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Problem-Solving Ability in Courses with Multiple Types of Experiential Learning

John P. Walker Louis M. Rocconi
University of Tennessee, Knoxville

Abstract

This study seeks to understand how courses with multiple types of experiential learning (EL) affect students' perceptions of problem-solving ability. Problem-solving, an approach that applies knowledge and skills to resolve or address a problem that has no formal solution process, has a strong connection with EL. Studies show students that participate in EL have stronger problem-solving skills compared to students who have not participated in EL (Blair et al., 2004; Conrad & Hedin, 1991; Prentice & Robinson, 2010); however, few studies have examined the effects of students exposed to multiple types of EL on problem-solving ability. Two surveys collected student perceptions of problem-solving attainment at the beginning and end of EL courses. A multilevel model was constructed to measure the problem-solving ability of students (N = 385) based on characteristics of their course (N = 20). Courses that incorporate combinations of EL, such as using service-learning and undergraduate research together, have strong impacts on problem-solving skills for undergraduate students, particularly freshmen and sophomores, compared to students in courses with one type of EL. Students that are exposed to multiple types of EL in the early stages of their undergraduate studies will show stronger growth in their problem-solving ability prior to entering the workforce.

Keywords: Experiential learning, problem solving, student engagement

Problem-Solving Ability in Courses with Multiple Types of Experiential Learning

Experiential learning (EL) – defined as the transformation of knowledge through reflective practices from applied experiences (Kolb, 1984) – provides students with real-world, hands-on experiences as they earn course and co-curricular credit. Employers have stressed the need for graduates to enter the workforce with hands-on experience (Jackson, Lower, & Rudman, 2016; Lowden, Hall, Elliot, & Lewin, 2011); however, most students do not gain experience from the traditional academic setting. Instead, students need opportunities outside of the traditional classroom to allow them to problem-solve on challenges encountered in real-world settings. Students at some institutions are required to participate in EL, which includes internships, research opportunities, study abroad, service-learning, and simulation and role- playing activities, prior to graduation (e.g. University of Georgia; Elon University; Kent State University; University of Wisconsin, Stevens Point; Washington and Lee University; Northeastern University; University of North Carolina, Chapel Hill).

Although EL has been around since the existence of formal education, the modern theory of EL did not take shape until the 1980s (Kolb, 1984). David Kolb (1984) formalized the basic concepts of experiential education that outline the steps necessary for learning to occur in a hands-on experience. Kolb theorizes that formal reflection after an experience allows a student to understand the successes and shortcomings from the experience. After reflection, the student plans out ways to make improvements for the next experience. Thus, a cyclical process of doing, reflecting, and thoughtful planning is created. When the theory is put into practice, students are expected to develop and refine desirable attributes employers seek in a potential employee. Eyler and Giles (1999) found students who practice regular reflection showed a statistically significant increase in problem-solving and critical- thinking skills after involvement in an EL opportunity.

An American Management Association (2010) survey discovered employers are interested in hiring individuals with traits that are aligned with many of the benefits attributed to EL, such as strong problem-solving skills. Higher education institutions are now beginning to integrate hands-on experiences into the curriculum and co-curriculum by making EL opportunities more available to a wider range of students. Some universities have even made EL a general education requirement, while others have integrated EL into the curriculum as part of their continuous improvement plan (e.g. University of Alabama; University of Tennessee; Loyola University, New Orleans).

The career significance of problem-solving skills

Problem-solving is an approach that applies knowledge and skills to resolve or address a problem that has no formal solution process (Lovett, 2002; Wang & Chiew, 2010). In essence, effective problem- solving is comprised of four essential traits: cognition, process, direction, and personal experience (Mayer & Wittrock, 2012). Cognition refers to a problem solver's ability to connect their knowledge and skills with the current problem. The process refers to the problem solver's ability to employ their knowledge and skill in a methodical manner. Direction refers to the problem solver's ability to plan and set goals as a means to guide the cognitive process. Personal experience refers to the problem solver's ability to reflect on previous experiences to apply relevant knowledge and skills. To that end, Funkhouser and Dennis (1992) suggest that successful problem-solving ability contains equal parts cognition, behavior, and attitude. An effective problem solver can connect and apply knowledge and skills to find solutions to new problems. In addition, they possess the self-confidence to explore and experiment with new connections.

Problem-solving in a real-world context adds value to students' employability. A Hart Research Associates (2013) study shows employers are most interested in potential employees who exhibit strong problem-solving skills. In this national survey of business and nonprofit leaders (n = 318), respondents were asked what they valued from employees and the attributes current students should develop. The study found 93% of respondents indicated problem-solving, communication, and critical thinking skills were more important than the undergraduate major of the potential employee. When asked about what attributes were most significant to develop, more than 75% of respondents emphasized problem-solving skills and applied knowledge in real-world settings. Employers suggested colleges should place more emphasis on learning outcomes that focus on "critical thinking and analytical skills" (82%), "the ability to analyze and solve complex problems" (81%), and "the ability to apply knowledge and skills to real- world settings" (78%; Hart Research Associates, 2013).

A recent survey conducted by the National Association of Colleges and Employers (2017) shows, in addition to strong collaborative skills, students who displayed the strongest problem-solving skills were most likely to be hired by an employer. More than 80% of respondents indicated they look for evidence of problem-solving skills on candidates' resumes. Research has shown students involved in EL display high levels of problem-solving ability, as well as demonstrate increased levels of reflective behavior and social awareness (Mak et al., 2017).

Exposure to multiple types of EL

To the knowledge of the author, no studies have investigated the effect multiple types of EL in a single class have on student outcomes. Although students who are exposed to a class with multiple types of EL have not been extensively examined, the connection between EL and the development of problem-solving skills is well documented (Batchelder & Root, 1994; Blair et al., 2004; Eyler & Giles, 1999; Osborne et al., 1998; Prentice & Robinson, 2010). Students who participate in EL tend to show stronger problem-solving skills after their experience compared to before their experience (Rich et al., 2015; Wang et al., 2014). Conrad and Hedin (1991) found problem-solving skills, measured as the time to react to a sequence of real-life situations, improved for students in a service-learning experience when compared to students who did not participate in a service-learning opportunity. EL, coupled with academic learning, has shown to make drastic improvements in problem-solving ability; however, the number of EL opportunities have an even greater impact on student performance (Coker et al., 2017).

Students' exposure to multiple EL opportunities can have many positive effects on student learning. A study from Elon University examined the breadth and depth of EL for undergraduate students (Coker et al., 2017). In the study, depth was operationalized as the amount of time spent in EL, where breadth was operationalized as the number of different types of experiences. The researchers found students who participated in multiple EL opportunities (breadth) have higher retention rates than students who participated in one or no EL activities. Participants in multiple EL opportunities were also shown to have significantly stronger problem-solving skills compared to students who were exposed to one or no EL activity. In another study on breadth, students showed positive perceptions of increased learning from exposure to different types of EL (Finley & McNair, 2013).

The effect of EL on racial and ethnic minority students

Several studies have shown the positive impact hands-on learning experiences have on minority students (Finley & McNair, 2013; Hurtado et al., 2010; Marshall et al., 2016; Plokowski & Joseph, 2011). Finley and McNair (2013) found students of underrepresented minority racial and ethnic groups who participated in multiple types of EL reported higher levels of deeper learning approaches (i.e., engaging in the learning through application of knowledge and skills, and reflecting on experiences to integrate earlier learning with new learning) compared to those who did not participate in any type of EL. African American, Asian American, and Hispanic students all showed increasingly higher gains in learning as they participated in more EL activities (Finley & McNair, 2013). Students who participate in EL were also shown to have high retention rates and graduation rates compared to students who did not participate in EL (Crosling et al., 2009; Plokowski & Joseph, 2011). Comparatively, students of racial and ethnic minority groups who participated in EL displayed higher retention and graduation rates than the average student from those groups (Adedokum & Burgess, 2011; Hurtado et al., 2010; Jones et al., 2010).

Despite the positive achievement effects of EL, a large discrepancy in student achievement and exposure to EL between students from different ethnic and racial groups has historically persisted (Kuh et al., 2017; Lundberg et al., 2007; Ortiz et al., 2015; Penn & Tanner, 2009; Pearl & Christensen, 2017). Ethnic and racial minorities, including African Americans, Asian Americans, and Hispanics, have had lower participation rates in many types of EL when compared to the White students (Kuh et al., 2017; Pearl & Christensen, 2017). However, a study from the National Survey of Student Engagement (NSSE) shows service-learning participation rates were higher among minority students compared to White students (NSSE, 2012). The NSSE (2012) also found participation rates in other types of EL were closely behind their White counterpart. This trend likely indicates that institutions are finding more substantive ways of drawing-in minority students.

Coker and Porter (2015) found students were most likely to participate in EL opportunities they felt were more relatable to their identity, beliefs, and backgrounds. For example, students showed interest in study abroad programs that were geographically aligned with their ethnic background. Even so, students need to see the value of the experience for it to produce any substantive, long-term gain for the student (Coker & Porter, 2015). Penn and Tanner (2009) recommended that institutions include service-learning pedagogy in a study abroad opportunity to increase minority interest in EL. Minority students who have participated in EL have not only shown increased participation rates, but also higher levels of learning and active involvement (NSSE, 2017). Students of underrepresented populations who participated in EL have also shown increased levels of problem-solving ability after completing their hands-on experience (Fedynich et al., 2012).

First-generation students in EL

Although first-generation students continue to participate at lower rates than most minority groups (Kim & Sax, 2009; NSSE, 2017), they often have the most to gain from hands-on experiences. Lundberg et al. (2007) used multiple OLS regressions to examine the relationship between first-generation status and predictors of student involvement and learning. This study found a negative effect between first- generation status and student involvement, but found that first-generation status and student learning were positively correlated. First-generation students who participate in EL see both academic and cultural gains (Conley & Hamlin, 2009; Yeh, 2010). These students benefit significantly when they are exposed to EL opportunities, such as service-learning and study abroad (Kuh, 2008). First-generation students who participated in multiple types of EL have reported engagement in deep learning approaches compared to first-generation students who did not participate in a hands-on experience (Finley & McNair, 2013).

Yeh (2010) found first-generation students felt their problem-solving ability improved because of their exposure to EL. When compared to their counterparts, first-generation students have shown increasingly similar levels of problem-solving ability as both sets of students participated in more EL activities (Finley & McNair, 2013). Other studies showed connections between problem-solving ability and exposure to EL among many different groups (Conrad & Hedin, 1991; Fedynich et al., 2012; Thomas et al., 2017). However, EL has shown a positive effect on first-generation students in the areas of problem-solving and other high-impact skills (Finley & McNair, 2013). While studies have investigated the effects of EL on first-generation students and problem-solving abilities, few, if any, studies have looked at the effects of problem-solving abilities on multiple types of EL from a single class and first-generation status.

Purpose and Research Questions

This study will examine the effect of courses with multiple types of EL on students' perceptions of problem-solving ability. Additionally, the study seeks to understand if an effect on students of color and first-generation students exists after students complete the course. In this study, students enrolled in an experiential course rated their problem-solving abilities in a real-world context before and after their experiences. To determine the effect of multiple types of EL, we will explore the following questions:

RQ1: What effects do multiple types of EL in a class have on students' perception of problem-solving ability at the end of the semester controlling for pre-course perceptions of problem-solving ability?

RQ2: What influence does race and first-generation status have on changes in students' perceptions of problem-solving ability?

RQ3: What influence does class-level (i.e., graduate, majority freshman/sophomore, majority junior/senior courses) have on changes in students' perceptions of problem-solving ability?

RQ4: Does the relationship between first generation status and race on changes in perceptions of problem-solving ability depend on the number of EL types the students are exposed to?

A multilevel model will be used to address the research questions since there are multiple factors that can contribute to the student responses across multiple levels (student and course). Race, first-generation status, and the number of EL types taught in a course will serve as key explanatory variables in the model.

Method

This study examines the responses to two surveys administered to students who participated in a course with EL as the main pedagogy at a four-year, research-intensive, southeastern U.S. university. The courses selected for the study were part of a year-long EL program that redesigned the course to incorporate different forms of EL into the course. Some courses included a single type of EL, while others added multiple types of EL into the curriculum. Students enrolled in the courses without prior knowledge of the redesign. Students were given a survey that asked about their perceived achievement of four outcomes: value lifelong learning, application of knowledge and skills, collaboration with others, and reflective behavior. However, the responses to the application of knowledge and skills construct were only examined since this study is concerned with problem-solving behaviors. The survey was given at the beginning of the semester to serve as a baseline and again at the end of the semester to examine any changes. Responses to the post-experience surveys were examined using a multilevel modeling analysis.

Sample

Data were collected from completed pre-experience and post-experience surveys administered to students who enrolled in a course that took part in the EL program during the 2017-18 academic year. The response rate for the completion of both surveys was 44.2%, of which 385 students enrolled in 20 EL courses gave consent to use their responses for this study. Responses from the two student surveys were analyzed to examine student perceptions of problem-solving ability. Students were instructed to rate their level of agreement on questions related to the application of knowledge and skills in a real- world context using a 7-point scale (i.e., (1) *strongly disagree*, (2) *disagree*, (3) *somewhat disagree*, (4) *neither agree nor disagree*, (5) *somewhat agree*, (6) *agree*, (7) *strongly agree*). In addition, the students reported the course in which they were enrolled within the program.

Courses varied in size, level, and number of EL types. Survey participants came from two graduate EL courses, nine undergraduate EL courses with majority freshman and sophomores, and nine undergraduate EL course with majority juniors and seniors. The EL courses ranged in size from one to 174 students per course. The EL courses in this study included at least one of type of EL (i.e., internships, research opportunities, study abroad, service- learning, or simulation and role-playing activities) as the main pedagogy of the course. Ten courses contained only one form of EL and eight courses contained more than one type. In total, 20 EL courses from 15 departments at the university took part in the surveys, including Agricultural Leadership, Art, Earth and Planetary Sciences, Educational Policy, Education, English, Forestry, Geography, Information Sciences, Journalism, Management, Marketing and Supply Chain Management, Materials Science and Engineering, Foreign Languages, Nursing, and Philosophy.

Demographic information was collected from a data warehouse maintained by the institution and reported by the student upon enrollment. Collected demographic information included: gender (male = 0, female =1), Pell eligibility (No = 0, Yes = 1), race/ethnicity (White = 0, Non-white = 1), class standing (Graduate as the reference group), and first-generation status (Non-first-generation as the reference group). Table 1 outlines the aggregated demographic information of survey completers.

Table 1

Descriptive Statistics of Participants

	Pre-Scores		Post-Scores			
Variable	Mean	SD	Mean	SD	Frequency	Percentage
Gender						
Female	5.51	0.96	6.21	0.83	238	62%
Male	5.67	0.89	6.23	0.80	147	38%
Race/Ethnicity						
Non-white	5.43	0.95	6.25	0.68	71	18%
White	5.60	0.93	6.24	0.77	314	82%
Class Standing						
Freshman	5.51	0.95	6.16	0.76	119	31%
Sophomore	5.61	0.91	6.25	0.76	112	29%
Junior	5.77	0.97	6.35	0.95	50	13%
Senior	5.59	0.93	6.36	0.61	81	21%
Graduate	5.27	0.93	5.61	1.29	23	6%
Pell Eligible (SES)						
Yes	5.51	1.04	6.37	0.60	76	20%
No	5.59	0.91	6.18	0.86	309	80%
First-Generation						
Yes	5.65	1.07	6.46	0.65	33	8%
No	5.56	0.92	6.22	0.75	316	82%
Unknown	5.63	0.97	6.19	0.90	36	9%

Note. N = 385, Pell eligible measures socioeconomic status (SES). Male, White, Graduate, Pell Eligible (No), and First- Generation (No) serve as the reference group for their respective variables. Pre-Scores and Post-Scores are scored using a likert- scale: 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree.

Outcome variable: Problem-solving in a real-world context

An exploratory factor analysis was used to identify factors from the pre-experience and post-experience surveys. The surveys contained multiple observable items used to measure each learning outcome in the program, including "students' ability to apply knowledge and skills in a real-world situation". The surveys are composed of the same four factors including one identified as "application of knowledge and skills in a real-world situation". The factor consists of the same six items related to the application of knowledge and skills through problem-solving scenarios. For the purposes of this study, items under the "application of knowledge and skills in a real-world situation" factor were averaged, providing a single mean composite score for each respondent. The list of items, factor loadings, and percentage of variance explained are outlined in Table 2. The alpha reliability of the factor in the post- experience survey was .921, while the same alpha reliability in the pre-experience survey was .901. The composite score from the first survey is used as an individual-level predictor, while the composite score from the second survey serves as the outcome variable in this analysis.

Table 2
Application of Knowledge and Skills in a Real-world Scenario Factor

Items	Factor Loading_{pre}	Factor Loading_{post}
I can describe a real-world problem to someone who knows little about the problem	.810	.696
I have been introduced to more than one way to address real-world problem(s)	.845	.788
I feel confident in my ability to develop a logical, consistent approach to improve a real-world problem	.865	.821
I can list potential ethical issues for real-world problems	.748	.793
I can draw conclusions from data	.533	.874
I am able to identify and apply information to address and potentially improve real-world problem(s)	.837	.854
Percentage of Variance	32.98	48.98

Note. The pattern matrix converged in 5 iterations using PAF extraction and promax rotation. Cronbach's alphapre = .901. Cronbach's alphapost = .923.

Individual-level variables

Multiple explanatory variables were added to the model at the individual-level which include student reported identities of race, first-generation status, gender, and socioeconomic status (SES). Race is distinguished between White students and non-White students. First-generation status is defined as an individual with neither parent receiving any formal postsecondary education. SES is operationalized through a student's eligibility for the Pell Grant; that is, a student is either Pell eligible (low SES) or not eligible (non-low SES). Gender, race, and SES are operationalized as nominal dichotomous variables, while the pre-experience survey score is treated as a continuous variable. First-generation status contained missing values that were determined to be missing completely at random, Little's MCAR $\chi^2(1) = .417$, $p = .519$. Therefore, first- generation status is dummy coded such that first-generation student (known cases) and the unknown status (unknown cases) are each dichotomized with the reference group, non-first-generation student. Given the large number of missing cases for this variable (9% of cases), dummy coding the variable will minimize the chances of bias results and maintain power compared to a deletion method because no cases will be excluded from the analysis (Baraldi & Enders, 2010).

The individual predictors of interest, race, first-generation status, and the pre-experience survey scores were centered on their group means while the SES and gender were centered on the grand mean. Group mean centering was determined to be the most appropriate centering method for race and first- generation status because both predictors are essential to answering the first two research questions and both predictors interact with a course-level predictor, number of EL types (Enders & Tofighi, 2007; Peugh, 2010). The pre-experience survey scores interact with class standing, another course-level predictor variable. Thus, the pre-experience survey scores were centered on the group mean (Enders & Tofighi, 2007). Gender, SES, and first-generation status with unknown cases are not essential to answering any research question, nor do the predictors interact with any other predictor in the model; therefore, grand mean centering was determined to be the best choice (Enders & Tofighi, 2007).

Random-effects were added to the race and first-generation status coefficients to explore the variation of race and first-generation status across the number of EL types in a course. The significance value of the random-effects was explored to determine if the coefficients for each variable should be allowed to vary across course-level variables.

Course-level variables

The number of EL types and class standing were examined at the course-level. The number of EL types is operationalized as a dichotomous variable (i.e., two or more ELs and single EL). Class standing is defined by the cohort classification of the majority in the course. That is, courses with majority freshmen and/or sophomores are classified as underclassman courses; courses with majority juniors and/or seniors are classified as upperclassman courses; courses with majority graduate students are classified as graduate courses. Class standing is dummy coded such that courses with majority graduate students serve as the reference group. The course-level predictors, number of EL types and class standing, were centered on the grand mean. Enders and Tofighi (2007) note grand mean centering should be used for course-level predictors that are essential to the research question. The cross-level interactions between the number of types of EL and race, and the number of types of EL and first- generation status are necessary to explore the fourth research question.

Results

Unconditional model

The modeling process follows the steps suggested by Peugh (2010). This section outlines the estimation method and a quantitative justification for the use of multilevel modeling. Restricted maximum likelihood (REML) was used as the estimation method for this study because differences between models with varying random slopes and fixed slopes will be explored (Peugh, 2010). Additionally, REML is the preferred method when the study contains few level-2 units (Bryk & Raudenbush, 1992; Hox et al., 2018). McNeish (2017) states that analyses with fewer than 50 upper level units are too few for the full maximum likelihood method resulting in increased chances of Type I error. Research has shown that REML estimations for models with small level-2 sample sizes can reduce the chances of Type I error even for models fewer than ten level-2 samples (McNeish & Stapleton, 2016).

An unconditional model was constructed to explore the appropriateness of a multilevel model. Hox et al. (2018) found 5% variability between the upper level units is necessary for multilevel modeling to be justifiable. An intraclass correlation (ICC) shows 6.9%, $\tau_{00} = .04$, $\chi^2(19) = 52.16$, $p < .001$, of the variability in responses to the post-experience survey is due to the differences between courses. Peugh (2010), however, notes an intraclass correlation of $\rho > .05$ does not necessarily indicate a need for multilevel modeling. He recommends a design effect (*deff* > 2) couple the ICC to justify a need for multilevel modeling. A design effect of 2.25 indicates a multilevel model is needed for this analysis.

Individual-level model

Several assumption tests were conducted for the level-1 predictors. First, a chi-squared test indicated homogeneity of variance was violated at the individual-level model, $\chi^2(18) = 52.96$, $p < .001$. A graphical examination of the model was evaluated to determine if specific values skew the data. Two outliers that could potentially influence the homogeneity of variance were found. A comparison between the models with the two outliers omitted and included showed issues of homoscedasticity with the outliers; therefore, an individual-level model with the outliers omitted was used for the remainder of the study. The level-1 residuals were examined for normality using histograms and Q-Q plots. Although the tails show some deviation from the expected value of the model, the observed scores appear to show a normal distribution; thus, normality was assumed for the level-1 residuals. A test for multicollinearity between level-1 predictors showed a variance inflation factor less than 4, indicating that there are no multicollinearity problems with the level-1 predictors.

The individual-level model was constructed to allow each predictor variable centered around its group to vary across courses. Three conditional models with random intercepts and random slopes were constructed such that each conditional model allowed for one predictor to vary across levels at a time. The purpose of this test was to prevent misspecification of the random component. Each model was compared to the fixed conditional model with a random intercept and no random slope. Likelihood tests determined no model was significantly different from the conditional model with fixed slopes (see Table 3). The most parsimonious model was chosen at the individual-level (M_1):

$$Post = \beta_{0j} + \beta_{1j}pre + \beta_{2j}race + \beta_{3j}firstgen\_known + \beta_{4j}firstgen\_unknown + \beta_{5j}ses + \beta_{6j}gender + u_{0j} + r_{ij}$$

Table 3
Likelihood Test for Varied Slopes at the Individual-level

Variable	χ^2	df	*p*-value
Pre-Score	4.01	2	0.135
Non-White	< 0.01	2	0.998
First-Gen_Known	0.02	2	0.990

Note. Chi-squared values are the difference between deviances of individual-level random-effects models of the specified variables and the individual-level fixed-effects model of the specified variables. Degrees of freedom are the difference between the number of parameters of the individual-level random-effects models and the individual-level fixed-effects model.

The individual-level conditional model with random intercept found significant fixed-effects for the intercept and pre-experience survey scores. The coefficient of the intercept indicates the mean score for post-experience survey for all students when controlling for individual-level predictors ($\beta = 6.32$, $p < .001$). Thus, students indicated high levels of achievement in problem-solving ability in a real-world context after the experience. Results from the pre-experience survey showed a significantly, positive relationship for post-experience survey scores ($\beta = .88$, $p < .001$). Results for race and first-generation status were not statistically significant. Overall, the individual-level predictors explained 9% of the within-course variance in post-experience survey scores, while no between-course variance was explained by the individual-level predictors. The global effect size of the conditional model showed little variance between the individual-level and course-level predictors (pseudo-$R^2_{global} = 0.14$).

Course-level model

Level-2 diagnostics were assessed for multivariate normality, homogeneity of variance, and multicollinearity. The level-2 residuals were examined in Q-Q plots showing weak multivariate normality. McNeish and Stapleton (2016) note that models with few level-2 units will likely lack a normal structure. The homoscedasticity assumption was met after examination of the scatterplot of the Empirical Bayes intercept and the predicted intercept found no visible pattern. The variance inflation factors between the level-2 predictors showed that multicollinearity between predictors was unlikely (*VIF* < 3). Thus, the assumptions for level-2 predictors were met.

Course-level predictors were added to the model intercept to determine if differences in post-experience survey scores were significant between different groups across the course-level (see M_2 and M_3 in Table 4). A comparison between the Akaike Information Criterion (AIC) of the course-level fixed- effects model (M_2) and the cross-level interaction-effects model (M_3) showed that the course-level

fixed-effects model produces the most parsimonious model. Therefore, the mixed model for the course- level fixed-effects was constructed such that:

$$Post = (\gamma_{00} + \gamma_{01}ELtype + \gamma_{02}upper + \gamma_{03}under) + \gamma_{10}pre + \gamma_{20}race + \gamma_{30}firstgen\_known + \gamma_{40}firstgen\_unknown + \gamma_{50}ses + \gamma_{60}gender + u_{0j} + r_{ij}$$

Table 4
Multilevel Model for Individual-level and Course-level Predictors on Post-Experience Survey Scores

Model	M_0: Unconditional	M_1: Individual-level fixed-effects[a]	M_2: Course-level fixed-effects	M_3: Cross-level interactions
Fixed-effect	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	6.31 (.06)***	6.32 (.06)***	6.30 (.06)***	6.30 (.06)***
Pre-Score		0.88 (.14)***	0.25 (.04)***	0.20 (.06)***
Non-White		-0.01 (.10)	-0.01 (.10)	<0.01 (.10)
First-Gen_Known		0.14 (.13)	0.15 (.13)	0.13 (.14)
First-Gen_Unknown[b]		-0.10 (.13)	-0.03 (.13)	-0.07 (.13)
Pell Eligible		0.14 (.09)	0.15 (.09)	0.15 (.09)
Female		-0.01 (.08)	-0.01 (.08)	-0.02 (.08)
No. of EL Types			0.23 (.10)*	0.23 (.10)*
Underclassman			0.37 (.19) †	0.35 (.19) †
Upperclassman			0.50 (.21)*	0.49 (.21)*
Pre-Score*EL Types				0.06 (.09)
Pre-Score*Underclass				0.36 (.19)†
Pre-Score*Upperclass				0.27 (.22)
Non-White*EL Types				0.07 (.20)
First-Gen_Known*EL Types				-0.16 (.27)
First-Gen_Unknown*EL Type[b]				0.09 (.25)
Random-effect				
σ_r^2	0.53	0.48	0.48	0.48
σ_{u0}^2	0.04	0.04	0.01	0.01
-2*log likelihood	859.76	837.05	832.19	837.49
AIC	853.76	841.05	836.19	841.49
BIC	865.75	842.04	838.18	843.48

Notes. Standard errors are in parenthesis for fixed-effects. First-Gen_Known and First-Gen_Unknown are dummy coded at the individual-level with non-first-generation students as reference group. Upperclassman and Underclassman are dummy coded at the course-level with Graduates as the reference group. Individual-level N = 385, Course-level N = 20.
[a] Two individual-level values were excluded from the analysis after it was determined that they were outliers; hence, individual-level N
= 383 after unconditional model.
[b] First-Gen_Unknown is not of substantive importance (0 = known values, 1 = unknown values) and was not interpreted in the analysis, but fixed-effects were included for reader's interest.
†$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$

The number of experiential types predictor examined the difference between post-experience survey scores between courses with multiple types of EL and courses with a single type of EL. There was significant difference in survey scores between multiple types of EL and courses with a single type of EL amongst students in the program ($\gamma = .23$, $p < .05$). In addition, significant differences in survey scores between courses with majority upperclassman and majority graduate students were found ($\gamma =$ $.50$, $p < .05$) and courses with majority underclassman and majority graduate students were also found to be significantly different ($\gamma = .37$, $p < .10$). The course-level predictors explained 75% of the between- course variance on the post-experience scores.

Discussion

Significant increases between the pre-experience survey scores and the post-experience survey scores were found across all students. However, the difference between post-experience scores among the different groups of students were mostly negligible when other factors were held constant. This section examines and interprets the results.

Differences between Groups at the Individual-level

Although most minority students in EL courses perceived their problem-solving abilities to be greater than White students' perceived problem-solving ability, there was no significant difference between the non-White group and White group. The findings from this study are consistent with previous studies on race and EL (Fedynich et al., 2012; Finley & McNair, 2013; Hurtado et al., 2010). Finley and McNair (2013) showed students from minority backgrounds benefited significantly more in problem-solving ability from EL compared to their White counterpart. The participation disparity between White and non-White students in the program likely influences the results; however, the results indicate all students, regardless of race, are benefiting from EL.

Other studies have found similar findings (Batchelder & Root, 1994; Blair et al., 2004; Eyler & Giles, 1999; Osborne et al., 1998; Prentice & Robinson, 2010). Prentice and Robinson (2010) found college students participating in EL reported statistically higher levels of application of coursework in real-world situations compared to students not in an EL course. Osborne et al.

(1998) observed service- learning students and non-service-learning students did not significantly differ in cognitive complexity related to problem-solving ability at the beginning of the experience but did at the end of the semester. Other studies on the effects on problem-solving ability before and after experiences were also examined from Rich et al. (2015) and Wang et al. (2014). Although this study was not able to verify the differences between students in an EL course and non-EL course, there is evidence to suggest student perceptions of problem-solving skills may have improved not only in service-learning courses, but in other types of EL, too.

Although the results suggest first-generation students do benefit from participation in EL, their perceived gains in problem-solving ability are not significantly different from non-first-generation students in courses with EL. This was consistent with Lundberg et al. (2007), who showed first-generation students benefit from participation in EL; however, the results from this study show differences of perceived gain in problem-solving ability was negligible.

Differences between Groups at the Course-level

The number of types of EL in a course does impact the students' perception of problem-solving. The post-experience survey scores for students in courses with multiple types of EL indicated higher levels of perceived problem-solving ability than students in courses with a single type of EL with constant pre-experience scores are held constant. The results are comparable to the Coke et al. (2017) study on the effects of breadth and depth of EL. Students who took many different forms of EL (i.e. breadth) were more likely to see higher scores on problem-solving assessments compared to students who only took one or no EL course. Additionally, Finley and McNair (2013) found positive impacts on perception of learning after students took multiple types of EL. The results from these studies show the added benefit of student exposure to multiple forms of EL. Not only do students gain from multiple types of EL over the course of the curriculum, but the effects could be almost immediate from a single course.

Interestingly, courses with majority underclassman and majority upperclassman showed significantly higher levels of problem-solving ability compared to courses with majority graduate students. The underclassman courses even indicate higher problem-solving ability compared to graduate-level courses when taking the pre-experience student scores into account. The results likely indicate graduate students have already had enough exposure to EL, through past academic studies or industry, that the impactful effect on them is less compared to an undergraduate student. The results suggest institutions should incorporate EL into undergraduate level courses, especially courses with majority first-years and sophomores, to gain the most from real-world experiences during a student's academic tenure. Maguire (2018) found students who were exposed to EL early in a business program had strong associations with increased levels of confidence and higher levels of engagement with classmates. Early exposure to the EL has many added benefits for students and should be considered in all academic programs.

The differences between race in multiple types of EL and a single type of EL are mostly non-significant. Non-White students have similar post-experience survey responses with White students, whether they are in a course with a single type of EL or multiple types of EL. These results suggest EL has a positive impact on students, regardless of race and the number of EL types exposed to students. The differences between first-generation students and non-first-generation students in courses with a single type of EL and multiple types of EL was not different. This result indicates the combination of first-generation status and the number of EL types in a course does not significantly impact the post- experience survey scores. First-generation students not only have nonsignificant differences in perceived problem-solving ability with non-first-generation students, but do not differ among themselves in perceived problem-solving ability when comparing the number of EL types they are exposed to in a single course. Although results show no differences between groups, the benefit of participation in EL shows all students have made gains in problem-solving ability after involvement in EL. These results are significant to show students are all gaining from these experiences.

In addition to students' exposure to different types of EL throughout their undergraduate experience, some courses have integrated multiple types of EL into a single class. For example, a Spanish course could conduct a service-learning project that works with the Hispanic community to integrate cultural events in the local community. They could also include undergraduate research by surveying the community on their knowledge and attitudes of the Hispanic community. Students in these courses produce higher levels of perceived problem-solving skills compared to students who are exposed to the service-learning or undergraduate research only. Although increases occur regardless of the number of experiential learning types, integration of multiple types of experiential learning into a single course seem to have additional benefits.

Limitations

Maas and Hox (2005) recommends sample sizes in a multilevel model exceed 50 upper level units to ensure statistical power. This study contained small sample sizes ($N_{lvl1} = 385$; $N_{lvl2} = 20$) that may influence the statistical significance of the interaction between the level-1 and level-2 units. Additionally, several variables (race, first-generation status, and SES) had disproportional sample sizes between groups which also could affect the statistical power of the model.

This study did not regulate the number of EL types used in the study. Specifically, it was difficult to know how many types of EL could be beneficial for a course. Some courses claimed to have used as many as five types of EL in a course. Courses with too many EL types could have influenced the outcome of the results. Although this study does suggest that students in courses with multiple types of EL report significantly higher levels of problem-solving ability compared to students in a course with a single type of EL, courses with only two or three types of EL could have even greater impact when only compared to a single type of EL. In addition, this study does not contain a control group of students who were not in an EL course. A control group could provide further insight into the benefits of EL.

Conclusion

Institutions interested in improving problem-solving abilities for all students could implement policies requiring multiple types of EL in courses. Courses that incorporate combinations of EL, such as using service-learning and undergraduate research together, have strong problem-solving impacts on undergraduate students, particularly freshmen and sophomores. Students who participate in multiple types of EL in the early stages of their undergraduate studies have the added benefit of refining and building their problem-solving ability prior to entering the workforce. This outcome makes these types of students a desirable candidate for future employers. If facilitated correctly, the benefits of exposing students to multiple types of EL in a course have the potential to improve problem-solving skills. Supporting faculty to implement combinations of EL could greatly affect student learning even beyond problem- solving ability.

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