PBL BRIEF #2

WPI

Project-Based Learning in Community Colleges

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Briefer Brief

- Many community college students do not experience high-impact practices with any regularity; however, faculty at community colleges often expect their students to learn 21st century skills (Center for Community College Student Engagement, 2015).

- Experiential learning, such as project-based learning (PBL), has been found to be one of seven high-impact practices that promote retention (Kuh, 2008; National Survey of Student Engagement, 2007).

- Learning communities offer mixed results on retention, likely related to the quality of active learning and academic supports provided to students (Sommo, Mayer, Rudd, & Cullinan, 2012; Weiss, et al., 2015).

- The impact of PBL and other experiential learning experiences on community college students' academic outcomes is scant, revealing mixed outcomes on grades, competencies, and course credits earned (Taggart & Crisp, 2011; Prentice, 2009).

- Several practices common in PBL, such as student choice and authentic problems, increase the positive effects of service learning (Yorio & Ye, 2012) and of learning communities (Sommo, Mayer, Rudd, & Cullinan, 2012; Weiss, et al., 2015).

Introduction

By design, community colleges serve multiple missions, providing developmental education as a bridge to college-level coursework, preparing students for bachelor's degrees, and credentialing adults who have been in the workforce or

military. Nearly half of the country's undergraduate students attend community colleges.[1] Yet compared to four-year colleges and universities, community colleges are deeply underfunded. Community colleges operate on a fraction of the funding that four-year universities spend per student, even when excluding budgets allocated to the research functions of other types of institutions.[2] These structural inequities are reflected in outcomes that demonstrate the struggle of this sector to maintain their original promise as a social equalizer.

While advocates pursue greater funding, educators at community colleges work within their limited resources to provide educational opportunities to their students. Many community college students do not experience high-impact practices with any regularity.[3] However, faculty at community colleges often expect their students to learn 21st century skills. Almost two thirds of community college students report that their coursework quite a bit or very much emphasized applying theories or concepts to practical problems or in new situations; two-thirds of students also reported that their coursework quite a bit or very much involved using information they have read or heard to perform a new skill.[4]

These are the types of skills that project-based learning (PBL) requires students to practice over the course of defining new problems, identifying the steps to generate solutions, and demonstrating evidence of their success or failure. There has been a push in the community college sector to increase the presence and quality of engaging, student-centered pedagogies.[5] The empirical evidence supporting PBL as one possibility for doing so is promising.

Effects of Project-Based Learning on Retention

Retaining students is a major challenge for most community colleges[6] and, according to recent national reports[7], finding strategies to support students while engaging them is a priority for the sector. Experiential learning has been found

to be one of seven high-impact practices that promote retention[8] and PBL is one way of focusing best practices within various types of experiential learning.

Studies of Project Lead The Way, a national model that uses PBL in middle school and high school, have demonstrated the influence of early PBL on subsequent enrollment, retention, and transfer from community college to four-year institutions. Schenk and colleagues (2012) found that participating in Project Lead The Way in high school increases the odds of attending community college (rather than not continuing to any postsecondary education) by 50%. Using propensity score matching to conduct a longitudinal, quasi-experimental study with 16,000 students in Iowa, Starobin and colleagues (2013) demonstrated that students who experienced the PBL program in high school were less likely to leave community college without a degree or without transferring to another institution and were more likely to transfer to a 4-year institution than non-participants.

The high-impact practice of experiential learning for community college students can take several forms similar to PBL. Taggart and Crisp (2011) reviewed 17 empirical studies of service learning at community colleges and found positive relationships between participating in a service learning course and student retention. Prentice (2009) analyzed social, academic, and career outcomes of 199 students enrolled in developmental reading/writing courses at Miami Dade College using a quasi-experimental approach. Student retention into the next two semesters was significantly higher for service learning students.

Learning communities offer community-building to a cohort of students taking multiple linked classes together, often centered around a theme (e.g., STEM) or a stage of learning (e.g., First Year Experience).[9] Learning communities offer mixed results, likely related to the quality of active learning and academic supports provided to students. MDRC and the National Center for Postsecondary Research conducted a series of studies to assess the value of the learning communities at Kingsborough Community College and five other community colleges around the country.[10] Using random assignment of almost 7,000 developmental education students, the studies found only small effects on credits earned and no impact on student persistence.

However, longitudinal analyses of Kingsborough Community College found that students from their learning communities earned more credits over six years than those not in learning communities and were more likely to persist

to a degree. Kingsborough Community College's program was reported to have exceptionally high quality, which researchers posit may account for the differences in impact on students. Some community colleges have embedded PBL within their learning communities to support the high quality active learning required to achieve results.[11]

Effects of Project-Based Learning on Academic Learning

Service learning couples academic content with a service project, most often in the community where the institution is located.[12] In a meta-analysis of 40 controlled outcome studies involving 5,495 participants in college settings, Yorio & Ye (2012) found a moderate positive significant effect of service learning on cognitive development. Similar effects have been found in two other meta-analyses.[13]

Furthermore, these analyses have demonstrated that several practices commonly practiced in PBL increase the positive effects of service learning. Students who choose to participate in service learning, rather than being assigned to a particular project, experience significantly higher gains in cognitive development. Celio, Durlak, and Dymnicki (2011) found that structured reflection significantly increased the effect of service learning on all outcomes assessed, including academic learning outcomes. Using even one recommended practice to ensure high quality significantly increased overall effect sizes.[14] Such practices include linking the service project to the curriculum, youth voice and choice in service project, and community involvement in setting service learning objectives, in addition to the use of reflection activities.

While these meta-analyses did not focus specifically on community college settings, the positive effects of service learning were found to be comparable across K-12 and higher education. Taggart and Crisp's (2011) review of studies at community colleges found a similar trend in evidence of positive relationships between participating in a service learning course and grades, as well as student ability to apply content knowledge to real-world projects.

However, empirical investigation of the impact of PBL and other experiential learning experiences on community college students' academic outcomes is scant, revealing mixed outcomes. In Prentice's (2009) study at Miami Dade College, students who participated in service learning projects in developmental courses gained interpersonal skills in addition to college learning skills. Students in

sections without service learning projects also gained college learning skills. Service learners were also less likely to pass the course than students in the non-service learning course sections.

Effectiveness of PBL with Underprepared Students

Understanding whether and how PBL impacts student learning among low academic performers has direct implications for the potential value of using PBL within community colleges. An estimated two-thirds (68%) of students enrolling in public community colleges take at least one developmental course to learn content and skills necessary to be successful in college-level coursework.[15] Estimates of the costs associated with developmental education range from $2 billion to $4 billion every year.[16] Determining strategies to ensure student success in these courses is a priority for the sector.

Research has demonstrated that PBL can provide effective learning opportunities to low academic performers. Laursen and colleagues (2011) examined the impact of inquiry-based learning in mathematics courses at four universities. Of the students who enrolled in the inquiry-based course, those with fewer college-level math courses experienced greater gains in learning than those with more experience in college-level math. Furthermore, students with a low GPA (2.5 or below) who took an inquiry-based math class achieved greater grades in subsequent required courses than those who took math classes with traditional instruction.

Much of the research on the effectiveness of PBL with academically struggling students has focused on team-based PBL, which requires student assignment to groups. Researchers and educators have expressed concerns that PBL requires students to engage in self-regulated learning,[17] which can be a challenge for some students as they respond to deeply ingrained habits as passive learners.[18] Some studies find that allowing academically struggling students to work in groups with high achievers benefits low achieving students without hindering high achievers' learning. A meta-analysis by Lou and colleagues (1996) assessed 20 findings from 12 studies and found that low achievers performed better in heterogeneous groups, whereas high achievers performed equally well in either homogeneous or heterogeneous groups. Using multilevel modeling, Donovan, Connell, and Grunspan (2018) found that low achievers had higher learning outcomes when working in groups with both low

achievers and high achievers in a large-enrollment, student-centered biology class for non-majors than high achievers; high achievers performed equally well in heterogeneous and homogenous groups.

Attending to the quality of interactions among group members during projects may have a greater impact on learning than investing time in arranging groups according to students' prior achievement. In Hong Kong, Cheng, Lam, and Chan (2008) examined group processes, self-efficacy, college efficacy, and student achievement of 1,921 secondary students working in 367 PBL teams to determine the role of group work processes in mediating the contribution of group composition to student learning. Using hierarchical linear modeling to analyze students within their teams, the researchers found that the quality of group processes was the most salient factor in determining students' learning efficacy for both low achievers and high achievers—not group composition.

Cheng and colleagues also found that high achievers were able to recognize poor quality processes at greater rates than their low-achiever teammates, suggesting an important function in moderating the effects of cooperative learning processes. High achievers reported lower collective efficacy than low achievers in teams when faced with low-quality group processes. Although this study was conducted at the secondary level and not at a US community college, the findings point to the importance of focusing on facilitating team dynamics, rather than debating group composition.

Case Studies Of Project-Based Learning At Community Colleges

Case studies of PBL curricula and pedagogy at community colleges describe implementation and associated outcomes for the institution (see Table 1). PBL at community colleges is frequently situated within a call for student-centered learning strategies. The details these articles provide on their contexts, the PBL strategies implemented, and the learning outcomes for their students may provide additional inspiration and practical knowledge.

Table 1. Case Studies of Project-Based Learning in Community Colleges

Citation	Institutional Context	PBL Practices Studied
Ariyo, O., Hagler, A., Armstrong, M., & Woodson, H. M. (2018). SPARC3: The future of Associate of Science. *Community College Journal of Research and Practice*, *42*(9), 606-616.	Gaston College, a mid-sized suburban community college in North Carolina	Transformation of the Associate of Science program to embed inquiry-based instruction, authentic undergraduate research experiences in core STEM courses, and learning communities.
Bray, N. J., Johnson, S., Katsinas, S. G., & Shadduck, P. (2019). Course revision in introductory STEM courses: An exploratory study at an HBCU community college. *Community College Journal of Research and Practice, 43*(7), 481-493.	A community college Historically Black College & University	Professional development of faculty in the natural sciences to expand their strategies related to WestEd's Reading Apprenticeship program
Butler, A., & Christofili, M. (2014). Project-based learning communities in developmental education: A case study of lessons learned. *Community College Journal of Research and Practice, 38*(7), 638-650.	Portland Community College, a large urban community college in Oregon	Implementation and improvement of a pilot PBL model embedded in learning communities for first-term college students enrolled in a program of developmental education in reading, writing, math, and college survival and success.
Chuppa-Cornell, K., & Zimmerer, M. (2017). The proof is in the project: Integrating the Framework for Information Literacy in developmental education through project-based learning. *Community College Journal of Research and Practice, 41*(7), 459-461.	Chandler-Gilbert Community College, a mid-sized urban community college in Arizona	Redesign and implementation of a developmental reading curriculum that uses PBL to strengthen students' reading and information literacy skills.
Dancz, C. L. A., Ketchman, K. J., Burke, R., Mahmud, R., Bilec, M. M., Parrish, K., et al. (2016). Integrating sustainability grand challenges and experiential learning into engineering curricula: Years 1 through 3. Paper presented at 2016 ASEE Annual Conference & Exposition, New Orleans.	Mesa Community College, a large urban community college in Arizona; Laney College, a mid-sized urban community college in California; Community College of Allegheny County, a mid-sized urban community college in Pennsylvania; & four research universities	An evaluation of two models of integrating sustainability grand challenges into engineering programs: course-based, in which distinct courses address grand challenges in depth, and modular-based, in which grand challenges are woven throughout existing courses through modules. Both use experiential and active learning strategies; implementation, a faculty network, and student learning outcomes are assessed.
Evenbeck, S. E. (2019). Designed to be different: The Stella and Charles Guttman Community College. *New Directions for Higher Education, 2019*(185), 71-84.	The Stella and Charles Guttman Community College, a small urban community college in New York	This chapter explores the creation of the new addition to the CUNY system, including a description of the experiential curriculum and various support systems.
Greenwood, D. A. (2015). Outcomes of an academic service-learning project on four urban community colleges. *Journal of Education and Training Studies, 3*(3), 61-71.	Four diverse, urban community colleges in New York	Exploratory study of community engagement and academic outcomes of support provided to faculty to implement service-learning projects at four community colleges.
Johnson, B., Ulseth, R., Smith, C., & Fox, D. (2015, October). The impacts of project based learning on self-directed learning and professional skill attainment: A comparison of project based learning to traditional engineering education. In *2015 IEEE Frontiers in Education Conference (FIE)* (pp. 1-5). IEEE.	Itasca Community College, a small urban community college in Minnesota	Comparison of professional learning outcomes from students in an entirely PBL-based upper division undergraduate engineering program (in which students complete lower division coursework at community colleges) to those of community college juniors and traditional four-year graduates.

Table 1. Case Studies of Project-Based Learning in Community Colleges (continued)

Citation	Institutional Context	PBL Practices Studied
Johnson, B., & Ulseth, R. (2017). Student experience for the development of professional competencies in a project-based learning curriculum. *The International journal of engineering education, 33*(3), 1031-1047.	Itasca Community College, a small urban community college in Minnesota	Qualitative study of the student experience in an entirely PBL-based upper division undergraduate engineering program (in which students complete lower division coursework at community colleges) to better understand which elements of PBL influenced the development of professional competencies.
Mosley, P., Liu, Y., Hargrove, S. K., & Doswell, J. T. (2010). A pre-engineering program using robots to attract underrepresented high school and community college students. *Journal of STEM Education, 11*(5 & 6), 44-54.	Baltimore City Community College, a small urban community college in Maryland	Description of a new curriculum designed to use robots to attract underrepresented students to pursue careers in STEM. The program uses a combination of lecture and laboratories using PBL LEGOs.
Mocahedzadeh, F., Linzemann, A., Quintero, E., Aveja, J., Thompson, W., & Martyn, M. (2014). Life in and around the Chicago River: Achieving civic engagement through project based learning. *Science Education and Civic Engagement, 6*(2), 34-41.	Harold Washington College, a mid-sized urban community college in Illinois	Description of implementation and findings of one microbiology lab in which students used PBL to engage in authentic research.
Walker, C. (2019). Experiential learning as a strategy for student completion and course success in the community college. *Community College Journal of Research and Practice, 43*(10-11), 803-806.	Greenville Technical College, a mid-sized urban community college in South Carolina	Analysis of graduation rates and end-of-course grades for students participating in experiential learning activities in an accounting course compared to those who did not participate in experiential learning.

Conclusions & Next Steps

PBL provides opportunities for community colleges to address retention and student learning while fulfilling their complex missions. Best practices for PBL can be embedded into common learning experiences, such as learning communities, service learning, and first-year seminars. The mixed evidence of PBL's impact in community colleges suggests that attending to the quality of implementation is key to realizing desired outcomes.

Less is known about how to manage the adoption of PBL at community colleges while bringing such practices to scale. Studies that focus on implementation in community colleges tend to be case studies that do not test hypotheses about design features against institution contexts. What makes PBL effective and pragmatic at one community college and not at another? More cross-institutional studies that examine implementation and the realities of organizational change are needed to provide guidance to community colleges interested in capitalizing on the impacts of high-quality PBL.

Notes

[1] See the Community College Research Center at Teachers College Columbia University online at https://ccrc.tc.columbia.edu/Community-College-FAQs.html

[2] Desrochers, D. M., & Hurlburt, S. (2016). *Trends in college spending 2003 to 2013*. Washington, DC: Delta Cost Project and American Institutes of Research.

[3] Center for Community College Student Engagement. (2015). *Engaging rising: A decade of CCSSE data shows improvements across the board.* Austin, TX: The University of Texas at Austin, Program in Higher Education Leadership.

[4] Center for Community College Student Engagement. (2019). *Community College Survey of Student Engagement.* Austin, TX: The University of Texas at Austin, Program in Higher Education Leadership.

[5] Center for Community College Student Engagement. (2014). *A matter of degrees: Practices to pathways (High-impact practices for community college student success).* Austin, TX: The University of Texas at Austin, Program in Higher Education Leadership.

[6] Center for Community College Student Engagement. (2019).

[7] Center for Community College Student Engagement. (2015); Desrochers & Hurlburt (2016)

[8] Center for Community College Student Engagement (2014; 2015)

[9] See the National Resource Center for Learning Communities at http://wacenter.evergreen.edu/learning-communities

[10] See Sommo, C., Mayer, A. K., Rudd, T., & Cullinan, D. (2012). *Commencement day: Six-year effects of afreshman learning community program at Kingsborough Community College.* New York: MDRC; Vishner, M. G., Weiss, M. J., Weissman, E., Rudd, T., & Wathington, H. D. (2012). *The effects of learning communities for students in developmental education: A synthesis of findings from six community colleges.* National Center for Postsecondary Research. New York: MDRC; Weiss, M. J., Mayer, A. K., Cullinan, D., Ratledge, A., Sommo, C., & Diamond, J. (2015). A random assignment evaluation of learning communities at Kingsborough Community College—Seven years later. *Journal of Research on Educational Effectiveness, 8*(2), 189-217; See also MDRC commentary, "What have we learned about learning communities at community colleges?" at https://www.mdrc.org/publication/what-have-we-learned-about-learning-communities-community-colleges

[11] See, for example, Butler, A., & Christofili, M. (2014). Project-based learning communities in developmental education: A case study of lessons learned. *Community College Journal of Research and Practice, 38*(7), 638-650.

[12] Gelmon, S. B., Holland, B. A., & Spring, A. (2018). *Assessing service-learning and civic engagement: Principles and techniques.* Stylus Publishing, LLC.

[13] Celio, Durlak, & Dymnicki (2011) analyzed 62 controlled outcome studies involving 11,837 students and Conway, Amel, & Gerwien (2009) analyzed 103 studies with no total student sample noted.

[14] Recommended practices were assessed in Celio, Durlak, & Dymnicki (2011) as potential moderators of effects, including the use of reflection (reported in 74% of service learning programs), linking to curriculum (38% of programs), youth voice and choice (33%), and community involvement (26%).

[15] Chen, X. (2016). *Remedial coursetaking at U.S. public 2- and 4-year institutions: Scope, experiences, and outcomes* (NCES 2016-405). U.S. Department of Education. Washington, DC:

[16] See Chen, 2016; Scott-Clayton, J., & Rodriguez, O. (2012). *Development, discouragement, or diversion? New evidence on the effects of college remediation* (National Bureau of Economic Research Working Paper 18328).

[17] English, M. C., & Kintsantas, A. (2013). Supporting student self-regulated learning in problem- and project-based learning. *Interdisciplinary Journal of Problem-Based Learning, 7*(2), 6.

[18] Hung, W. (2011). Theory to reality: A few issues in implementing problem-based learning. *Educational Technology Research and Development, 59*(4), 529-552.

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