Using Simple Cooperative Learning Techniques in a Plant Propagation Course

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Abstract

Many employers believe problem-solving and data synthesis skills can be improved in horticultural graduates. However, traditional lecture-based courses often are inferior in terms of equipping students with problem solving skills. The objective of this study was to evaluate if implementing Think-Pair-Share (T-P-S) exercises (a cooperative learning technique) would improve student learning as reflected by final course grades. Most students (91.5%) indicated that T-P-S exercises better equipped them to solve plant propagation problems. However, final course grades were not significantly influenced by T-P-S exercises. Despite the lack of impact on student grades, open-ended comments on the usefulness of T-P-S exercises were overwhelmingly positive.

Introduction

Many employers believe problem-solving and data synthesis skills are lacking in recent horticultural graduates (Andelt et al., 1997; Berle, 2007; Kitto, 1996). Traditional lecture-based courses, however, often are inferior in terms of equipping students with problem solving skills (McKeachie, 1999). Cooperative learning techniques are increasingly being used in the college classroom to address these issues.

Cooperative learning is the use of group work in the classroom. Students in these small groups work together to solve a problem or work on an assignment. Research demonstrates that this technique maximizes the entire group's learning (Johnson et al., 2006) and promotes data analysis skills (Ebert-May et al., 1997). One such low-risk strategy that is ideally suited for students and instructors who are new to cooperative learning is called the Think-Pair-Share (T-P-S) technique (Lyman, 1981).

The T-P-S technique uses informal ad-hoc groups that last only a few minutes during class whereby the instructor poses an open-ended or difficult question to the students. Individual students think about the problem and possible solutions for a minute then pair with a partner to discuss solutions together and reformulate a more concise answer. Finally, solutions are shared with the class. To promote individual accountability, the instructor may call at random on any student to describe the group's answer (Johnson et al., 2006).

Background and Objectives

The Department of Horticulture at Michigan State University (MSU) offers two concentrations for a B.S. degree (Horticulture Science (HS) or Landscape Design, Construction, and Management (LDCM)), both of which are required to take a 200-level plant propagation course (HRT 204 Plant Propagation). Recently, HS students' final grade has been more than a full letter grade higher than LDCM students in HRT 204 (Table 1). Interestingly, non-majors fare similar to LDCM students. LDCM students are not necessarily poorer students as the final grades imply, but they are usually less interested in propagation and they tend to be more artistic and less science and math oriented (personal observation). It is quite possible that these grades would be reversed if all the same students took a landscape design course.

Because of these grade differences between student concentrations, the goal of this research was to engage LDCM students in HRT 204 with the intended outcome of demonstrating the importance of propagation in their future career in the landscape industry. Therefore, the primary objective of this study was to evaluate if allocating more class time to application and analysis of problems via T-P-S would improve student learning as seen by final course grades. A second objective was to determine student opinion of the exercises as it pertained to their own learning. Our rationale was that LDCM students are less likely to end up working in the propagation industry after graduation (as compared to HS students) and as such perhaps are less attentive in this class. While the specific purpose of this study was to engage LDCM students, the T-P-S technique was used for the benefit of all students in the class.

Table 1. Mean final grades in HRT 204 (Plant Propagation) by concentration for 2006 and 2007

Concentration	N	Mean Grades
HS	29	84.5 a
LDCM	38	72.5 b
Non-Majors	32	75.8 b

Mean separation in columns by LSD ($P \leq 0.05$). Lowercase letters denote comparisons between student concentration (n=99). HS=Horticulture Science majors; LDCM=Landscape Design and Construction Management majors; Non-majors=Non horticulture majors (i.e., class taken as an elective).

Material and Methods

Plant Propagation (HRT 204) is a ten-week course consisting of two 50-minute lectures per week and three sections of two-hour laboratories each week, and is offered in the spring semester every year. The course is also open to students from any other department as an elective, with no prerequisites.

Think-Pair-Share exercises were performed at the beginning of each weekly laboratory class during the spring 2008 semester. Each T-P-S exercise lasted five to ten minutes and questions were geared towards solving real-world propagation issues that students would likely see in the landscape design industry (Table 2). Written work from the exercise was turned in individually, but only effected student grades in terms of the effort and attendance portion of their final class scores (i.e., students were not graded on the accuracy of their written answer). All other portions of the class remained the same as the last three years, including exam questions and homework assignments.

Eight questionnaire items were developed to assess the new teaching practice (Table 3). Three questions on the survey were designed to query students' prior propagation experience. These questions had the students categorize their professional and personal propagation experience prior to taking this course. The remaining five questions asked for student opinions on the usefulness of T-P-S exercises using a ten-point scale with 1 being "Didn't Help at All" and 10 being "Helped A Lot." The survey was entirely voluntary, anonymous, and followed all university Institutional Review Board regulations. The survey was administered during the last laboratory period at the end of the spring 2008 semester.

Mean final course grade data for spring semester 2008 were compared to the previous two years (i.e., spring semesters of 2006 and 2007) using analysis of

Table 2. Think-Pair-Share questions administered at the beginning of each laboratory

Variegated plants are common chimeras that exist in the landscape. Sometimes they revert back to their non-variegated form. How do you maintain such a plant when you first notice the reversion so that your customer is kept happy by the pretty variegated form?
Your client notices a particular annual that you planted has an unusual color. She collects seeds from this species, so that she can grow it next year for her landscape. Once the seed germinates and grows and is finally in the landscape, she is very disappointed in the color. What happened?
You get a huge contract to landscape an entire community with street-side trees. You choose *Gleditsia triancanthos* 'Majestic', because a nearby nursery has an overstock of that species and because it is both podless and seedless – so won't be a messy tree. What are potential problems with this plan?
Mr. Jones and Mr. Smith are neighbors who are fiercely competitive about the beauty of their landscapes. They both purchase the same flowering shrub for their yards, all-be-it from different sources. Mr. Jones is heckling Mr. Smith because Mr. Smith's shrub hasn't flowered in two years, but Mr. Jones did. Why might this be?
Apple trees are almost always grafted on dwarf root stock to keep them small for landscape use. A client bought one from your greenhouse and 5 years later is feeling like he was ripped off because the tree has grown huge. What happened?
You have two turf grasses that you are trying to keep out of your vegetable garden. One is bermuda grass and the other is perennial rye grass. To control the spread of the grasses you rototill the garden area every year. Each year the burmuda comes back even stronger, but the rye grass doesn't. Why?
There is a particular weed that is really noxious in the Michigan landscape. It propagates itself primarily through seed. It produces seeds that dehisce. Why is this fact important in your control of the weed?
Your client collects seeds of a favorite annual that you planted in her garden as part of your design project. She stores the seeds inside her office desk. The seeds don't germinate. What happened?
Norway maples are considered invasive by many and are non-native to Michigan. However, it is an excellent street tree because it is very tolerant of the urban environment. In the middle of an urban area, will it become invasive? How about in the country landscape? What about a native species like Black Eyed Susan?

Table 3. Selected questions on final student survey

How would you describe your propagation experience (professional or personal) prior to taking this course?
Personal: (Circle One)

No Personal Experience	A little Personal Experience	Moderate Personal Experience	A lot of Personal Experience

Professional: (Circle One)

No Professional Experience	A little Professional Experience	Moderate Professional Experience	A lot of Professional Experience

For the think-pair-share exercises at the beginning of each lab, please rate how these exercises better equipped you to solve propagation problems. On a scale of 1 to 10, 1 being "Didn't help at all" and 10 being "Helped a LOT". Please Circle One.

1 2 3 4 5 6 7 8 9 10
Didn't help at all ----------Helped A LOT

Please rate how you believe the think-pair-share exercises helped your final course grade. On a scale of 1 to 10, 1 being "Didn't help at all" and 10 being "Helped a LOT". Please Circle One.

1 2 3 4 5 6 7 8 9 10
Didn't help at all ----------Helped A LOT

On the same scale of 1 to 10, please rate if the think-pair-share exercises were useful to you in general. (Circle One)

1 2 3 4 5 6 7 8 9 10
Didn't help at all ----------Helped A LOT

Why or why not?

variance. Although original means are presented, all grade values were transformed prior to analysis using a squared transformation to stabilize the variance and normalize the data set (Ott and Longnecker, 2001). Significant differences between treatments were determined using multiple comparisons by LSD (PROC GLM, SAS Version 9.1.3, SAS Institute, Cary, NC).

Results and Discussion

In spring semester 2008, there were 55 students enrolled in HRT 204 Plant Propagation, 96% of whom responded to the optional post-class survey. Most students (89%) had at least some personal propagation experience prior to taking this course, while only 50% of the students indicated they had professional propagation experience (data not shown). Non-majors had higher proportions of students with no personal or professional propagation experience, while LDCM students had more 'little' propagation experience and HS students had more "moderate" propagation experience.

Most students felt that T-P-S exercises better equipped them to solve propagation problems (Figure 1). In fact, 91.5% of the students responded on scale of 1 to 10 with a 7 or greater. However, fewer students felt these same exercises would help their final grade in this propagation course (Figure 2). Only 72.3% answered 7 or greater for this question. It is interesting that many students didn't see a connection between solving propagation problems and their course grade in a propagation course. This could be due to the fact that the bulk of final student grade in the course was in the form of two graded exams, one of which students had already taken at the time of the student survey. The exams were primarily short answer, true-false, and multiple-choice in format.

As students predicted, final course grades were not impacted by T-P-S exercises (Table 4). In fact, for all concentrations, final course grades were lower this semester as compared to the previous two years, although not statistically different. However, the differences in final course grade between concentrations were minimized this year. Therefore, the result suggests that LDCM students may have viewed plant propagation as a topic pertinent to their careers. These findings also support Haines and McKeachie (1967) who found that psychology students working in groups had no better grades than those working competitively, although they did find that cooperative learning did improve student morale. While not the

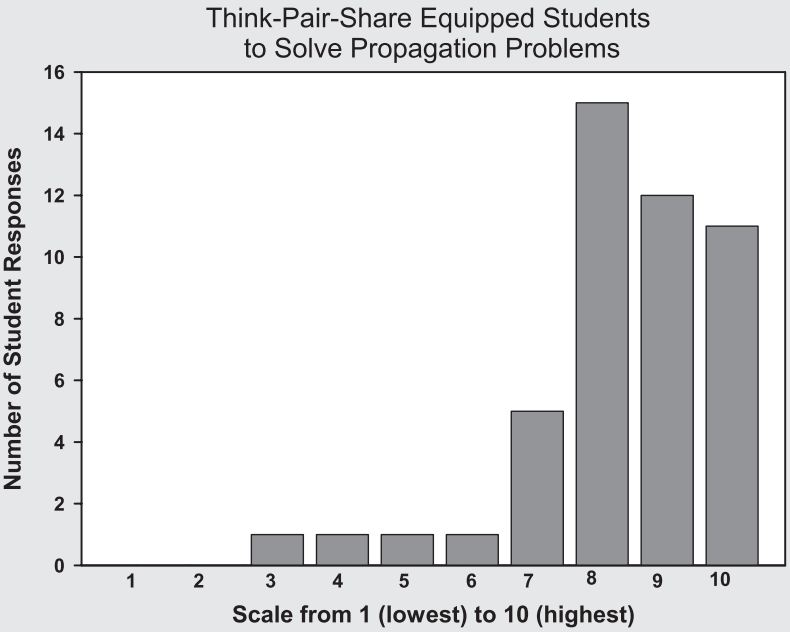

Figure 1. Results of student survey for the question: "For the think-pair-share exercises at the beginning of each laboratory, please rate how these exercises better equipped you to solve propagation problems. On a scale of 1 to 10, 1 being 'Didn't help at all' and 10 being 'Helped a lot'. Please Circle One."

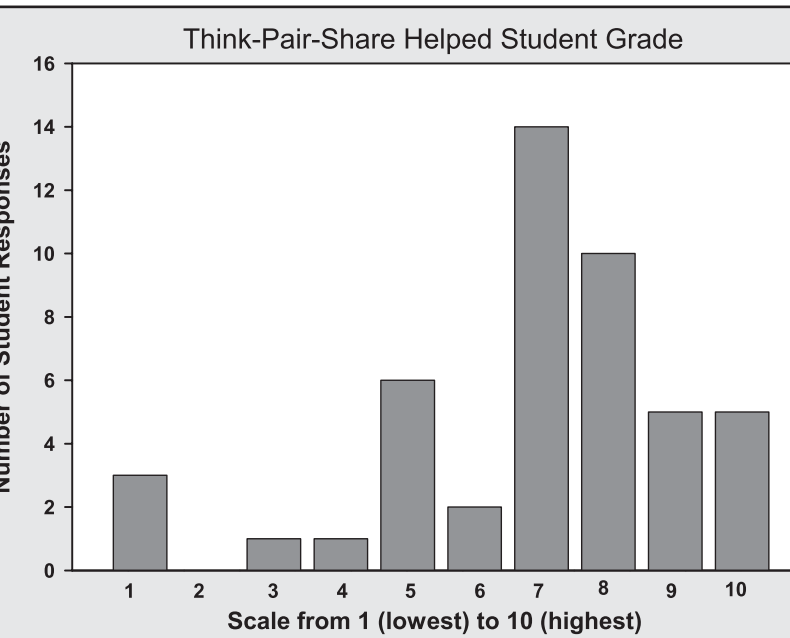

Figure 2. Results of student survey for the question: "Please rate how you believe the think-pair-share exercises helped your final course grade. On a scale of 1 to 10, 1 being 'Didn't help at all' and 10 being 'Helped a lot'. Please Circle One."

case here, other research suggests that cooperative learning techniques can affect student performance as seen by exam scores (Lord, 1997).

Despite the lack of impact on student grades, open-ended comments on the usefulness of the T-P-S exercises were overwhelmingly positive (Table 5). Many students appreciated that this exercise was not a part of their grade, so that they could practice real-life problems without worry of a grade penalty. These students may have been using this activity to monitor their learning progress, which is a key element to developing expertise in any area (Ericsson et al., 1993).

The general theme from student comments was that T-P-S exercises helped the students apply lecture content to real-world situations. These results support what the National Research Council considers the ultimate goal of learning: to achieve student transfer of knowledge to other circumstances (Bransford et al., 2000). While the T-P-S exercises

Table 4. Mean final grades in HRT 204 (Plant Propagation) by concentration for 2006 and 2007 ('Old' Teaching Method) and 2008 ('New' Teaching Method)

Teaching Method	Concentration HS	LDCM	Non
Old	84.5 b A	72.5 a A	75.8 a A
New	77.1 a A	67.9 a A	74.6 a A

Mean separation in columns by LSD (P≤0.05). Lowercase letters in rows denote comparisons within a teaching method between student concentration (n=154). Uppercase letters in columns denote differences within concentrations between teaching methods (n=154). HS=Horticulture Science; LDCM=Landscape Design and Construction Management; Non-majors=Non horticulture majors (i.e., class taken as an elective).

Table 5. Selected student open-ended comments on the usefulness of T-P-S exercises

Comment
"It connected what we were learning in lecture with what we were experimenting with in lab. Many of the questions related to concepts we learned during lecture."
"I really liked the activity because it gave you a chance to think critically about real propagation problems and come up with a solution without penalty of being wrong."
"Made me remember more of what we learned in lecture and applied to the real world."
"It was a fun approach that allowed you to pool minds together to solve difficult tasks as you would in a business situation."
"They were real everyday problems and involved questions we may be asked about. I wish other classes had think-pair-share. I'd especially like questions on diagnosing plant problems because people already ask me questions like that."
"Class time was used for thinking and learning instead of 10 minutes used for taking attendance."
"Helped apply knowledge"
"I was able to better understand/clarify unclear information that I did not get or understand before"
"It got me using what I learned to solve problems"
"I would like to see more of this in this class and other classes. I like the setup of this one, simple, no points, but I also would like to have the opportunity to take it a step further - like a whole project."
"Discussion is ALWAYS good."
"It helped me develop critical thinking skills without the pressure of a quiz grade."
"It got me thinking about real world problems and the many ways they can be answered."
"Got everyone involved, was able to see different opinions and ideas."
"Didn't think it was useful information for me, seemed like basic information"
"Talking about new concepts with peers helped me better understand them - I liked having the opportunity to share knowledge and learn from classmates."
"They helped me to use my knowledge from class with practicle problems."
"Helped me think about real-world problems and to think about them from several perspectives."
"Helps apply what we've learned to real life."
"The exercise helped me by making me think how to apply what I was learning and see how on track I was with the answer."
"They represented common questions one would encounter. By answering individually and with classmates I was able to acquire numerous solutions to various issues."

alone may not be achieving the transfer of knowledge, they certainly are giving the students practice at trying to transfer their knowledge.

Finally, some students felt that T-P-S exercises were a better use of class time. Since these exercises were used as a proxy for laboratory attendance, time was not wasted on taking attendance. In addition, because this exercise was at the beginning of each laboratory, students not only got to class on time, but they also were more actively involved in the class right at the start (personal observation).

Summary

This study demonstrated that while T-P-S exercises did not improve student final grade in this course, the student survey indicated that they felt better equipped to solve propagation problems because of this exercise. Many students appreciated practicing real-life problems and felt that the exercises helped them apply lecture content to real-world situations. In addition, some students felt that T-P-S exercises were a better use of class time.

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