Assessing Intellectual Development of Horticulture Undergraduates Using the Perry Scheme and Learning Environment Preferences Instrument[1]

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Abstract

Measurement of the intellectual development of undergraduate students can provide insights into their behavior, learning preferences, and attitudes. The Learning Environments Preferences (LEP) instrument objectively assesses intellectual development according to the Perry Scheme, which outlines the progression of intellectual and ethical development using nine hierarchical positions that are grouped into distinct ways of viewing the world: dualism (positions 1 and 2), multiplicity (positions 3 and 4), relativism (position 5), and commitment (positions 6 to 9). In this study, the LEP instrument was administered at the beginning (pretest) and end (posttest) of the fall 2002 semester to 60 students in two undergraduate horticulture courses to determine if different teaching strategies—a collaborative learning environment versus lecture-only—would influence students' intellectual development. At the beginning of the semester, all students were operating in positions 2 through 4. At semester's end in the lecture-only course, positions remained constant for 50% of the students; decreased for 44%; and increased for 6%. In the collaboratively-taught course, positions remained constant for 43% of the students; decreased for 45%; and increased for 12%. The two class means were not different. In the collaboratively-taught course, posttest scores of those students with previous horticultural experience in the subject matter decreased compared to those with no experience, suggesting that students who must reconcile new knowledge with previously learned information may retreat in their intellectual development in the short-term. This study supports the value and applicability of using the LEP instrument to recognize intellectual development positions 2 to 5 of Perry's Scheme.

Introduction

Intellectual development describes a person's increasing ability for rational and abstract thinking and the application of knowledge to new situations (King and Kitchener, 1994). This study focused on characterizing the intellectual development of a group of horticultural students by investigating the possible influence of different teaching strategies on students' view of learning as measured using the Learning Preferences Environment (LEP) instrument. Educational theorist William Perry recognized the uniqueness of each student's perception of learning and how those perceptions might change as a result of their college experience. These perceptions act as filters through which a student ascribes meaning to their world (Perry, 1981). Subsequently, Perry developed a scheme describing the forms of intellectual and ethical development of college students (Perry, 1999).

Overview of the Perry Scheme

Perry investigated intellectual development in Harvard undergraduate students in the 1950s and 1960s (Perry, 1999) by performing a four-year longitudinal study using student year-end interviews. In response to listening to student voices describing their experiences while in college along with considerable qualitative analyses, he developed the Perry Scheme, a continuum of positions that quantify and describe how students change intellectually and ethically. Perry determined that students' perceptions evolve as they progress through college so he chose the word position to indicate changeable vantage points from which students view their world (Perry, 1999). The students' vantage point influences their views about knowledge; the role of the instructor and fellow students; the sources of challenge; and the method used to evaluate their work (Moore, 2002). Perry and other researchers working with the scheme recognized that the journey of intellectual development was fluid and recursive (Moore, 2002; Perry, 1999). Perry also considered that transformation and expansion in students' thinking was occurring as the learner made the transition between the

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positions. Perry observed that the learner may even be in several positions simultaneously. In fact, they may temporarily retreat, or digress to a lower position, dependent on the complexities or uncertainties that they may be exposed to during a new course or experience (Love and Guthrie, 1999).

The scheme is separated into intellectual positions (1 to 5) and commitment positions (6 to 9) with four main categories within the nine positions: Dualism (positions 1 to 2); early and late multiplicity (positions 3 to 4); contextual relativism (position 5); and the anticipations and experiences of commitment (positions 6 to 9). The first five Perry positions are significant in the context of intellectual growth because they describe the development of the student as a learner. Perry (1999) determined that students entering college have certainly passed through position 1, referred to as strict dualism. Positions 6 through 9 describe the acknowledgement and progression of commitment in a relativistic world. Most researchers agree that the establishment of commitments, priorities, and values actually occur over a lifetime—not just during college (King, 1978). Additionally, Perry positions 6 through 9 are difficult to measure using a survey instrument (Moore, 1989). Consequently, positions 2 through 5 were the focus of this study.

Position 2 learners view the world dichotomously: right or wrong, good or bad, success or failure (Perry, 1999). Because many lower-level college courses serve to facilitate acquisition of information that students will need to succeed in upper-level courses, they are often taught as if everything about the content is known as fact, so dualistic thinking appears as the norm. Dualistic learners expect the transfer of knowledge to come from the teacher, who they view as the absolute or good authority on the subject, versus from fellow students or student teachers, who they view as bad authority because they are not considered legitimate sources of knowledge (Love and Guthrie, 1999). These learners prefer a high degree of structure and organization, and they welcome the opportunity to practice skills through experiential learning activities. Position 2 learners do not like open-ended class discussions with peers (bad authorities) or nebulous formats. Dualist thinkers are uncomfortable with unguided assignments or situations that require independent thought. They have difficulty and grow frustrated when they receive multiple views from good authorities because to them, there can only be one good authority. These learners correlate a sense of self directly to how well they perform on tests and other evaluations.

Fact based information may not offer enough challenge to move students into position 3 so change may not transpire until the learner is exposed to ambiguous knowledge (Moore, 1994). In many horticultural courses, the challenges of multiplicity (positions 3 and 4) usually come in upper-division courses, which can lead to stress for students in courses where several correct answers are common and they are suddenly expected to function in a world with multiple answers or solutions (Evan et al., 1998). Doubt appears to play a significant role in the shift to multiplicity, particularly for males (Belenky et al., 1997). Transition to early multiplicity (position 3) is prompted by diversity of opinion and uncertainty as the learner begins to recognize that some knowledge is ambiguous (Moore, 2002). Multiplicity allows for differing views when a correct answer is not readily known and is generally an optimistic and functional perspective for most learners. Peers are now considered a valid source of reference. Although these learners still require transparency on assignments, tests and evaluations, they demonstrate pride in this new found freedom of learning. Multiplistic students begin to question instructors' expertise. Multiplistic learners may disagree with the instructors' assessment of their answers or exam scores, and fairness is an issue. The method of evaluation becomes a significant issue as these learners expect their amount of effort to correlate to their grade. Clever students can often escape the challenges of multiplicity through sheer competence. According to Perry (1999), students in early multiplicity (position 3) will typically attempt to discover what an instructor "wants and then tries to give it" to them. He considered this behavior intellectual progress because as students strive to mimic instructors' ways of thinking, they are actually attempting to substantiate their own reasoning.

As students move from early multiplicity (position 3) into late multiplicity (position 4), they begin to see themselves as self-reliant thinkers shifting from the mind-set of "what do instructors want" to "the way instructors want us to think." They begin to realize that hard work alone does not guarantee a good score (Perry, 1999). Position 4 learners still have misgivings about their instructors, although they benefit from instructors who model good thinking. Position 4 learners attempt to retain a somewhat dualistic right-versus-wrong position while realizing that there are indeed areas of legitimate uncertainty and diversity of opinion; or they begin to subscribe to what the instructor seems to want, subsequently developing forms of independent intellectual thought (Evan et al, 1998; Love and Guthrie, 1999). These students learn that independent-like thought will earn them good grades; they may even seek out the courses that allow for freedom of thought. Students can now relate learning the subject matter to other issues and contexts. Instructors can design topics to help students draw connections between disciplines and ultimately engage them in the type of thinking that promotes critical reflection (Moore, 1994). The instructor who understands how learning changes the learner can thoughtfully incorporate ambiguity and multiple interpretations and perspectives into a course that will continue to encourage intellectual development.

The shift from position 4 to 5 is radical (Love and Guthrie, 1999). In position 5, relativism, the learner begins to develop metacognitive skills. They realize that knowledge can be contextual and relative. Relativistic thinkers are comfortable making decisions, and they value choices. They recognize the importance of considering different options to arrive at conclusions (Perry, 1999). Relativism becomes the common characteristic of everything, and absolutes become a special case (Moore, 2002). These learners recognize the need to support their views (Love and Guthrie, 1999) and they begin to realize that there can be a difference in opinion about accuracy or correctness among good authorities. They recognize that good authorities can and will disagree, but this does not frustrate them as in dualism. In relativism, students form their own conclusions because of personal observation and reflective thinking. Students in position 5 will view a good instructor as a source of expertise, recognizing that the teacher may not know all the answers since many answers are unknowable (Perry, 1999). Instructors can assist relativistic thinkers by helping them become adept at forming rules to develop reasonable and likely solutions that are supported by sound reasoning.

Perry and other researches recognized that movement along the Perry continuum could be purposely advanced. Learning activities and environments can be designed to bridge a student's current position of intellectual development to a more advanced position (Evans et. al., 1998; Moore, 1994). Courses that provide enough structure for position 2 learners may be too restrictive to the learner who appreciates a more open-ended approach. So if the instructor perceptively introduces situations and assignments that offer diversity of thought, the dualistic learner may be encouraged and the multiplistic thinker satisfied. Thoughtfully designed experiential learning activities can reinforce the theories learned in the classroom that will benefit all learners, but the dualistic thinkers are significantly rewarded from this type of supported learning (Knefelkamp, 1984). An important component to promoting intellectual development is encouragement, particularly when the student is attempting to become actively involved in constructing contextual meaning (Baxtor Magoda, 1992).

Pascarella and Terenzini (2005) performed extensive literature reviews on how college affects students. Their findings confirm that those students who experience instructional formats carefully designed to support the potential for intellectual growth tend to advance developmentally more than those not exposed to some type of instructional intervention. In a one-semester study, Kronholm (1996) found that those students who were purposely exposed to instructional intervention designed to positively influence their reflective thinking made greater gains in intellectual development. In an engineering design course that included collaborative instruction, Marra et al. (2000) measured students' Perry positions using semi-structured interviews at the end of the semester and found that students advanced significantly along the Perry continuum. A study by Culver and Hackos (1988) showed that engineering students moved into higher Perry positions in a short-term study of one semester. They also found some retreat in intellectual development among students, though most were operating and remained in position 3.

The Learning Environment Preferences Instrument

Moore (1988) designed an evaluative, replicable method to measure the intellectual development portion (positions 2 to 5) of the Perry Scheme called the Learning Environments Preferences (LEP) instrument. The LEP is a computer-scored questionnaire consisting of five different content domains related to learning: view of knowledge/learning; role of the instructor; role of the student/peers; classroom atmosphere/activities; and role of evaluation/grading. Within each domain are thirteen statements ranging from simple to more complex items. Respondents are asked to rate an item as the most significant to their ideal learning environment. Items within each domain are rated on a Likert scale of 1 to 4. Respondents then rank the three most significant items to them personally from each domain. Completion of the LEP instrument takes approximately 30 to 45 minutes. The LEP's validity and reliability studies indicate that the instrument accurately measures intellectual development along the Perry Scheme (Moore, 1990). The LEP is grounded in qualitative data collected on the Perry Scheme (Baxter Magolda, 1992; Moore, 1988) and addresses an individual's perception of their educational experience (Wilson, 2000).

The LEP is a copyrighted instrument and must be scored by the Center for the Study of Intellectual Development in Olympia, Washington, which develops an LEP Score Report. The Cognitive Complexity Index (CCI) is the major scoring index of the LEP instrument because the CCI incorporates the respondents' most significant responses into its score. This score reflects a more complex composite of the individual's reasoning (Moore, 1989). Each respondent's CCI score ranges from 200 to 500 along a continuous scale that corresponds to Perry positions 2 through 5 (Table 1).

The objectives of the study reported here were to 1) explore the feasibility of using the Learning Environment Preference (LEP) instrument as a tool to recognize the intellectual development of horticultural students; and 2) determine if two different teaching strategies –collaborative teaching versus lecture-only—would influence students' intellectual development according to the Perry Scheme over one semester.

Table 1. Cognitive Complexity Index[z] (CCI) pretest and posttest score ranges as related to Perry positions[y] and participants[x] (n=60). The distribution of the results did not deviate significantly from normality (p >0.25) and the variances of the distributions of the two classes were not different

Perry Positions[y]	CCI Scores	Pretest	Posttest
Dualism—position 2 (Learner sees a world of dichotomies, good or bad)	200-240	1	2
Transition to position 3 (Learner begins to recognize that pluralism may be legitimate)	241-284	5	11
Early Multiplicity—position 3 (Learner accepts legitimate uncertainties)	285-328	23	30
Transition to position 4 (Learner recognizes uncertainty as widespread, unavoidable)	329-372	19	11
Late Multiplicity—position 4 (Learner begins using supportive evidence in thinking)	373-416	11	6
Transition to position 5 (Learner recognizes relativistic thinking will be required)	417-460	1	0
Relativism—position 5 (Learner sees most knowledge as contextual)	461-500	0	0

[z] The Learning Environments Preferences (LEP) instrument Cognitive Complexity Index score

[y] Perry's Scheme comprises intellectual positions 2 to 5: Dualism (position 2), Multiplicity (positions 3 and 4), Relativism (position 5) relating to CCI scores 200-500

[x] Participants were undergraduate students enrolled in two upper-division horticulture classes; Landscape Irrigation Systems (HORT 550) and Arboriculture (HORT 585)

Materials and Methods

Teaching methodology was the manipulated variable in this study: traditional lecture versus collaborative learning. The three-credit Arboriculture course (HORT 585) was taught using lecture exclusively during the 50-minute class that met twice weekly. The instructor delivered the information using PowerPoint® presentations with minimal student interaction (questions, discussion, or sharing of ideas). In addition, a 90-minute weekly laboratory occurred during which the instructor reduced collaborative learning situations by using 10 of the 13 laboratories as an extended lecture while the remaining three labs were spent learning how to climb trees.

The three-credit Landscape Irrigations Systems course (HORT 550) was also a 50-minute class that met twice weekly. This course was taught using PowerPoint® presentations to deliver information; however, a variety of collaborative learning experiences were purposely included: guided discussions and questioning, turn-to-your-neighbor during lecture for brief sharing, consensus small group work, and numerous hands-on skill-development activities. Each 90-minute weekly laboratory was designed to use the information from the 50-minute class periods and required interaction between students and instructor. The primary activity during the laboratories was the installation of a residential irrigation system.

The sample for this study consisted of sixty undergraduate horticulture students at Kansas State University enrolled in two courses, Arboriculture (n=18) and Landscape Irrigation Systems (n=42) during the fall 2002 semester. The students in these two classes were working toward B.S. degrees in one of the following specializations: Golf Course Management, Greenhouse Management, Horticultural Therapy, Landscape and Turf Management, or Landscape Design. These two upper-level undergraduate courses are traditionally taken by juniors and seniors during their last few semesters in the program.

The LEP pretest was administered to the 60 students during the second day of class in both courses of the fall 2002 semester. One student was enrolled in both courses; they completed only one LEP instrument and their results are included in the Arboriculture class. Students were told that the LEP instrument was a component of the instructor's research and that completing it, or not, would have no impact on their grade. All 60 students did elect to participate. Demographic data collected when the pretest LEP was issued included student gender, age, class rank (senior, junior, sophomore, freshmen), and information about any previous horticulture experience of three months or more. The posttest was given during the last week of the semester prior to finals week. Analysis of variance was performed using general linear models (PROC GLM; SAS Inst., Cary, NC) to determine if the means of the pretest and posttest

scores between classes and within each class were different. An alpha level of 0.05 was used for all statistical tests.

Results and Discussion

All 60 students' pretest CCI scores from the LEP instrument ranged from 230 (position 2) to 417 (position 4; Table 1). There were no students, in either course, in positions 1 or 5 (Table 1). The distribution of the results did not deviate significantly from normality ($p > 0.25$), and the variances of the distributions of the two classes were not different (Table 1).

In the lecture-only course, pretest CCI scores ranged from 230 to 413 with a mean of 332. Student posttest scores ranged from 237 to 407 with a mean of 317 (Table 1). Positions remained constant for 50% of the students; decreased for 44%; and increased for 6%.

In the course taught with collaborative learning techniques, pretest scores ranged from 263 to 417 with a mean of 333, and posttest scores ranged from 230 to 410 with a mean of 308 (Table 1). At semester's end, Perry positions remained constant for 43% of the students; decreased for 45%; and increased for 12%.

The mean differences between pretest and posttest results of the two classes were not different ($p=0.41$). The mean difference in scores for the lecture-only course was -15.1 with a SE ± 9.3, which is not significantly different from 0, indicating no difference between pretest and posttest scores. In contrast, the mean difference in scores for the collaboratively-taught course was -24.3 with a SE (standard error of the mean) + 6.1 (Table 2), which is significantly different from 0, indicating a difference between pretest and posttest scores.

CCI scores of students in the lecture-only course, Arboriculture, were not influenced by their previous horticultural experience (n=16; Table 3). The posttest scores of those students in the collaboratively-taught course, Landscape Irrigation Systems, who had previous horticultural experience (n=25) decreased more so than the scores of students without experience (p-value = 0.0006; Table 3).

Students in the irrigation course with previous horticulture knowledge may have been experiencing temporary retreat—an alternative to forward movement through Perry's positions. When faced with ambiguity, students may retreat to dualist thinking where right and wrong are clear and there is only one good authority (Knefelkamp, 1999). Gains in intellectual development are not entirely linear; Perry himself identified periods of "temporary suspension" in development (Perry, 1999; Pascarella and Terenzini, 2005). Piaget (1972) used the term "disequilibrium" to describe the intellectual change that occurs when individuals encounter experiences that they cannot completely understand.

Intellectual retreat in this study may have been caused by the discrepancy that students experienced when hearing different approaches or techniques from two different good authorities, for example, the instructor of the irrigation course versus an irrigation

Table 2. ANOVA[z] of the CCI[y] pretest and posttest scores (n=60) from two undergraduate horticulture classes[x] and a comparison of the difference between pre and post CCI scores

	Lecture-only (n=18)			Collaboratively-taught (n=42)		
	Pre	Post	Difference	Pre	Post	Difference
Mean	332	317	-15.1	333	308	-24.3
SE[w]	12.7	10.7	9.3	5.8	7.1	6.1

[z] Analysis of Variance was conducted on the differences in the means between the pretest and posttest scores within each class and between each class
[y]The Learning Environments Preference (LEP) instrument Cognitive Complexity Index score
[x]Participants were undergraduate students enrolled in two upper-division horticulture classes; Landscape Irrigation Systems (HORT 550) and Arboriculture (HORT 585)
[w]Standard error of the mean

Table 3. Comparison of previous horticultural experience[z] to changes in CCI Scores[y] from two undergraduate horticulture courses[x]

Class	Hort. Exp.[z]	CCI diff	SE[w]	Pr>t
Collaboratively-taught	no	-12.0	39.6	0.7632
	yes	-22.9	6.3	0.0006
Lecture-only	no	-23.3	14.0	0.1028
	yes	-7.8	13.2	0.5584

[z] Previous experience in horticulture of three months or more
[y]The Learning Environments Preference (LEP) instrument Cognitive Complexity Index score
[x]Participants were undergraduate students enrolled in two upper-division horticulture classes; Landscape Irrigation Systems (HORT 550) and Arboriculture (HORT 585)
[w]Standard error of the mean

contractor or a golf course superintendent with whom they had previously worked. When the learners were faced with different or conflicting opinions, they may have been experiencing cognitive dissonance leading to a temporary retreat in their Perry positions. This finding serves to emphasize that instructors should be aware of the difficulty that some students with previous experience may have in reconciling conflicting information, particularly those learners who are operating in position 2 or are in transition to position 3. As students move through multiplicity, they may experience uncertainty and periods of retreat, so the wise instructor would do well to provide encouraging support along with the challenge (Kloss, 1994). When courses are carefully designed and implemented, disequilibrium may be stimulated that results in upward movement along the Perry scheme (Kloss, 1994; Moore, 1994; Perry, 1999).

In learning situations that require students to substantiate their answers, Perry (1981) discovered an interesting paradox. Students in position 4 may begin to think more independently and critically out of desire to conform to the expectations of their instructors. Consequently, instructors might consider using more discussion venues to demonstrate diversity of thought; they should exhibit out loud their own thought patterns; and they should avoid the strict use of delivering PowerPoint® presentations in an attempt to cultivate and promote intellectual development.

Future Research

Our use of the LEP instrument to measure intellectual development suggests that a long-term study, such as at the beginning and end of a degree program or during periods of significant transition, may show substantial intellectual progression. Transitions are significant moments for students' intellectual development because these new, uncertain situations typically force students to step outside the familiar and in so doing, they grow. This may indicate why students accrue significant personal and professional growth when they undertake out-of-state internships. Additionally, the LEP instrument could be used to assess if any intellectual change might occur as a result of international travel or study abroad experiences as these too require the student to venture beyond the familiar.

Further, a department-wide study could be performed using the LEP instrument to determine if students advanced along the Perry continuum as they progressed through a four-year curriculum, especially if multiple instructors incorporated changes designed with movement in mind. For example, extensive longitudinal studies performed over a ten-year period at Alverno College using the Perry scheme indicated that students and alumni showed a gradual pattern of intellectual development during college, with changes continuing after graduation (Hart et al., 1995).

Summary

Results from this study do not suggest any significant movement along the Perry continuum over the course of one semester; in fact, a significant number of students showed backward movement in their intellectual development. However, this research illuminates the challenge of instructing students who have had prior experiences related to their field of study because these students may retreat in order to reconcile differences in the information provided by both good, yet different, authorities.

An awareness of Perry's Scheme may help instructors recognize that student perspective, behavior and performance in class may reflect their position of intellectual development more than instructor effectiveness. For example, comments on teaching evaluations such as *"This was the most disorganized course I have ever taken"* or *"I taught myself everything that I learned in this course with no help from the instructor"* can be disheartening and frustrating for teachers to read. However, armed with an appreciative realization of how students view their world, instructors have a context to interpret such comments.

As higher education continues to experience rapid changes in the diversity and complexities of student populations, and university and industry leaders demand that students graduate with critical-thinking skills, it is clearly to the instructors' advantage to avail themselves to a powerful framework for understanding student intellectual development, the Perry Scheme.

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