The SoTL Grant Proposal:

Problem Based Learning: Perceptions and Impact on Student Learning in a Liberal Studies-Critical Thinking and Communication Course

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Abstract

There is an increased use of active learning strategies in higher education to create more student-centered learning environments. This proposed work seeks to investigate the influence of problem-based learning on student learning, and the perception of problem-based learning as an active learning strategy. The main objectives are to evaluate the impact of this instructional method on students' critical thinking and communication skills, and to provide recommendations based on insights gained from this work. Qualitative and quantitative approaches are used to answer the research questions and to fulfil the research objectives. The context of this work is embedded within a Liberal Studies-Critical Thinking and Communication (LBST 2301) pilot section offered by the Engineering Technology and Construction Management department. This work can serve to complement UNC Charlotte LBST 2301 pilot group's efforts and to bolster the department's future LBST 2301 offerings.

Budget Request for SOTL Grant

Year 2017

Joint Proposal? ____ Yes x No

Title of Project: Problem Based Learning: Perceptions and Impact on Student Learning in a Liberal Studies-Critical Thinking and Communication Course

Duration of Project: January 2018 to June 2019

Primary Investigator(s): Nicole Barclay

Email Address(es): nbarclay@uncc.edu

UNC Charlotte SOTL Grants Previously Received (please names of project, PIs, and dates): NA

Allocate operating budget to Department of: Engineering Technology and Construction Management

		Year One
Account #	**Award**	**January to June**
Faculty Stipend	Transferred directly from Academic Affairs to Grantee on May 15	$ 3850
911250	Graduate Student Salaries	
911300	Special Pay (Faculty on UNCC payroll other than Grantee)	
915000	Student Temporary Wages	
915900	Non-student Temporary Wages	
920000	Honorarium (Individual(s) not with UNCC)	
921150	Participant Stipends	
925000	Travel - Domestic	

926000	Travel - Foreign	
928000	Communication and/or Printing	
930000	Supplies	
942000	Computing Equipment	
944000	Educational Equipment	
951000	Other Current Services	
	GRAND TOTAL	$ - 3850

		Year Two
Account #	**Award**	**July to June**
Faculty Stipend	Transferred directly from Academic Affairs to Grantee on May 15	$ -
911250	Graduate Student Salaries	
911300	Special Pay (Faculty on UNCC payroll other than Grantee)	
915000	Student Temporary Wages	
915900	Non-student Temporary Wages	
920000	Honorarium (Individual(s) not with UNCC)	
921150	Participant Stipends	
925000	Travel - Domestic	$1200
926000	Travel - Foreign	
928000	Communication and/or Printing	
930000	Supplies	
942000	Computing Equipment	
944000	Educational Equipment	

951000	Other Current Services	
	GRAND TOTAL	$ - 1200

Attachments:

1. Attach/provide a narrative that explains how the funds requested will be used.

2. Has funding for the project been requested from other sources? ___ Yes __x__ No. If yes, list sources.

Faculty Stipend ($3850)

A Summer 2018 stipend is requested to complete data analysis and prepare recommendation reports.

Travel (Domestic) ($1200)

$1200 is requested for travel to Tampa, Florida to present findings at the American Society of Engineering Education conference.

UNC CHARLOTTE

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October 19, 2017

Scholarship of Teaching and Learning Grants Committee
Center for Teaching and Learning

Dear Review Committee:

I am pleased to support the Scholarship of Teaching and Learning grant proposal by Dr. Nicole Barclay, titled *Problem Based Learning: Perceptions and Impact on Student Learning in a Liberal Studies–Critical Thinking and Communication Course*. This project seeks to assess student and instructor perceptions of problem based learning and to evaluate student learning outcomes as a result of employing this instructional strategy. Formal assessment will lead to structured and informed revision that supports the alignment of learning objectives, instructional strategies, and student learning outcomes.

Dr. Barclay is developing the pilot section of LBST 2301 for the Engineering Technology and Construction Management department. I believe this project will contribute to the university-wide implementation of the LBST 2301 courses, and directly aid the College of Engineering in developing course sections. Thus, I enthusiastically support this project.

Sincerely,

Anthony L. Brizendine

Anthony L. Brizendine, Ph.D., P.E.
Professor and Department Chair

Specific Aims

The ***overall purpose*** of this project is to investigate the use of problem-based learning (PBL) on student learning and the perception of PBL use in a newly developed section of the Liberal Studies-Critical Thinking and Communication (LBST 2301) course. The resulting assessment from this study will be used to better align learning objectives, teaching strategies, and assessments. Additionally, relevant recommendations will be highlighted to the LBST 2301 pilot group faculty who will intentionally use active learning strategies in their courses. The ***objectives*** to be achieved with this project are to:

1. Assess the impact of problem-based learning on students' critical thinking and communication skills.
2. Provide recommendations to the LBST 2301 pilot group to help better align learning objectives, instructional strategies, and assessments for developing critical thinking and communication skills.

The ***research questions*** to be answered as a result of the project are as follows:

1. What is the influence of using a problem-based learning approach on students' critical thinking and communication skills?
2. What are the instructor's perceptions of problem-based learning for developing critical thinking and communication skills for problem solving?
3. What are students' perceptions of problem-based learning?
4. How do students' perceptions of problem-based learning align with their assessment results?

The ***rationale*** for this project and ***impact*** on undergraduate teaching and learning:

LBST 2301, required for all new incoming UNC Charlotte students from Fall 2018, encourages the use of active learning strategies to deliver material that develop students' critical thinking and communications skills. Throughout UNC Charlotte Colleges, several LBST 2301 pilot sections are being offered in Spring 2018, in preparation for full scale offerings from Fall 2018. This project proposes systematic investigation of problem-based learning, an active learning strategy, in a pilot section of LBST 2301 offered through the Engineering Technology and Construction Management (ETCM) department. Considering the context, there are implications for this work on the university, college and department levels.

Assessment results will contribute to the LBST 2301 pilot group's efforts. For example, relevant recommendations resulting from this project will aid in developing the critical thinking model that the LBST 2301 pilot group is tasked with creating for UNC Charlotte. Recommendations provided to the LBST 2301 pilot group can benefit all LBST sections which will eventually serve the entire undergraduate student body. More specifically, there will be five future sections of LBST 2301 offered by the ETCM department, each holding approximately thirty-five students. Assessing problem-based learning in engineering, engineering technology and construction management fields can help to encourage its informed use across the College of Engineering.

As a project based on a pilot section of the LBST 2301 course, it is a prime opportunity to improve the course with respect to the alignment of learning objectives, instructional strategies, and assessments for future offerings based on the assessment data from this project.

Literature Review

Definition of Problem-based Learning

Problem-based learning is a well-established active learning strategy that uses a student-centered approach to learning. The strategy is characterized by "learning by doing" (Steinemann Anne, 2003) through solving ill-structured problems. Ill-structured problems are used because they reflect more realistic scenarios that students will encounter in professional settings than textbook type problems. Gallagher et al. (1995) outline additional traits of the strategy including: teachers are facilitators; student learning is self-directed; learning occurs in small groups; problems are the tool to develop problem solving skills. The goals of problem-based learning include collaborative and interdisciplinary problem solving, critical thinking, motivation for learning, and active learning (Hmelo-Silver, 2004; Steinemann Anne, 2003).

Problem-based Learning in Engineering and Engineering Technology Education

As an active learning strategy, problem-based learning has increased in use in a range of fields, including Engineering and Engineering Technology. These fields emphasize developing problem-solving skills, however, the skill is commonly taught and practiced through traditional instruction (Yadav et al., 2011). With traditional instruction, the instructor provides students with background information on a topic, and gives students well-defined problems that have known solutions. In contrast, with problem-based learning, the given problem activates the self-directed learning process (Gallagher et al., 1995).

In engineering and engineering technology, it is common to interchange project-based learning and problem-based learning; however, the two strategies are different. According to Lee (2013), the focus of project-based learning the outcome of the project, whereas the focus of problem-based learning is the process of problem solving and learning. Project-based learning is

a more common strategy used in these fields, especially in senior students' capstone design experience. Problem-based learning can be used as a scaffold, to develop skills necessary to apply to project-based learning activities.

Assessing Problem-based Learning

Problem-based learning can be assessed in a variety of ways including through technical reports, exams, collaborative teamwork assessment, self and peer assessment (Gijbels et al., 2005). Gijbels et al. (2005) assert that problem-based assessment should account for students' problem solving skills in addition to the organization of their knowledge base while using the one or more of the aforementioned measures. Additionally, analyzing the effect of PBL from the angle of assessment, found that the effect of PBL reported in studies is influenced by the method of assessment. In addition, other factors such as study design, student year of study, and scope of implementation, play a role in the reported effects of problem-based learning.

Though the literature reports studies that assess the impact of problem-based learning on student learning, work is needed to assess the strategy explicitly with respect to students' critical thinking and communication skills for problem solving, as goals of the strategy. This study aims to include a study of student perception as it relates to their assessment results. Psychology research suggests that though students' judgements may not accurately reflect their actual learning outcomes (Yadav et al., 2011). Additionally, several works have studied student perceptions of the strategy, but this work seeks to include the instructor's perspective as well.

Methods

Data Collection

Both qualitative and quantitative data collection methods will be used to carry out this project. Data will be collected for instructor perceptions, students' perceptions and problem-based learning impacts. The expected number of participants is thirty six. The seat capacity for this course is thirty five students. The researcher is the only course instructor for this section, from whom the instructor perceptions will be gathered. The course is organized by modules, three of which will be primarily led and assessed using problem-based learning.

The data collection methods for each measure are described below.

1. *Problem-Based Learning impacts*: Students will work in teams of 4-5 to solve the problems given by the instructor. The teams will be interdisciplinary in nature to reflect the realities of professional problem-solving. For example, students from a mix of engineering, engineering technology and non-College of Engineering majors will form each group according to the majors represented in the class. Deliverables will include brief technical reports and succinct oral presentations. These will be used as data for this project. Feedback will be given to students before each subsequent PBL module is started.
2. *Instructor perceptions*: Reflective responses to student learning and progress for each PBL module will be recorded and collected. Also, responses will include insights into the role of the instructor as a facilitator of student learning.
3. *Student perceptions*: Students will be given a survey to assess their perceptions of PBL in the form of a Canvas quiz at the end of each PBL module. The survey will contain Likert-scale questions that assess students' perceptions of their ability to clearly define a

problem for systematic inquiry, gather valid evidence for analysis, and come to logical conclusions. Questions about their ability to organize and articulate ideas will be also included. The survey will end with open-ended questions to give a richer meaning to the quantitative results.

Limitations

Two prominent limitations are discussed here. Firstly, the researcher holds different roles as an instructor and a research participant. There may be issues for interpreting the results of the instructor perceptions. Logic of interpretation will be checked against the literature and through the level of agreement with a peer. Secondly, the method of assessment, in this case-the problems given to students-affects the measured impact of PBL. Thus, the consistency of the degree of difficulty for each problem given must be considered. The researcher will ask colleagues to give their opinions about the consistency of the degree of problem difficulty.

Evaluation

It is expected that students' critical thinking and communication skills will increase from the first PBL module to the last. It is also expected that student and instructor perceptions about their ability will also increase. To evaluate whether these statements hold true, there will be analysis of the following measures below to answer the research questions and to fulfil the objectives.

1. *Impact of Problem-Based Learning:* To measure the impact of problem-based learning on critical thinking and communication, student work will be scored based on the Critical Thinking VALUE Rubric, a rubric developed by faculty experts from universities across the United States. This rubric evaluates student explanation of issues, evidence, influence

of context and assumptions, position on the problem, and conclusions. This rubric is not for grading but for evaluating and discussing student learning. In addition, a communication rubric will be used to score student work. The communication rubric is based on a shared rubric by the LBST 2301 pilot group.

2. *Instructor Perception:* The qualitative text recorded and collected will be coded using themes found in the literature.
3. *Student Perception:* Descriptive statistics will be used to analyze the Likert-scale survey items, and themes found in the literature will be used to code the qualitative survey items.
4. *Alignment of student perception and assessment results*: Correlations will be done to examine the relationship between student perceptions and the impact of PBL. The correlation will be done on Likert-scale questions that align with measured score for the impact of PBL.

Knowledge Dissemination

Locally, the results of this work will be disseminated to the UNC Charlotte LBST pilot group and through the poster presentation event for SoTL awardees. Externally, this work will be presented at the American Society of Engineering Education conference in June 2019. The targeted journal for dissemination is the Journal of Professional Issues in Engineering Education and Practice.

Human Subjects

Approval from the UNC Charlotte Institutional Review Board would be obtained before asking students to participate in this study.

Extramural Funding

No extramural funding is being sort at this time for this project.

Timeline

Semester	Objective
Spring 2018	● Obtain IRB approval ● Develop survey and integrate to Canvas as a quiz assignment ● Complete data collection
Summer 2018	● Complete data analysis ● Prepare recommendations based on insights of the work ● Revise LBST 2301-ET (Engineering Technology) section based on the assessment results
Fall 2018	● Prepare poster presentation, prepare abstract for conference submission, and prepare journal article
Spring 2019	● Complete conference submission ● Submit journal article
Summer 2019	● Present work at American Society for Engineering Education conference

References

Gallagher, S. A., Sher, B. T., Stepien, W. J., & Workman, D. (1995). Implementing Problem-Based Learning in Science Classrooms. *School Science and Mathematics*, *95*(3), 136–146. https://doi.org/10.1111/j.1949-8594.1995.tb15748.x

Gijbels, D., Dochy, F., Van den Bossche, P., & Segers, M. (2005). Effects of Problem-Based Learning: A Meta-Analysis From the Angle of Assessment. *Review of Educational Research*, *75*(1), 27–61. https://doi.org/10.3102/00346543075001027

Hmelo-Silver, C. E. (2004). Problem-Based Learning: What and How Do Students Learn? *Educational Psychology Review*, *16*(3), 235–266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Lee, N. (2013). A Conceptual Framework for Technology-Enhanced Problem-Based Learning in Construction Engineering and Management Education (p. 23.35.1-23.35.12). Presented at the 2013 ASEE Annual Conference & Exposition. Retrieved from https://peer.asee.org/a-conceptual-framework-for-technology-enhanced-problem-based-learning-in-construction-engineering-and-management-education

Steinemann Anne. (2003). Implementing Sustainable Development through Problem-Based Learning: Pedagogy and Practice. *Journal of Professional Issues in Engineering Education and Practice*, *129*(4), 216–224. https://doi.org/10.1061/(ASCE)1052-3928(2003)129:4(216)

Yadav, A., Subedi, D., Lundeberg, M. A., & Bunting, C. F. (2011). Problem-based Learning: Influence on Students' Learning in an Electrical Engineering Course. *Journal of Engineering Education*, *100*(2), 253–280. https://doi.org/10.1002/j.2168-9830.2011.tb00013.x