



PBL BRIEF #9.0 SERIES

WPI ALUMNI SURVEY FINDINGS



WPI

9.2 Transformative Educational Experiences through Project-Based Learning

Kimberly LeChasseur, PhD & Kris Wobbe, PhD • Center for Project-Based Learning • January 2024

Briefer Brief

- While the most direct charge of higher education may be academic, college has long been a time for discovering oneself.
- The current college-age generation (among traditional age students) places particularly high value on experiences that are personally meaningful and aligned with one's values. Project-based learning allows colleges and universities to provide such opportunities as part of the curriculum.
- At Worcester Polytechnic Institute (WPI), students attribute personal outcomes beyond academic achievement and career preparation to their experiences completing required projects in the second, third, and fourth year.
- Specific mechanisms involved appear to include the development of self-efficacy and self-awareness, as well as connecting internal values to external impact.

Introduction

The benefits of high-quality project-based learning (PBL) have been well established. At the undergraduate level, an abundance of literature demonstrates PBL's impact on learning professional skills, such as communication and collaboration¹, as well as domain knowledge and technical skills.² PBL has been shown to support the development of this variety of academic skills as students make the transition into college³, deepen their mastery within a discipline⁴, and bring their knowledge and skills into the workforce.⁵ Although scholarship on PBL tends to favor STEM disciplines, these effects have been assessed across a wide array of disciplines and institutional contexts.⁶

Less widely documented, though equally impressive, is PBL's potential to deepen students' personal lives. The current college-age generation (among traditional age students) places particularly high value on experiences that are personally meaningful and aligned with one's values. Project-based learning allows colleges and universities to provide such opportunities as part of the curriculum. This research brief lays out the ways in which PBL can transform how students think about the human condition, the world, and their place in it. Using analyses from a recent alumni study at Worcester Polytechnic Institute, the first section provides an overview of the personal impact of PBL on students at WPI. The following sections lay out three mechanisms to which alumni attribute their personally transformation during project work: empowering agency through authentic problems, developing self-awareness, and having an opportunity to do good in the world.

Personally Fulfilling Lives

Alumni of WPI's unique project-based curriculum indicate that there are far-reaching personal outcomes of their project work. At WPI, all students are required to participate in three projects. One is the culminating activity for the six-course humanities and arts requirement, either a seminar or practicum that involves individual creative work. Students interested in the history of technology, for example, may conduct scholarship in this area and write an in-depth paper, while students who have pursued studies in music may compose and perform an original piece. Some travel to an international off-campus site to fulfill this requirement.

In the junior year, students complete an interactive qualifying project (IQP) in small teams coached and facilitated by faculty. Nearly 90% of students complete this project off campus at one of WPI's global project centers in Africa, the Americas, Asia-Pacific, or Europe, where students and faculty spend seven weeks away from courses tackling a problem of local importance that lies at the

intersection of society and technology. These problems are sourced from local organizations who then serve as project sponsors and often involve one of the UN's Sustainable Development Goals.

In the final year, students work in small teams supported by faculty on a design or research project of significant scope in their major field. Projects may focus on a problem chosen by the students, posed by external sponsors, or derived from faculty research. All projects involve developing innovative solutions at a professional level. As with the project in the third year, students may elect to conduct this project off campus.

The vast majority of students at WPI go on to describe their projects as having a deep impact on them personally. As part of a recent study in 2021, 2,236 alumni completed a survey about their project experiences and a variety of outcomes. Across those participating in the study, alumni

credited their project experiences with helping them become generous, hardworking, empowered, thriving, intelligent, self-aware, ethical, and confident. When asked to comment on their project experiences, one alumnus of the Mechanical Engineering Program captured the essence of many fellow alumni responses. "I was fundamentally transformed during my time at WPI. I can think of no other life event that could have done as much."

This experience is not an isolated case of a flattering outlier; it can be the norm for students who experience projects throughout their education. When surveyed, 89% of alumni indicated that their project work contributed to enriching their lives in ways that were not necessarily academic or work-related. A similar majority (88%) reported that their project work helped them to develop a stronger personal character and 77% indicated an impact on feelings of being able to make a difference.

Figure 1. Alumni Indicating Project Work Transformed Them Personally in Various Ways



Empowering Agency Through Authentic Problems

Why might PBL promote personal transformation? Our study suggests a few mechanisms are at work. Many alumni emphasized how their project work held a high degree of authenticity – one of the “gold standards” of high-quality projects.⁷

One of the ways that projects at WPI develop this sense of authenticity for students is to provide actual problems – either those experienced by a particular community, which are identified and researched by students, or those issued by a sponsoring industry or governmental partner. Putting students in charge of developing feasible solutions to real-world situations teaches them that

understanding content and developing skills gives them the power to change the world.

[T]his focus on collaboration and creative problem-solving has had far-reaching effects on my life—both personally and professionally—after leaving WPI. The strong sense of self-efficacy developed through rising to the challenge of these projects has served me well in uncountable ways.

Such sentiments shared by an alumnus of the Biomedical Engineering Program represents a much larger trend in how these experiences translate into greater self-efficacy. In fact, 83% of alumni who participated in the study reported that their project work increased feelings that their own ideas are valuable.

Developing Self-Awareness

Another mechanism through which PBL can be personally transformative is its ability to increase students' sense of self-awareness. The processes of project work—problem identification and scoping, researching stakeholder experiences, making sense of conflicting priorities and perspectives, collaborating with others—often involve high degrees of ambiguity and flexibility.⁸ Being able to navigate such processes nimbly requires awareness of one's own contributions alongside a willingness to change.⁹

Alumni of the WPI Plan's multiple projects often attribute these experiences with teaching them to become more self-aware, not only of their own learning, but of many facets of life. An alumnus of the Industrial Engineering Program described this impact of PBL in the following way:

The WPI Plan ... provides a lot of self-learning and self-awareness of discipline, passion, ethics, and [how to] give back to team, to community, etc. This approach and structure allows and/or forces a WPI student to grow their character in many directions, while developing their technical education skills.

Notably, this personal learning is not a prerequisite or an outcome of technical learning, but concurrently developed in projects.

Similar to self-efficacy, developing self-awareness is a natural extension of the authenticity of PBL. As one alumnus of the Chemical Engineering Program included in their response to the 2021 alumni survey, "There is no better way in my mind to understand who you will be out there in the 'real world' than to take part in the WPI project curriculum." This window into one's potential is afforded through project work that is not divorced from the real world but taught through experience.

The Ethics Of Making A Difference

One of the aspects of project work that alumni cited most often for the personal impact of PBL was the opportunity projects provided them to do good in the world. As one alumnus of the Civil Engineering Program explained,

The best feeling as a student is knowing your work will actually impact someone/something and that it is taken seriously. Through my project experience, I was able to provide potential solutions to real-world organizations looking to tackle a challenge. With the help of advisors,

I was able to produce work that made me feel valuable, intelligent, and victorious.

This alumnus and others describe the importance of the cyclical nature of PBL: they addressed challenges, which taught them they could do so effectively, which then made them feel even more capable of addressing challenges in the future. This process of learning while doing is WPI's motto—*Lehr und Kunst (Theory and Practice)*. Yet it also captures the transformational power of PBL more broadly.

As an alumnus from the Electrical Engineering Program offered, PBL provides a means of maturing in responsibility. "PBL changed the way I approached the world. It greatly influenced my transition from child (dependent) to adult (responsible/empowered)." What this sense of transition captures is a shift in how students relate their internal world to their place in the world around them. By connecting their desire to provide a positive impact to others to their skills and knowledge, PBL demonstrates that learning is about so much more than being a receptacle for the right answers to hypothetical problems; instead, learning becomes empowering, a way to live one's values more effectively.

WPI Alumni Study

WPI conducted an alumni survey of its signature PBL offerings in 2021. A survey with closed- and open-response items was emailed to 15,528 alumni who graduated between 1980 and 2019. Data was collected through Qualtrics. One reminder was sent one week after the original invitation to participate to alumni who had not yet submitted a response.

Of those invited, 2,236 alumni responded, yielding a low—but typical—response rate of 14%. The sample included in the analyses presented here includes 61% men, 39% women, and less than one percent non-binary or gender-fluid alumni. The majority of respondents were white (89%), 6% identified as Asian, 4% identified as Hispanic/Latino (any race), 1% identified as Black/African American or African, and 1% identified as Middle Eastern or North African. Within the sample, 62% were engineering majors, 35% were science majors, and 3% majored in other subjects, such as business or social sciences, without also earning a science or engineering degree. These characteristics reveal a sample that is largely representative of alumni demographics within these years. (Women students are slightly overrepresented and non-binary and gender fluid students are underrepresented).

Notes

¹ do Amaral, J. A. A., Gonçalves, P., & Hess, A. (2015). Creating a project-based learning environment to improve project management skills of graduate students. *Journal of Problem Based Learning in Higher Education*, 3(2); Hart, J. (2019). Interdisciplinary project-based learning as a means of developing employability skills in undergraduate science degree programs. *Journal of Teaching and Learning for Graduate Employability*, 10(2), 50-66.

² Yazici, H. J. (2020). Project based learning for teaching business analytics in the undergraduate curriculum. *Decision sciences journal of innovative education*, 18(4), 589-611; Konings, D., & Legg, M. (2020, December). Delivering an effective balance of soft and technical skills within project-based engineering courses. In *2020 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)* (pp. 157-164). IEEE.

³ See the Center for Project-Based Learning's Research Brief, "PBL & High-Impact Practices in the Transition to College"

⁴ See the Center for Project-Based Learning's Research Brief, "PBL & Demonstrating Mastery"

⁵ See the Center for Project-Based Learning's Research Brief, "Career Preparation Outcomes of Project-Based Learning"

⁶ See the Center for Project-Based Learning's Research Briefs, "Project-Based Learning in the Arts and Humanities" and "Project-Based Learning in the Social Sciences"

⁷ Larmer, J., Mergendoller, J., & Boss, S. (2015). *Setting the standard for project based learning*. ASCD; Joo, Y. J., Lim, K. Y., & Lee, S. Y. (2019). Project-based learning in capstone design courses for engineering students: Factors affecting outcomes. *Issues in Educational Research*, 29(1), 123-140.

⁸ Pan, G., Seow, P. S., Shankaraman, V., & Koh, K. (2021). An exploration into key roles in making project-based learning happen: Insights from a case study of a university. *Journal of International Education in Business*, 14(1), 109-129; Elmes, K. (2018). Networks of Ambiguity in Project-Based Learning: Understanding How Students Experience and Manage Ambiguity in WPI's IQP Experience. *Networks*, 2018, 12-11.

⁹ Konrad, T., Wiek, A., & Barth, M. (2021). Learning processes for interpersonal competence development in project-based sustainability courses—insights from a comparative international study. *International Journal of Sustainability in Higher Education*, 22(3), 535-560; Vidergor, H. E. (2022). Effects of Innovative Project-Based Learning Model on Students' Knowledge Acquisition, Cognitive Abilities, and Personal Competences. *Interdisciplinary Journal of Problem-Based Learning*, 16(1), n1; Wijayati, N., Sumarni, W., & Supanti, S. (2019). Improving student creative thinking skills through project based learning. *KnE Social Sciences*, 408-421.

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WPI

Center for Project-Based Learning
100 Institute Road
Worcester, MA 01609
508-831-6836

wpi.edu/projectbasedlearning

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