# Lessons Learned in Cross-College Collaborations: An Engineering and Early Childhood Education Design Project

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## Abstract

While the benefits of cross-college collaboration are known, these collaborations are often challenging for faculty members to facilitate. However, collaborations such as the one reported in this study offer rich opportunities for cross-content learning and professional growth. An examination of this collaborative process is of value to researchers who engage in cross-disciplinary collaborative work.

In this pilot study, the researchers examined the collaborative process that occurs when students majoring in engineering collaborated with students majoring in education to design and construct exhibits to be used in an informal learning setting for children. The tudents collaborated to design exhibits that are functional, durable, and developmentally appropriate for children. Specifically, engineering students in the Russ College of Engineering designed an interactive, hands-on exhibit for a local discovery museum. Early childhood students in the Patton College of Education collaborated with the Engineering students to provide design insight about developmentally appropriate features, safety considerations, and providing multiple levels of engagement. Researchers observed the collaborative meetings between the students and conducted follow-up interviews with students from both colleges. Qualitative data collected from interview questions, field notes, and written participant reflections was coded to create a system of categorical aggregation, which allowed for patterns and multiple instances of data to be readily identifiable. Where appropriate, direct interpretation was used for single instances or vignettes that emerged from the coded data.

**Keywords:** cross-college collaboration, design engineering, early childhood education, project-based learning

## Background and Justification

Despite the benefits of interdisciplinary project-based learning experiences to positively impact student learning outcomes, college programs often act in isolation from other majors of study [1]. Engaging in cross-college collaborative work often poses challenges that present impediments to meaningful and ongoing facilitation of collaborative projects [2, 3]. When collaborators persist in the face of challenges, rich opportunities for cross-content learning and professional growth may emerge [4-8]. In this pilot study of cross-college project-based learning, the researchers examined the collaborative process that occurred when engineering and early childhood education students partnered to design and construct exhibits for use in an informal learning setting for children. Students collaborated to design exhibits that were functional, durable, and developmentally appropriate for children. Specifically, engineering students were asked to design an interactive, hands-on exhibit for a local discovery museum, while early childhood education students provided design insight about developmentally appropriate features, safety considerations, and providing multiple levels of engagement. The researchers investigated the following research questions:

1. In what ways were the finished design products impacted by the collaborative process?
2. Is the collaborative model one that is feasible and productive for future projects?
3. What best practices may be identified for duplicating the collaborative process?

The findings from this pilot study inform best practices in the development and implementation of future cross-college collaborative partnerships. An examination of this pilot study is of value to practitioners who wish to design collaborative experiences for their students and for researchers who engage in cross-disciplinary, collaborative work with an emphasis on project-based learning.

## Literature Review

Project-based learning (PBL), which may trace its roots to the student-centered educational work of Dewey's [11] "learning by doing" movement is inherently collaborative. In today's college classrooms, PBL represents a progressive trend that focuses on the process of learning as opposed to the method of teaching [4]. Project-based learning is the "effortful process" by which "powerful interactions between cognitive engagement and motivational drive" [12] create an environment where active learning flourishes and students and the intellectual problems they face are the primary focus of classroom learning experiences. Ideally, PBL should be an arena where students are presented with interdisciplinary problems where "the answer" is not clear and something practical and tangible is produced as a result. While no instructional method is perfect, project-based learning attempts to create an environment that is the opposite of what higher education is often criticized to be – too much top down dissemination of content and too few practical, hands-on experiences. Though direct instruction is one of the primary methods of instruction in higher education classrooms, it is considered a poor option for delivering content and concepts in an interactive and engaging manner [4, 6, 8]. Active learning, when students are engaged in creating knowledge, is almost always more conducive to learning than direct instruction [12].


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Both within specialized engineering courses and across disciplines, PBL methods are associated increased student learning outcomes [4-8]. Studies report that PBL increases student interest and motivation in course content [7-9], positively influences student self-efficacy [5, 13, 14], and encourages active engagement in the learning process [6, 10]. Further highlighting the value of PBL as an instructional strategy, research by Chua [4] suggests that college students who regularly engage in PBL experience fewer conflicts during collaborative projects, an essential life-skill that has implications for future career success.

Although cross-college collaborations may be challenging to facilitate, when collaborations do occur, they are often project-based in nature [1]. Despite the known benefits of collaborative PBL, successful implementation is not without challenges [1]. Developing partnerships across colleges and programs requires persistence. Indeed, it can be challenging to find and maintain community contacts both within communities and university settings [8, 15]. Institutional structures such as scheduling, resource allocation, and course learning outcomes sometimes contribute additional constraints [16]. To allow for cross-college collaborations, instructors must work creatively to find compatible meeting times and spaces and to identify and develop appropriate course outcome alignment [17]. Research suggests that seeking to overcome barriers is a worthwhile endeavor as collaborative PBL experiences resonate particularly well with millennial students, who seek social interactions in conjunction with content knowledge acquisition [15]. PBL can create a sense of community, not only among fellow students in the same classroom, but also among those in other majors [10]. Referred to as disciplinary egocentrism, interdisciplinary PBL also encourages students to examine topics from outside their own discipline, giving them the opportunity to develop an understanding of how other disciplinary content may influence their understanding of the PBL's tasks and goals [10].

Maintaining collegial relationships over the course of several semesters and still providing meaningful work for students introduces a further challenge, however, using project-based instruction may help to motivate students to perform in ways that traditional assignments do not [8]. As with any teaching pedagogy, implementation is key. Some studies find that, in university settings, PBL is frequently used as a form of final or capstone assessment, [5, 18, 10] rather than the primary vehicle by which students learn and create knowledge. While the work that the students are showing in these projects can be substantial, ideally PBL should be an ongoing formative assessment utilized to create meaning and knowledge rather than an end-of-the-road summative assessment to demonstrate what has already been learned. Instructors need to be aware of the challenges mentioned above in regards to faculty oversight and realize that projects must be realistic in terms resource management and student development expectations [17]. If this balance can be achieved by faculty and enough buy-in is generated for the students, authentic student learning can be achieved and the struggles to create an enriching PBL experience become worth the labor.

**Project Overview**

This pilot project existed as a collaboration between a junior-level engineering design class (ETM 3010 – Engineering Graphics Applications) and a junior-level education class (EDEC

3500 – Early Childhood Social Studies) at Ohio University. The objective of the project was to allow both of the students to work together to create and validate a product design portfolio. The project requirements were provided as an open-ended design project, requesting design proposals from the engineering students for a discovery museum. The theme of the project was green energy.

The final deliverable from the project was a preliminary design proposal and design review which was presented by the engineering students to their instructor. This project was conducted across a six week timeframe and was executed against three course outcomes for the engineering students and two course outcomes for the early childhood students.

Engineering design course overview and selected course objectives:

ETM 3010: Engineering Graphics Applications, is a junior-level design class. Prerequisites for this class include a freshman level introduction to engineering graphics class, where the students are exposed to the fundamentals of engineering graphics. There are also several manufacturing process classes that are prerequisites to ensure that the students have an appropriate manufacturability background. These prerequisites are intended to ensure that the students understand enough about manufacturing processes that they can (1.) document the design of parts using modern engineering design standards and (2.) ensure that they can design parts that can actually be manufactured. The design project in this study specifically assesses three of the course objectives of the class:

Course Objective 1: To provide students with an understanding of the product realization process.

By providing a loosely defined design project, the students are required to investigate the design project to develop their own requirements. The investigation process alone is one method of design synthesis where they begin to conceptualize the finished product. From the initial concept, the students are required conduct the analysis (how the product will function) and the design (what will the product look like) of the finished product. This process typically yields several design iterations where the group will discuss the design project and the feasibility of different design solutions to the central design problem.

The execution of a selected design will begin with concept sketches and a written description of the museum display. The students will then begin to design the components that are required to build the project. Through this process, they will consider manufacturability as well as which components should be purchased off the shelf or custom fabricated. The integration of these parts into the final project is the culminating task of this objective.

Course Objective 2: To expose students to the types of documentation and analysis commonly used during the product realization process.

The engineering students are required to perform multiple types of documentation and analysis to discover the optimal mix of design solutions. For example, the students are required to complete a house of quality (HoQ) as a method of discovering customer requirements as well as functional performance metrics for the product. Additionally, they are required to complete a failure mode and effects analysis (FMEA) against their product to identify and control hazards with their design. A product structure and costed bill of materials are required for identification of cost targets. The three dimensional designs drive the production of the engineering data as well as the engineering prints.

Course Objective 3: To allow students the opportunity to use engineering prints as a communication tool from both the creation and interpretation perspective.

The deliverables from course objective 2 provide the foundation for a product portfolio and the final design review presentation. Through the development of these deliverables, the students articulate their understanding of the customer requirements and their design solution to meet those requirements. The design review presentation provides a platform for the students to present their work to their peers, as well as providing an opportunity to answer questions and to determine if their design solution satisfies the requirements of the product. Design reviews also serve as an opportunity for the design group to discuss manufacturability challenges and to articulate concerns with their design against the product requirements.

Early childhood development course overview and selected course objectives:

EDEC 3500: Teaching Early Childhood Social Studies is a junior-level course for students majoring in early childhood education. The course focuses on developing curriculum and instructional practices that support social studies learning across disciplines and contexts. Emphasis is placed on identifying and practicing approaches and instructional strategies that will engage children in concepts such as families, community, and living in a diverse society. Integral to the course is promoting the development of engaged and involved citizens within a democratic society. As part of their clinical placement work, students taking the course also spend an average of 250 contact hours with young children over the course of the semester.

Course Objective 1: To acquaint students with the major themes of social studies education.

Social studies is the integrated study of the social sciences and humanities with a focus on promoting civic competence. As a school subject, social studies brings together the study of geography, history, civics, anthropology, sociology, and economics [19]. The early childhood social studies methods course is designed to promote understanding of social studies content in order to further students' awareness of the integrated nature of social studies curriculum and instruction. The design collaborative described in this project requires students to apply knowledge of early childhood development and pedagogy in a hands-on, authentic manner that will be replicated in professional education settings. Additionally, the project promotes understanding of each component of social studies core content areas.

Course Objective 2: To emphasize the need to encourage civic engagement and democratic discourse through social studies content.

Training teacher leaders who recognize their potential to be community change-agents is a foundational component of the early childhood social studies curriculum. Course outcomes place specific significance on encouraging early childhood teacher candidates to embrace civic engagement and to be leaders in their field. Engaging in a collaborative partnership across disciplines and with a community entity is itself a valuable act of civic engagement. Also, the collaborative discussions that occur during design meetings provide authentic opportunities to engage in democratic discourse. Community involvement is a key concept in social studies methods courses, connecting this project-based collaborative experience directly to social studies methods course content.

**Methodology**

Both classes were divided into seven groups and each of the groups selected a different green energy technology to investigate and for which to develop a proposal for a museum display. To control the scope and complexity of the designs, the volume of the displays was limited to a 4'X4'X2' volume. The intention was for the engineering students to work towards the development of mobile displays which could be easily deployed in multiple venues. The engineering students were expected to extrapolate their design and performance requirements from the open ended project scope.

The Early Childhood Development class was divided into similarly sized groups, who were then paired with the engineering students. The engineering students provided the education students with a brief write-up of their projects a few days before a planned meeting. Both classes of students joined each other in a neutral location (a large classroom) where they participated in a 10-minute team building session. After this session, the students participated in an open review and discussion of their designs, potential issues and concerns.

Figure 1: Engineering and Education Students Collaborating to Design Museum Displays

After this meeting, the engineering students worked to incorporate design changes. The researchers requested the voluntary participation from the student participants within the study and interviewed the students. The interviews occurred as group interviews of 2-4 students who were assigned to a design project. Table 1 illustrates the use of categorical aggregation [20], where the results were coded to allow for patterns and multiple instances to be readily identifiable. The coding system was inductive and was guided by the research questions. As such, interview data was coded according to a) impact of the collaborative process on design features, b) productivity/feasibility of the process, and c) best practices for future collaborative work. To ensure validity and reliability of the data, researchers utilized methodological triangulation via multiple data sources [21]. For example, data sources included field notes from collaborative meetings, student exit notes, and interview transcriptions. Obtaining multiple perspectives on the same event was an essential way to validate the research.

Table 1. Codes and Definitions

| **Category** | **Codes** | **Definitions** |
|---|---|---|
| **Design Features** | Design features modifications | Students explaining how the collaboration resulted in modifications in the design features. Students explaining how the design features were not modified as a result of the collaboration. |
| **Feasibility/Productivity** | | |
| | Participatory experiences | Students expressing enjoyment or dissatisfaction with the experience. |
| | Perceptions of the value of the experience | Students describing what they gained educationally and/or as professionals from the experience. |
| **Best Practices** | Insights of what made the experience positive | Students recommending specific practices that should continue for future application. |
| | Insights about what might improve the experience | Students describing specific practices that would improve future experiences. |

**Results**

In what ways were the finished design products impacted by the collaborative process?

The engineering students received the design requirements and then worked towards the completion of their design. However, their design did not meet some of the fundamental requirements of the product in application related to the early childhood stakeholders of their product. This was evident by the interactions between the early childhood students and the engineering students.

One explicit example of this existed through one of the projects where the engineering students designed a display to illustrate hydroelectric power principles. The concept of the display centered around creating electricity by turning a water wheel. The exhibit existed as a game where two participants could compete by using a carnival style water gun to squirt water at a wheel. Two participants would play by facing each other during the contest with the display in between them. The participants scored points by making the wheel turn from water that squirted from the top of the wheel with their water gun. The defending participant could counter by using their water gun to block the wheel from turning by directing a stream of water to counter their opposition. An electronic device would determine the number of revolutions in a particular direction to score points for a player. Points would be displayed via a series of lights for each player, and a race car would move forward or backwards on a track to indicate if they were gaining power or losing power. Once one player achieved a certain number of turns (perhaps 100 more than their opponent), the game would indicate the winner and reset for the next player. It is important to note that the entire display was designed as an enclosure to keep water from escaping during the event.

When asked what features of the display were their favorite and why, the engineering students stated: “I would say the fact that it was competitive.” Their education counterparts echoed this by stating, “I like that they had them as race cars. Not just one person doing it, but there was another person from the other side.”

While reviewing the project, the education students mentioned that it was inappropriate for children to use guns in an educational setting, and some may not have the fine motor coordination to pull the trigger and control the gun. Though the engineering students in the group disagreed with this perspective, they were eventually persuaded to change the water squirting mechanism to a steering wheel which had a button that would squirt the water. One engineering student reported “They wanted to remove the title of squirt ‘gun’ and I felt that we were defending ourselves during our time.”

This was the most pointed example of design changes experienced during this project. However, all of the collaborative design groups reported that there were changes to the projects to make them more appropriate for the end users. Many of the changes were with respect to signage, color usage, safety considerations and making the displays more developmentally appropriate. In general, the engineering students agreed with and accommodated the requests by the early childhood development subject matter experts. The engineering students unanimously agreed that their products were better when the advice of the education students were incorporated into the products.

Is the collaborative model one that is feasible and productive for future projects?

This project was well received by both of the groups of students, and in general appeared to be a rewarding and validating experience for each of the groups of students. For the engineering students, this project provided an unstructured exercise which required them to be creative to synthesize ambiguous project scope into discrete and well defined products. For the education students, this project provided a real-world, authentic experience where they could work as a subject matter expert on an applied project.

The students in both groups unanimously agreed that this was a valuable experience. The students also unanimously agreed that they have never had this experience outside of their own college. The students did offer some suggestions for improving the experience, which will be discussed in the Implications section of this paper.

What best practices may be identified for duplicating the collaborative process?

While the results of the project met (and in many cases exceeded) the learning objectives, the scale of this project was aggressive for a 6-week class project. The project was made more difficult because it was executed at the beginning of the design class. Even though this is the second design class that is completed in the engineering curriculum, the students need more time to explore the design process, not simply how to create engineering drawings (the focus of the first class). The next time this study is run, it will be for a longer duration and will start later in the class to allow the students ample time to work on the project. This will give both instructors the students more opportunity to explore the engineering design process, which should help with requirements gathering, product sketching and knowing the other students' strengths to allow them to format a prospective design for a preliminary design review.

Due to work styles of participating students, making group placements more purposeful will also be a component of a fully implement study. Additionally, as this project was a large project, it was executed as a single deliverable. It was noted informally by the engineering students that they would have been able to create better designs if there were several design checkpoints where they could receive feedback from their peers, their early childhood collaborators and the instructors of both courses instead of one large project grade from their instructor. Prior research reveals that PBL is best in an environment that offers ongoing formative assessment [18, 10]. Planning for multiple meetings over the semester will also allow the PBL component to be an ongoing formative assessment in both courses.

**Challenges**

There were comments from the students that there was a clear disconnect between the classes. Specifically, what does each major do and what are they going to contribute to this project. There were some comments from the education students that at the beginning of the project they were not clear what they could contribute to the project. These communication perspectives and misconceptions were echoed by the groups stating that they were anxious and/or nervous to meet with their counterparts to pursue the project. At the beginning of the project, the engineering students were concerned that the education students would want to change their designs once they were almost complete; and the education students were afraid to speak up because they knew that the engineering students had already put forward almost a month of work. Scheduling was also a challenge because the classes met at different times.

## Implications

While this pilot project seemed to be a very rewarding experience for everyone involved, it should be noted that educators who wish to replicate a multi-disciplinary educational experience such as this should expect some growing pains. They should expect to resolve perception misunderstandings between the two majors, and they should work to proactively educate the collaborating students in the other's strengths and content expertise. The first meeting should focus on resolving misunderstandings between what the students' perceive their counterparts do and what they will have to offer the project, as well as a team building experience.

Depending on the nature of the collaboration, educators may need a survey to discover prior knowledge and assumptions about their counterparts (content knowledge) and the types of jobs they will likely pursue once they graduate. Educators should allow their students to identify and verbalize what they themselves can do. These surveys should be openly reviewed with both groups to assist in understanding the roles and responsibilities of the individuals within the group.

## Recommendations and Future Work

Through this pilot project, we learned that it is important to connect the students from the beginning to give them as much time as possible to work together. Facilitators should work to discover and address any preconceived notions between the classes, and each class must have an equal stake in the project. Student groups should be paired together along with a team building exercise, and they should be prepared to receive constructive criticism concerning their projects.

When this project is executed in the future, it will exist as a culminating project experience for the class. The teams will work with each other more frequently and closely. We will tie the grade of the project to the students equitably, so that each engineering/education team must truly work together to achieve the design objectives. It was observed that many of the students became very involved with their design projects and wanted to see them develop into actual products. While this was not possible due to time and monetary constraints, it is recommended that at least one of the designs be prototyped into a physical display that could be installed locally at an informal learning site.

There may also exist other possibilities to partner with students from other departments such as art or marketing students. The art students could greatly assist the both groups of students with the aesthetics of the signage and the products. Marketing students could help develop an advertisement campaign to increase awareness of the displays and to help drive traffic to the exhibits. While these types of interactions could be valuable for creating an authentic learning experience, more cross-college and even cross-university collaborations should be pursued to determine a comprehensive procedure for developing the experience to achieve the optimal experience and assessment of the learning objectives.

## References


[1] Borrego, M., & Newswander, L. K. (2008). Characteristics of successful cross disciplinary engineering education collaborations. *Journal of Engineering Education*, *97*, 123-134. doi: 10.1002/j.2168-9830.2008.tb00962.x

[2] Baldwin, R. G., & Chang, D. A. (2007). Collaborating to learn, learning to collaborate. *Peer Review*, *4*, 26. Retrieved from https://www.aacu.org/publications-research/periodicals/collaborating-learn-learning-collaborate

[3] Matychak, X. & Schull, J. (2010). Collaborative innovation program: A creative conspiracy for cross-college collaboration at the Rochester Institute of Technology. *RIT Scholar Works*. Retrieved from http://scholarworks.rit.edu/other/689/

[4] Chua, K. (2014). A comparative study on first-time and experienced project-based learning students in an engineering design module. *European Journal of Engineering Education*, *39*, 556-572. doi: 10.1080/03043797.2014.895704

[5] Dunlap, J. C. (2005). Problem-based learning and self-efficacy: How a capstone course prepares students for a profession. *Educational Technology Research and Development*, (1), 65-85. doi: 10.1007/BF02504858

[6] Johnson, C. S., & Delawsky, S. (2013). Project-based learning and student engagement. *Academic Research International*, 4, 560-570. Retrieved from http://www.savap.org.pk/journals/ARInt./Vol.4(4)/2013(4.4-59).pdf

[7] Jones, B. D., Epler, C. M., Mokri, P., Bryant, L. H., & Paretti, M. C. (2013). The Effects of a collaborative problem based learning experience on students' motivation in engineering capstone courses. *Interdisciplinary Journal of Problem-Based Learning*, *7*, 33-71. doi:10.7771/1541-5015.1344

[8] Lee, J. J., Blackwell, S. B., Drake, J., J., & Moran, K. K. (2014). Taking a leap of faith: redefining teaching and learning in higher education through project-based learning. *Interdisciplinary Journal of Problem-based Learning*, 8, 1-17. Retrieved from http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1426&context=ijpbl

[9] Mantri, A. (2014). Working towards a scalable model of problem-based learning instruction in undergraduate engineering education. *European Journal of Engineering Education*, *39*, 282-299. doi: 10.1080/03043797.2013.858106

[10] Stozhko, N., Bortnik, B., Mironova, L., Tchernysheva, A., & Podshivalova, E. (2015). Interdisciplinary project based learning: Technology for improving student cognition. *Research in Learning Technology, 23*, 1-13. Retrieved from http://www.researchinlearningtechnology.net/index.php/rlt/article/view/27577

[11] Dewey, J. (1987). My pedagogic creed. *School Journal, 54*, 77-80.

[12] Stolk, J., & Harai, J. (2014). Student motivations as predictors of high-level cognitions in project-based classrooms. *Active Learning in Higher Education*, *15*, 231-247. doi: 10.1177/1469787414554873

[13] Chen, P., Hernandez, A., & Dong, J. (2015). Impact of collaborative project-based learning on self-efficacy of urban minority students in engineering. *Journal of Urban Learning, Teaching, and Research*, *11*, 26-39. Retrieved from http://www.aera-ultr.org/pdf/JULTR2015.pdf

[14] Schaffer, S., Chen, X., Zhu, X., & Oakes, W. (2012). Self-efficacy for cross-disciplinary learning in project-based teams. *Journal of Engineering Education*, *101*, 82-94. doi: 10.1002/j.2168-9830.2012.tb00042.x

[15] Smith, P. P., & Gibson, L. A. (2016). Project-based learning in colleges of business: is it enough to develop educated graduates? *New Directions for Teaching and Learning,* 145, 41-47. doi: 10.1002/tl.20173

[16] edBridge Partners & Hart Research Associates. (2014). *The collaboration imperative:Findings from a survey of school district and post-secondary leaders*. Retrieved from https://www.aascu.org/WorkArea/DownloadAsset.aspx?id=7705

[17] 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*, 638-650. doi: 10.1080/10668926.2012.710125

[18] Helle, L., Tynjala, P., & Olkinuora, E. (2006). Project-based learning in post-secondary education – theory, practice and rubber sling shots. *Higher Education*, *2*, 1-29. doi: 10.1007/s10734-004-6386-5

[19] Maxim, G. W. (2014). *Dynamic social studies for constructivist classrooms: Inspiring tomorrow's social scientists*. Boston: Pearson.

[20] Creswell, J.W. (2013). *Qualitative inquiry and research design: Choosing among five approaches*. Thousand Oaks, CA: Sage.

[21] Stake, R. E. (1995). *The art of case study research.* Thousand Oaks, CA:Sage.

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