intensity and enthusiasm
- use friendly controversy
- provide opportunities for students to talk about themselves
- present unusual or intriguing information

Design Question 7: What will I do to recognize and acknowledge adherence or lack of adherence to rules and procedures?

• demonstrate "withitness"

• apply consequences for lack of adherence to rules and procedures

• acknowledge adherence to rules and procedures

Design Question 8: What will I do to establish and maintain effective relationships with students?

• understand students' interests and background

• use verbal and nonverbal behaviors that indicate affection for students

• display objectivity and control

Design Question 9: What will I do to communicate high expectations for all students?

• demonstrate value and respect for low-expectancy students

• ask questions of low-expectancy students

• probe incorrect answers with low-expectancy students

Domain 2: Planning and Preparing

Planning and Preparing for Lessons and Units

• planning and preparing for effective scaffolding of information within lessons

• planning and preparing for lessons within units that progress toward a deep understanding and transfer of content

• planning and preparing for appropriate attention to established content standards

Planning and Preparing for Use of Materials and Technology

• planning and preparing for the use of available traditional resources for upcoming units and lessons (e.g., manipulatives, videotapes)

• planning for the use of available technology such as interactive whiteboards, voting technologies, and one-to-one computers

Planning and Preparing for Special Needs of Students

• planning and preparing for the needs of English language learners

• planning and preparing for the needs of special education students

• planning and preparing for the needs of students who come from home environments that offer little support for schooling

Domain 3: Reflecting on Teaching

Evaluating Personal Performance

- identifying specific areas of pedagogical strength and weakness
- evaluating the effectiveness of individual lessons and units
- evaluating the effectiveness of specific pedagogical strategies and behaviors across different categories of students (i.e., different socioeconomic groups, different ethnic groups)

Developing and Implementing a Professional Growth Plan

- developing a written growth and development plan
- monitoring progress relative to the professional growth plan

Domain 4: Collegiality and Professionalism

Promoting a Positive Environment

- promoting positive interactions about colleagues
- promoting positive interactions about students

Promoting Exchange of Ideas and Strategies

- seeking mentorship for areas of need or interest
- mentoring other teachers and sharing ideas and strategies

Promoting District and School Development

- adhering to district and school rules and procedures
- participating in district and school initiatives

As indicated above, Domain 1 contains 41 elements (5 + 18 + 18), Domain 2 contains 8 elements (3 + 2 + 3), Domain 3 contains 5 elements (3 + 2), and Domain 4 contains 6 elements (2 + 2 + 2). Given that 41 of the 60 elements in the model are from Domain 1, the clear emphasis is on what occurs in the classroom—the strategies and behaviors teachers use to enhance student achievement. This emphasis differentiates this model from some other teacher evaluation models.

Appendix E: Student Survey Frequencies

Survey Item	Always (3)	Frequently (2)	Sometimes (1)	Never (0)	No Response	Avg.
Item 5: My teacher encourages me to set goals for my work.	744	441	374	112	3	2.09
Item 6: I have a clear understanding of the goal or objective in each assignment.	747	529	356	33	9	2.20
Item 7: I can ask the teacher any questions I have about my work on my online course or assignment.	1,080	255	270	59	10	2.42
Item 9: My teacher clearly communicates rules, procedures, and expectations for this course or assignment.	901	411	288	67	7	2.29
Item 10: My teacher reviews the rules and procedures for this course or assignment while I am working on it.	523	428	495	216	12	1.76
Item 11: I have a clear understanding of the rules and procedures for this course or assignment.	977	442	212	37	6	2.41
Item 12: I have all the materials and resources I need to complete my course or assignment.	1,060	356	211	33	14	2.47
Item 13: I keep track of my own learning progress.	826	499	285	54	10	2.26
Item 14: I communicate with my teacher about my progress.	474	446	542	203	9	1.72
Item 16: My teacher provides encouragement or positive feedback when I do well on my online course or assignments.	745	395	351	170	13	2.03
Item 17: My teacher allows me to work at my own pace on my online course or assignments.	1,103	322	191	48	10	2.49
Item 18: The pace of the online lessons works for me in this class.	865	418	302	80	9	2.24
Item 19: I feel challenged and engaged using the computer to help me learn.	492	474	489	209	10	1.75
Item 20: My teacher allows me to communicate with other students through email or discussion tools available in the online course or assignment.	268	205	387	797	17	0.97
Item 21: My teacher helps me stay on task and focused while I work on my online course or assignments.	777	466	314	105	12	2.15
Item 22: When I am not focused in this class, my teacher helps me get back to work.	802	418	308	134	12	2.14

Item 24: When learning something new in my online course or assignments, I feel that my teacher provides the help I need to understand and practice new knowledge.	657	448	390	162	17	1.97
Item 25: When I send an email regarding questions I have about my online course or assignments, my teacher responds quickly.	511	367	314	446	36	1.58
Item 27: My teacher asks me questions about my learning in this class.	354	402	579	330	9	1.47
Item 28: The teacher explains that I am able to ask questions during this class.	897	385	275	105	12	2.25
Item 29: When learning something new, I feel that the online course or assignment provides the support I need to help me practice and deepen my understanding of new knowledge.	594	502	464	104	10	1.95
Item 30: There are clear consequences when someone gets in trouble in this class.	818	385	357	108	6	2.15
Item 31: When I do something right in this class, my teacher acknowledges it.	606	434	413	213	8	1.86
Item 32: The teacher is paying attention to what I am doing in this class.	802	466	314	81	11	2.20
Item 33: The teacher in this class makes an effort to get to know a little about me.	541	410	467	242	14	1.75
Item 34: If I saw the teacher of this class outside this classroom, he or she would recognize me.	951	291	285	133	14	2.24
Item 35: The teacher in this class remembers my name.	1,250	203	158	49	14	2.60
Item 36: My teacher treats all students in this class the same.	1,087	282	200	92	13	2.42
Item 37: The teacher asks questions about how I am doing with my work in this class.	641	435	408	170	20	1.94

Survey Item	Yes	No
Item 3: Which of the following best describe the reason why you are taking an online course or assignments? (Select all that apply.)		
I am using it to take an entire class over (credit recovery).	931	743
I am using it to take an entire class for the first time (original credit).	595	1,079
I am using it to work on some of my assignments (intervention).	440	1,234
Item 4: Which of the following best describe how you take your online course or assignments? (Select all that apply.)		
I do my entire class online; I do not go to a regular classroom (pure virtual).	891	783
I do some of my work in a regular classroom and some of it online (blended).	475	1,199
I do all of my work in either a regular classroom or in a school computer lab (classroom/lab).	427	1,247
Item 8: When I have questions about my work on PLATO assignments, I ask my questions (Select all that apply.)		
by sending email	177	1,497
by meeting with the teacher face-to-face (in person)	1,312	362
other	142	1,532
not applicable	148	1,526
Item 15: I talk with my teacher about my progress or assignments by (Select all that apply.)		
meeting with my teacher face-to-face (in person)	1,298	376
using virtual communication such as email or messages	207	1,467
other	74	1,600
not applicable	212	1,462
Item 23: My teacher typically helps me get focused and back to work on my online course or assignments by (Select all that apply.)		
meeting with my teacher face-to-face (in person)	1,293	381
using virtual communication such as email or messages	202	1,472
other	99	1,575
not applicable	198	1,476
Item 26: As I am learning something new in this online course or assignment, I feel I am		
only learning basic facts	555	1,093
understanding things at a deep level and am able to create new ideas from this knowledge	1,093	555
Item 38: If it were up to me, I would rather take a course or assignment		
online	604	1,062
in a regular classroom	309	1,357
some of it online, some of it in a regular classroom	512	1,154
I have no preference.	241	1,425

Item 39: I think I would do better in a class or on an assignment if I took it		
on the computer	628	1,031
in a regular classroom from a teacher	350	1,309
partially on the computer and partially in a classroom from a regular teacher	388	1,271
I would do the same in either situation.	293	1,366

Appendix F: Teacher Survey Frequencies

Survey Item	Always (3)	Frequently (2)	Sometimes (1)	Never (0)	No Response	Avg.
Item 4: I ask my students to set goals for their work.	47	53	40	4	0	1.99
Item 6: I provide an orientation prior to students beginning the online course or assignment to communicate the rules, procedures, and my expectations.	89	18	29	8	0	2.31
Item 7: I review the rules and procedures with my students.	64	42	33	5	0	2.15
Item 9: There are clear consequences when a student breaks the rules.	74	36	28	5	1	2.25
Item 10: I publicly acknowledge or celebrate when a student adheres to rules and procedures.	39	47	41	16	1	1.76
Item 11: Students are able to ask me questions about their work during this class.	120	14	9	0	1	2.78
Item 14: I interact with my students through virtual communication such as personal email or messages.	20	18	65	40	1	1.13
Item 15: I allow students to communicate with each other using virtual communication tools such as email or discussions.	7	4	37	94	2	.46
Item 16: I monitor students' online interactions with one another.	22	20	26	67	9	.98
Item 17: I ask my students to keep track of their own learning progress.	65	46	26	7	0	2.17
Item 19: I talk individually with students regarding their progress.	49	76	19	0	0	2.21
Item 21: I celebrate students when they do well on PLATO assignments.	69	47	24	4	0	2.26
Item 29: I purposely plan to actively engage learners.	77	45	18	4	0	2.35
Item 30: I monitor students carefully in order to keep students on task and focused.	82	51	10	0	1	2.50
Item 32: I make a conscious effort to get to know the students in this class on a personal level.	89	36	17	2	0	2.47
Item 33: I recognize and acknowledge students outside this classroom.	82	40	19	3	0	2.40
Item 34: I know each student's name in this class.	125	12	6	1	0	2.81
Item 35: I ask students questions about their learning in this class.	64	56	23	0	1	2.29

Item 36: Students understand that they are able to ask questions during this class.	131	10	2	0	1	2.90
Item 37: I ask students questions about how they are doing with their work in this class.	79	56	9	0	0	2.49
Item 39: I treat all students equally in this class.	121	18	4	1	0	2.80
Item 32: The teacher is paying attention to what I am doing in this class.	802	466	314	81	11	2.20
Item 33: The teacher in this class makes an effort to get to know a little about me.	541	410	467	242	14	1.75
Item 34: If I saw the teacher of this class outside this classroom, he or she would recognize me.	951	291	285	133	14	2.24
Item 35: The teacher in this class remembers my name.	1,250	203	158	49	14	2.60
Item 36: My teacher treats all students in this class the same.	1,087	282	200	92	13	2.42
Item 37: The teacher asks questions about how I am doing with my work in this class.	641	435	408	170	20	1.94

Survey Item	Yes	No
Item 2: Which of these describe the instructional setting(s) you use to implement PLATO Learning solutions? (Select all that apply.)		
All learning is virtual with no face-to-face class time (pure virtual).	52	92
Instruction is both virtual and in a classroom setting (blended).	54	90
All instruction is in a traditional classroom or lab setting (classroom/lab).	56	88
Item 3: What student population(s) are you specifically addressing with PLATO Learning solutions? (Select all that apply.)		
original/first-time credit	67	77
Advanced Placement	9	135
credit recovery	113	31
intervention	62	82
Item 5: I ask my students to set goals for their work via (Select all that apply.)		
face-to-face discussion	114	30
virtual communication such as email or messages	41	103
other	20	124
not applicable	7	137
Item 8: I communicate and review rules, procedures, and my expectations to students via (Select all that apply.)		
face-to-face discussion	121	23
virtual communication such as email or messages	47	97
other	17	127
not applicable	3	141
Item 12: Students are able to ask me questions about their work on PLATO assignments via (Select all that apply.)		
face-to-face discussion	130	14
virtual communication such as email or messages	76	68
other	13	131
not applicable	2	142
Item 13: I have regular office hours where my students can contact or visit with me (Select all that apply.)		
face-to-face discussion	97	47
virtual communication such as email or messages	61	83
other	14	130
not applicable	23	121
Item 18: I track student learning on specific assignments by using online progress reports (Select highest level)		
daily	25	119
weekly	77	67
monthly	10	134
upon completion	13	131

other	10	134
not applicable	9	135
Item 20: I communicate individually with students regarding their progress on PLATO assignments via (Select all that apply.)		
face-to-face discussion	119	25
virtual communication such as email or messages	48	96
other	14	130
not applicable	5	139
Item 22: I celebrate students when they do well on PLATO assignments via (Select all that apply.)		
face-to-face discussion	122	22
virtual communication such as email or messages	43	101
other	19	125
not applicable	5	139
Item 23: I individualize new learning for my students by (Select all that apply.)		
re-sequencing lessons	49	95
adding new resources to the course or assignment	52	92
using online discussions to interact with students	9	135
using the digital drop box to interact with students	4	140
other	20	124
not applicable	52	92
Item 24: I manage the pace of learning for my students by		
allowing them to work through assignments at their own pace	133	11
having all students within a course or assignment work at the same pace	4	140
other	7	137
Item 25: I help students practice and deepen their understanding of new knowledge by (Select all that apply.)		
reviewing practice and knowledge-deepening activities that my students submit online (drop box)	20	124
reviewing practice and knowledge-deepening activities that my students submit offline (printed)	49	95
providing feedback to my students on practice and knowledge-deepening activities	74	70
other	18	126
not applicable	39	105
Item 26: I help my students generate and test hypotheses about new knowledge by (Select all that apply.)		
using online communication such as discussion, email, or messages to help students generate and test hypotheses about new knowledge	69	75
working face-to-face with students to help them generate and test hypotheses about new knowledge	19	125
other	2	142
not applicable	62	82
Item 27: If it were up to me, I would rather teach a course or an assignment (143 responses)		
in a virtual setting	13	130

in a traditional classroom setting	28	115
in a blended setting	79	64
I have no preference.	23	120
Item 28: I think most students would do better in a class or on an assignment if they take it		
in a virtual setting	7	137
in a traditional classroom setting	24	120
in a blended setting	103	41
I don't think the setting has an impact on student learning.	10	134
Item 31: I monitor students in order to keep them on task and focused via (Select all that apply.)		
face-to-face discussion	122	22
virtual communication such as email or messages	62	82
other	14	130
not applicable	3	141
Item 38: I communicate high expectations to students via (Select all that apply.)		
face-to-face discussion	125	19
virtual communication such as email or messages	45	99
other	9	135
not applicable	2	142

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